J. Bangladesh Agril. Univ. 11(2): 249–256, 2013 **ISSN 1810-3030**

Performance of transplant *Aman* rice as influenced by tiller seedlings and nitrogen management

B. Kirttania, M. A. R. Sarkar and S. K. Paul*
Department of Agronomy, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh,
*E-mail: skpaull@gmail.com

Abstract

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from July to December 2012 to observe the effect of variety, age of tiller seedling used for transplanting and nitrogen management on the yield performance of transplant *Aman* rice. The experiment consisted of two varieties viz. BRRI dhan49 and BRRI dhan51, two ages tiller seedling viz. 25- and 35-day old, five nitrogen management viz. control (no urea), application of prilled urea @ 215 kg ha^{-1} (1/2 at 15 DAT+1/2 at 30 DAT), prilled urea @ 215 kg ha^{-1} (1/3 at 15DAT+1/3 at 30DAT+1/3 at 45DAT), urea super granules (USG) 1.8 g and USG 2.7 g four-$hill^{-1}$ in every alternate row. The experiment was laid out in randomized complete block design with three replications. The results revealed that higher plant characters, straw yield and harvest index were obtained from BRRI dhan49 compared to BRRI dhan51. Older seedlings (35-day old) produced higher grain yield to younger seedlings. The highest yield contributing characters and grain yield were obtained when 1.8g USG was applied. The grain yield was highest in 35-day old tiller seedlings of BRRI dhan51 while fertilized with 1.8g USG. This value was lowest when 25-day old tiller seedlings of BRRI dhan51 were fertilized with prilled urea in two split applications. It may be concluded that 35-day tiller seedlings of BRRI dhan51 fertilized with USG 1.8 g four-$hill^{-1}$ could be used for achieving higher yield of transplant *Aman* rice.

Keywords: Tiller seedlings of rice, Prilled urea, USG

Introduction

The average yield of rice in Bangladesh is still low, only 2.91 t ha^{-1}which is much lower than that of other rice growing countries of the world (BBS, 2011). Food deficit is alarming in Bangladesh due to increase of population and sudden natural hazards. There is no opportunity to increase rice area to mitigate additional rice requirement. It will have to come from higher average yield on existing land through adoption of high yielding cultivars and subsequent management practices. Rice has unique ability to tiller profusely as each leaf axil has the potential to produce a tiller (Langer, 1979). The potentiality of separated tillers is reported by many researchers (Sarkar *et al.*, 2011 and Biswas and Salokhe, 2001). In rice, many of the late tillers do not produce panicles due to higher population (Hanada, 1979). Removal of excess tillers from the mother hill at early stage could help better development for remaining tillers and the separated tillers can be used as seedling for crop production. This technique of transplanting of separated tillers may be a promising alternative for growing post-flood transplant *aman* rice (Mridha *et al*., 1991). The detached tillers can be used as seedlings especially during scarcity of seedling after flood or other natural hazards. Paul *et al*. (2002) reported that tillers can be separated at 25 or 35 days after transplanting (DAT) without hampering grain yield of mother plant.

Time of nitrogen application is an important aspect of overall nitrogen management in rice (Thakur, 1993). Proper timing of nitrogen application reduces the loss of nitrogen in rice fields. Efficient fertilizer management gave higher yield of crops and reduced fertilizer cost (Hossain and Islam, 1986). A number of experiments have shown that the efficiency of N is only about 30% of the applied fertilizer N and in many cases even it is less (Prasad and De Datta, 1979). However, the nature and magnitude of N loss largely depend upon the sources of N fertilizer and methods of N fertilizer application. The loss of nitrogen may be reduced by using deep placement of urea super granules (USG) instead of applying prilled urea. Point placement of USG can increase the efficiency of N utilization by rice in wet season (Roy, 1985). To increase nitrogen use efficiency and reduce yield gap of modern rice cultivars, the right form of nitrogenous fertilizer and appropriate timing of application are very important. So the present study was undertaken to examine the influence of variety, age of tiller seedlings and nitrogen management on the performance of transplant *Aman* rice.

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh to study the effect of variety, age of tiller seedling and nitrogen management on the growth and yield of transplant *Aman* rice. The experimental area belongs to the non-calcareous dark grey soil under Agro-ecological Zone of the Old Brahmaputra Floodplain (AEZ-9). The land was silty loam in texture having a soil pH 6.42, moderate in organic matter content. The experiment consisted of two varieties-BRRI dhan49 and BRRI dhan51, two ages of tiller seedlings -25 and 35-day old, and five nitrogen managements-i. control, ii. application of prilled urea @ 215 kg ha^{-1} (1/2 at 15 DAT+1/2 at 30 DAT), iii. prilled urea @ 215 kg ha^{-1} (1/3 at 15DAT+1/3 at 30DAT+1/3 at 45DAT), iv. USG 1.8g four-$hill^{-1}$ in every alternate row and v. USG 2.7g four-$hill^{-1}$ in every alternate row. The experiment was laid out in a randomized complete block design with three replications. Plot size was 4.0 m x 2.5 m and total number of plots was 60. Tillers were separated from 25 and 35 days after transplanting from the previously transplanted rice crop and then transplanted in the main field according to experimental plan. The experimental plots were fertilized with triple super phosphate, muriate of potash, gypsum and zinc sulphate @ 100, 70, 60 and 10 kg ha^{-1}, respectively. The entire amount of fertilizers except urea was applied at final land preparation. Prilled urea and USG were applied following the specification of treatments. Five hills were randomly selected in each unit plot excluding boarder rows to record the data on yield contributing characters. Grain yield and straw yield were determined by harvesting the whole plot. The grain was threshed, cleaned, dried and then weighed. The yield of grain was adjusted to 14% moisture content and then converted to t ha^{-1}. The recorded data were statistically analyzed using the "Analysis of Variance" technique and the differences among treatment means were adjudged by Duncan's New Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

Varietal performance

Crop characters and yield of transplant *Aman* rice were significantly influenced by variety. BRRI dhan49 produced significantly taller plant (101.42 cm), higher number of total tillers $hill^{-1}$ (10.27), longer panicle (25.97 cm) and grains $panicle^{-1}$ (127.22) compared to BRRI dhan51. This variety produced significantly higher number of effective tillers $hill^{-1}$ (8.57) than that of BRRI dhan51 (8.09) (Table 1). These findings corroborate with those reported by Bhowmick and Nayak (2000) who stated that effective tillers $hill^{-1}$ varied due to varietal difference. BRRI dhan49 produced significantly higher weight of 1000 grains (24.82 g) compared to BRRI dhan51 (Table 1). This result is in agreement with Shamsuddin *et al.* (1988) and Chowdhury *et al*. (1993) who reported differences in 1000-grain weight among the varieties. Sterile spikelets $panicle^{-1}$ differed due to varietal differences, which was also reported by Chowdhury *et al*. (1993). Apparently BRRI dhan51 had higher grain yield (3.92 t ha^{-1}) than BRRI dhan49 (3.83 t ha^{-1}). Varietal differences regarding grain yield was also reported by Khisha (2002). BRRI dhan49 produced significantly higher straw yield (4.21 t ha^{-1}) compared to BRRI dhan51 (4.00 t ha^{-1}). These results are in conformity with that of Chowdhury *et al.* (1993). BRRI dhan51 produced significantly higher harvest index (49.9%) compared to BRRI dhan49 (47.65%). Higher grain yield was the main reason for the increased harvest index in BRRI dhan51. Tyeb *et al*. (2013) reported that variety had great influence on harvest index.

Effect of age of tiller seedlings

Plant characters, yield contributing characters and yield of transplant *Aman* rice were influenced by age of tiller seedlings. Twenty five-day old tiller seedlings produced taller plant (101.5 cm) than that of 35-day old tiller seedlings (Table 2). Sarkar *et al*. (2011) also evidenced similar results. Twenty five-day old tiller seedlings produced higher number of tillers $hill^{-1}$ (10.66) than that of 35-day old tiller seedling. Anwar and Begum (2004) reported that age of tiller seedlings significantly influenced the total number of tillers $hill^{-1}$. Twenty five-day old tiller seedlings produced significantly higher number of effective tillers (8.87) and non-effective tillers $hill^{-1}$ (1.79) than that of 35-day old tiller seedlings. The longer panicle (25.72 cm) were obtained when 25-day old seedlings than that of 35-day old tiller seedlings (Table 2). Higher number of

sterile spikelets panicle^{-1} (16.00) was obtained when 25-day old seedlings were used than that of 35-day old tiller seedlings (Table 2). Thirty five-day old tiller seedlings produced higher number of total spikelets panicle^{-1} (143.95) than that of 25-day old tiller seedlings (Table 2). Differences in number of total spikelets panicle^{-1} due to age of tiller seedlings were also reported by Sarkar *et al.* (2011). Thirty five-day old tiller seedlings produced higher 1000-grain weight (24.96 g) than that of 25-day old tiller seedlings (Table 2). It was observed that 35-day old tiller seedlings produced higher grain yield than 25-old tiller seedlings (Table 2). Similar result was obtained by Biswas *et al*. (1987). They found the highest grain yield by transplanting tiller seedlings which were separated from mother plants 35 days after transplanting. BRRI (1988) reported that tiller could be separated at 30-40 days after transplanting (DAT). Paul *et al*. (2002) reported that the cultivar BR23 appeared to be resistant to tiller separation and that tillers could be separated at 25 or 35 DAT without grain yield reduction. Older (35-day old) tiller seedlings produced higher straw yield (4.21 t ha^{-1}) compared to 25-day old tiller seedlings (Table 2). Higher harvest index (48.87%) was observed in case of 25-day old tiller seedlings than that obtained from 35-old tiller seedlings (Table 2). Higher straw yield was the main reason for the reduced harvest index in case of 35-day old tiller seedlings.

Table 1. Effect of variety on crop characters and yield of transplant *Aman* rice

Variety	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of non-effective tillers hill^{-1}	Panicle length (cm)	No. of grains panicle^{-1}	No. of sterile spikelets panicle^{-1}	No. of total spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
BRRI dhan49	101.425a	10.27a	8.57a	1.70	25.97a	127.22a	15.22b	142.44a	24.82a	3.83	4.21a	47.65a
BRRI dhan51	91.162b	9.77b	8.09b	1.67	23.87b	124.63b	16.53a	141.16b	24.47b	3.92	4.00b	49.90a
CV(%)	7.93	8.15	9.83	31.29	5.57	8.93	22.46	7.29	7.67	8.15	9.49	11.72
Level of sig.	*	*	*	NS	**	*	**	*	*	NS	*	**

In a column, figures having similar letter(s) do not differ significantly whereas the figures with dissimilar letter(s) differ significantly as per DMRT
NS indicates not significant
* indicates significant at 5% level of probability
** indicates significant at 1% level of probability

Table 2. Effect of age of tiller seedling on crop characters and yield of transplant *Aman* rice

Age of tiller seedling (day)	Plant height (cm)	Total tillers hill^{-1}	Effective tillers hill^{-1}	Non-effective tillers hill^{-1}	Panicle length (cm)	Grains panicle^{-1}	Sterile spikelets panicle^{-1}	Total spikelets panicle^{-1}	1000-grain wt (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
25	101.50a	10.66a	8.87a	1.79a	25.72a	123.65	16.00a	139.66b	24.34b	3.80b	4.00b	48.87a
35	91.08b	9.38b	7.80b	1.58b	24.12b	128.19	15.75b	143.95a	24.96a	3.95a	4.21a	48.68b
CV(%)	7.93	8.15	9.83	31.29	5.57	8.93	22.46	7.29	7.67	8.15	9.49	11.72
Level of sig.	NS	*	*	NS	*	NS	*	*	*	*	**	*

In a column, figures having similar letter(s) do not differ significantly whereas the figures with dissimilar letter(s) differ significantly as per DMRT
NS indicates not significant
* indicates significant at 5% level of probability
** indicates significant at 1% level of probability

Effect of nitrogen management

Plant height was not significantly affected by nitrogen management. Numerically the tallest plant (98.82 cm) was produced when prilled urea was applied in three splits (1/3 at15 DAT+1/3 at 30 DAT+1/3 at 45DAT) and the shortest plant height (94.78 cm) was produced when prilled urea was applied in two splits (1/2 at 15 DAT+1/2 at 30 DAT) (Table 3). Number of total tillers hill^{-1}, number of effective tillers hill^{-1}, number of non-effective tillers hill^{-1}, panicle length, number of sterile spikelets panicle^{-1}, 1000-grain weight, grain yield, straw yield and harvest index was significantly influenced by nitrogen management. The highest number of tillers hill^{-1} (14.10) was produced by application of USG 1.8g four-hill^{-1} in every alternate row and the lowest one (7.55) was produced by the application of prilled urea in two splits (Table 3). The highest number of effective tillers hill^{-1} (12.92) was produced by application of USG 1.8g four-hill^{-1} in every alternate row and the lowest (5.77) was produced by application of prilled urea in two

splits (Table 3). The highest number of non-effective tillers hill^{-1} (2.09) was produced when urea was not applied and the lowest (1.18) was produced by application of USG 1.8g four-hill^{-1} in every alternate row (Table 3). The longest panicle (28.79 cm) was produced by application of USG 1.8 g per four hill in every alternate row and the shortest one (23.36 cm) was observed in prilled urea in two splits (Table 3). These differences were also found by Rahman (2003) who reported that panicle length differed significantly due to level of USG. The highest number of grains panicle^{-1} (138.3) was produced by application of USG 1.8g and the lowest number of grains panicle^{-1} (120.4) was produced by application of prilled urea in three splits (Table 3). The highest number of sterile spikelets panicle^{-1} (18.32) was produced from the application of prilled urea in two splits and the lowest one (13.35) was produced in control (Table 3). The highest total number of spikelets (150.8) was produced when USG 1.8 g was applied and the lowest (138.4) was produced when prilled urea was applied in three splits (Table 3). The highest 1000-grain weight (25.96 g) was produced from the application of USG 1.8 g and the lowest one (23.50 g) was produced by the application of prilled urea in three splits (Table 3). The highest grain yield (4.48 t ha^{-1}) was produced from the application of USG 1.8 g followed by application of USG 2.7 g and the lowest grain yield (3.38 t ha^{-1}) was produced by the application of prilled urea in two splits (Table 3). USG releases nitrogen slowly in the soil providing a steady supply of available nitrogen throughout the growing period of rice that might be the probable reason for higher grain yield. The highest number of effective tillers hill^{-1} and the highest weight of 1000 grains in USG 1.8 g were mainly responsible for the highest grain yield in this treatment (USG 1.8g). Ahmed *et al.* (2000) found that placement of USG @ 160 kg N ha^{-1} produced the highest grain yield. Visually the highest straw yield (4.61 t ha^{-1}) was produced from the application of USG 1.8 g and the lowest straw yield (3.81 t ha^{-1}) by the application of prilled urea (Table 3). The highest harvest index (49.35%) was produced from application of prilled urea in three splits and the lowest harvest index (47.22%) was produced from the application of prilled urea in two splits (Table 3).

Table 3. Effect of nitrogen management on crop characters and yield of transplant *Aman* rice

Nitrogen management	Plant height (cm)	Total tillers hill^{-1}	Effective tillers hill^{-1}	Non-effective tillers hill^{-1}	Panicle length (cm)	Grains panicle^{-1}	Sterile spikelets panicle^{-1}	Total spikelets panicle^{-1}	1000-grain wt (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
Control (no urea)	95.88	11.30b	9.20b	2.09a	24.41b	126.7b	13.35b	140.0b	24.86ab	3.87bc	4.12	48.67
Prilled urea (1/2 at 15 DAT+1/2 at 30 DAT)	94.78	7.55c	5.77d	1.78ab	23.36b	121.0b	18.32a	139.3b	23.50b	3.38c	3.81	47.22
Prilled urea (1/3 at15 DAT+1/3 at 30 DAT+1/3 at 45DAT)	98.82	8.93c	7.29c	1.64b	23.69b	120.4b	17.99a	138.4b	24.33b	3.73bc	3.94	49.35
USG 1.8g	95.02	14.10a	12.92a	1.18c	28.79a	138.3a	12.50b	150.8a	25.96a	4.48a	4.61	49.37
USG 2.7g	96.95	8.22c	6.49cd	1.73ab	24.36b	123.3b	17.24a	140.5b	24.61ab	3.92b	4.04	49.26
CV(%)	7.93	8.15	9.83	31.29	5.57	8.93	22.46	7.29	7.67	8.15	9.49	11.72
Level of sig.	NS	*	*	**	*	**	*	*	*	**	NS	NS

In a column, figures having similar letter(s) do not differ significantly whereas the figures with dissimilar letter(s) differ significantly as per DMRT
NS indicates not significant
* indicates significant at 5% level of probability
** indicates significant at 1% level of probability

Interaction effect

Panicle length was significantly affected by the interaction between variety and age of tiller seedling. The longest panicle (27.18 cm) was obtained when 25-day old tiller seedlings of BRRI dhan49 were planted and the shortest (23.48 cm) was obtained when 35-day old tiller seedlings of BRRI dhan51 variety were planted (Table 4). Panicle length, 1000-grain weight, grain yield, straw yield and harvest index were significantly influenced by the interaction of variety and nitrogen management. The longest panicle (28.95 cm) was obtained from the application of USG 2.7g in BRRI dhan49 and the shortest panicle (22.10 cm) was obtained from the control in BRRI dhan51 (Table 5). The highest1000-grain weight (28.63g) was obtained in BRRI dhan49 fertilized with prilled urea in three splits and lowest one (22.54) was obtained in BRRI dhan49 with control (Table 5). The highest grain yield (4.50 t ha^{-1}) was obtained in BRRI dhan51 and application of USG 2.7 g and the lowest (3.33 t ha^{-1}) was obtained due to the interaction of BRRI dhan49 in control (Table 5). The highest straw yield (4.65 t ha^{-1}) was obtained in BRRI dhan49 was

planted applying USG 2.7 g and the lowest straw yield (3.5 t ha^{-1}) was obtained in BRRI dhan51 fertilized with prilled urea in two splits (Table 5). The highest harvest index (51.57%) was obtained in BRRI dhan51 with control and the lowest harvest index (44.4%) was obtained when in BRRI dhan49 was planted and prilled urea in two splits (Table 5).

Table 4. Effect of interaction of variety and age of tiller seedlings on crop characters and yield of transplant *Aman* rice

Interaction (variety X age of tiller seedlings)	Plant height (cm)	No. of total tillers $hill^{-1}$	No. of effective tillers $hill^{-1}$	No. of non-effective tillers $hill^{-1}$	Panicle length (cm)	No. of grains $panicle^{-1}$	No. of sterile spikelets $panicle^{-1}$	No. of total spikelets $panicle^{-1}$	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
V_1 X A_1	108.06	10.78	8.98	1.80	27.18 a	126.61	14.90	141.51	24.76	3.82	4.17	47.886
V_1 X A_2	94.78	10.78	8.17	1.59	24.77b	127.83	15.53	143.36	24.88	3.84	4.25	47.42
V_2 X A_1	94.93	10.54	8.76	1.78	24.26bc	120.70	17.10	137.80	23.92	3.78	3.84	49.85
V_2 X A_2	87.38	9.00	7.43	1.56	23.48 c	128.56	15.96	144.53	25.03	4.05	4.16	49.94
CV (%)	7.93	8.15	9.83	31.29	5.57	8.93	22.46	7.29	7.67	8.15	9.49	11.72
Level of sig.	NS	NS	NS	NS	*	NS	NS	NS	NS	NS	NS	NS

In a column, figures having similar letter(s) do not differ significantly whereas the figures with dissimilar letter(s) differ significantly as per DMRT

NS indicates not significant
* indicates significant at 5% level of probability
** indicates significant at 1% level of probability

V_1 = BRRI dhan49
V_2= BRRI dhan51

A_1 = 25-day old tiller seedling
A_2 = 35-day old tiller seedling

Table 5. Effect of interaction of variety and nitrogen management on crop characters and yield of transplant *Aman* rice

Interaction (variety X nitrogen management)	Plant height (cm)	No. of total tillers $hill^{-1}$	No. of effective tillers $hill^{-1}$	No. of non-effective tillers $hill^{-1}$	Panicle length (cm)	No. of grains $panicle^{-1}$	No. of sterile spikelets $panicle^{-1}$	No. of total spikelets $panicle^{-1}$	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
V_1 X N_1	104.86	9.65	7.91	1.73	25.28bc	117.79	17.68	135.47	22.54d	3.33d	3.75ab	47.12ab
V_1 X N_2	98.37	7.26	5.40	1.86	24.09cd	122.29	17.31	139.60	24.05bcd	3.29d	4.12ab	44.40b
V_1 X N_3	101.03	12.56	10.35	2.21	25.35bc	131.50	12.88	144.39	28.63a	4.01 abcd	4.45ab	47.87ab
V_1 X N_4	103.25	7.58	6.15	1.43	26.2b	125.53	15.67	141.21	25.73ab	4.07abc	4.08ab	49.76ab
V_1 X N_5	99.60	14.31	13.06	1.25	28.95a	138.98	12.55	151.53	26.27a	4.46ab	4.65a	49.12ab
V_2 X N_1	92.77	8.22	6.67	1.55	22.10 e	123.01	18.28	141.30	26.12ab	4.14abc	4.13ab	51.57a
V_2 X N_2	91.19	7.85	6.15	1.70	22.63de	119.77	19.32	139.09	22.94d	3.47cd	3.50b	50.04ab
V_2 X N_3	90.72	10.03	8.06	1.96	23.48de	121.80	13.81	135.61	24.18abcd	3.72cd	3.80ab	49.47ab
V_2 X N_4	90.66	8.86	6.83	2.03	22.51de	120.98	18.79	139.78	23.50cd	3.76bcd	4.00ab	48.77ab
V_2 X N_5	90.45	13.88	12.76	1.11	28.63a	137.60	12.45	150.05	25.65abc	4.50a	4.57ab	49.63ab
CV (%)	7.93	8.15	9.83	31.29	5.57	8.93	22.46	7.29	7.67	8.15	9.49	11.72
Level of sig.	NS	NS	NS	NS	*	NS	NS	NS	**	**	*	*

In a column, figures having similar letter(s) do not differ significantly whereas the figures with dissimilar letter(s) differ significantly as per DMRT

NS indicates not significant
* indicates significant at 5% level of probability
** indicates significant at 1% level of probability

V_1 = BRRI dhan 49
V_2= BRRI dhan 51

N_1 = Control (no urea)
N_2 = Prilled urea (1/2 at 15 DAT+1/2 at 30 DAT)
N_3 = Prilled urea (1/3 at15 DAT+1/3 at 30 DAT+1/3 at45DAT)
N_4 = USG 1. 8 g, N_5 = Application of USG 2.7 g

Crop characters and yield were also influenced by the interaction between age of tiller seedlings and nitrogen management. The highest number of total tillers $hill^{-1}$ (14.17) was obtained in of 35-day old tiller seedlings fertilized with USG 2.7g and the lowest one (8.03) was obtained in 25-day old tiller seedlings fertilized with USG 1.8g (Table 6). The longest panicle (28.80 cm) was obtained due to the interaction of 35-day old tiller seedlings and application of USG 2.7g and the shortest panicle (22.44 cm) was obtained due to the interaction of 35-day old tiller seedlings in three split application of prilled urea (Table 6). The highest number of grains $panicle^{-1}$ (138.4) was obtained when 25-day old tiller seedlings were planted applying USG 2.7g and the lowest number of grains $panicle^{-1}$ (110.4) was obtained when 25-day old tiller seedlings were planted in control (Table 6). The highest number of total spikelets (150.8) was obtained in 25-day old tiller seedlings were planted applying USG 2.7 g and the lowest (129.9) was obtained when 25-day old tiller seedlings with control (Table 6). The highest 1000-grain weight (26.03g) was obtained in 35-day old tiller seedlings fertilized with USG 2.7 g and the lowest one (22.43g) was obtained in 25-day

old tiller seedlings fertilized with prilled urea in two splits (Table 6). The highest grain yield (4.48 t ha^{-1}) was obtained due to the interaction of 25-day old tiller seedlings fertilized with USG 2.7 g and the lowest one (2.97 t ha^{-1}) was obtained in 25-day old tiller seedlings with two splits of prilled urea (Table 6). The highest straw yield (4.75 t ha^{-1}) was obtained in 35-day old tiller seedlings fertilized with USG 2.7 g and the lowest straw yield (3.45 t ha^{-1}) was obtained in 25-day old tiller seedlings under control treatment (Table 6).

Table 6. Effect of interaction of age of tiller seedlings and nitrogen management on crop characters and yield of transplant *Aman* rice

Interaction (age of tiller seedlings× nitrogen management)	Plant height (cm)	No. of total tillers $hill^{-1}$	No. of. effective tillers $hill^{-1}$	No. of non-effective tillers $hill^{-1}$	Panicle length (cm)	No. of grains $panicle^{-1}$	No. of sterile spikelets $panicle^{-1}$	No. of total spikelets $panicle^{-1}$	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
A_1 X N_1	102.82	9.57b	7.92	1.65	24.47cd	110.4d	19.56	129.9d	23.27bc	3.25 cd	3.45b	48.96
A_1 X N_2	105.26	8.25bc	6.41	1.83	24.05cde	114.9cd	18.98	133.8cd	22.43c	2.97d	3.71ab	45.04
A_1 X N_3	101.54	13.43a	10.85	2.58	26.38b	131.2ab	12.73	143.9abc	25.49a	4.21ab	4.31ab	50.11
A_1 X N_4	100.20	8.03bc	6.36	1.66	24.93bc	123.5bc	16.31	139.8abcd	24.49abc	4.10ab	4.08ab	50.10
A_1 X N_5	97.66	14.03a	12.80	1.23	28.78a	138.4a	12.41	150.8a	26.03a	4.48a	4.46 ab	50.14
A_2 X N_1	94.81	8.30bc	6.66	1.63	22.92de	130.4ab	16.40	146.9ab	25.38ab	4.22ab	4.43 ab	49.74
A_2 X N_2	84.30	6.86c	5.13	1.73	22.67e	127.2abc	17.64	144.9abc	24.56abc	3.79abc	3.91 ab	49.40
A_2 X N_3	90.21	9.16b	7.56	1.60	22.44e	122.1bcd	13.96	136.1bcd	24.23abc	3.52bcd	3.94 ab	47.22
A_2 X N_4	93.71	8.41bc	6.61	1.80	23.78cde	123.0bcd	18.16	141.2abcd	24.73ab	3.73bc	4.00 ab	48.43
A_2 X N_5	92.38	14.17a	13.03	1.13	28.80a	138.2a	12.58	150.8a	25.88a	4.48a	4.75a	48.61
CV (%)	7.93	8.15	9.83	31.29	5.57	8.93	22.46	7.29	7.67	8.15	9.49	11.72
Level of sig.	NS	*	NS	NS	*	*	NS	*	**	*	*	NS

In a column, figures having similar letter(s) do not differ significantly whereas the figures with dissimilar letter(s) differ significantly as per DMRT

NS indicates not significant

* indicates significant at 5% level of probability

** indicates significant at 1% level of probability

A_1 = 25-day old tiller seedling; N_1 = Control (no urea)

A2 = 35-day old tiller seedling; N_2= Prilled urea(1/2 at15 DAT+1/2 at 30 DAT)

N_3 = Prilled urea (1/3 at15 DAT+1/3 at 30 DAT45DAT)

N_4 = USG 1. 8 g, N_5 = USG 2.7 g

The interaction of variety, age of tiller seedlings and nitrogen management significantly influenced crop characters and yield of transplant *Aman* rice. The highest number of total tillers $hill^{-1}$ (14.47) was obtained due to the interaction of BRRI dhan49, 35-day old tiller seedlings and application of 2.7g USG and the lowest one (5.80) was obtained in 35-day old tiller seedlings of BRRI dhan51 fertilized with prilled urea in two splits (Table 7). Number of effective tillers $hill^{-1}$ ranged from 4.46 to 13.23. The highest number of effective tillers $hill^{-1}$ was obtained due to the interaction of 35-day old seedling and application of USG 2.7g in BRRI dhan49 while the lowest one (4.46) was obtained due to the interaction of 35-day old seedling and application of prilled urea in two splits in BRRI dhan51 (Table 7). The highest number of grains $panicle^{-1}$ (139.13) was obtained in 35-day old tiller seedlings of BRRI dhan49 fertilized with USG 2.7g. The lowest number of grains $panicle^{-1}$ (106.47) was obtained in 25-day old tiller seedlings of BRRI dhan51 fertilized with prilled urea in two splits (Table 7). The highest number of sterile spikelets $panicle^{-1}$ (21.53) was obtained in 25-day old tiller seedlings of BRRI dhan49 under control treatment and the lowest one (12.30) was obtained in 25-day old tiller seedlings of BRRI dhan49 fertilized with 2.7g USG (Table 7).The highest number of total spikelets (153.87) was obtained in 35-day old tiller seedlings of BRRI dhan51 under control treatment and the lowest one (126.81) was obtained in 25-day old tiller seedlings of BRRI dhan51fertilized with prilled urea (Table 7). The highest 1000-grain weight (28.10 g) was obtained in 35-day old tiller seedlings of BRRI dhan51 under no urea application and the lowest one (20.79 g) was obtained in 25-day old tiller seedlings of BRRI dhan51 were fertilized with prilled urea in two splits (Table 7).The highest grain yield (4.86 t ha^{-1}) was obtained due to the interaction of 35-day old tiller seedlings of BRRI dhan51 fertilized with USG 1.8 g and the lowest grain yield (2.78 t ha^{-1}) was obtained in 25-day old tiller seedlings of BRRI dhan49 fertilized with two splits of prilled urea (Table 7). The highest straw yield (5.00 t ha^{-1}) was obtained in 35-day old tiller seedlings of BRRI dhan49 fertilized with USG 2.7 g and the lowest straw yield (3.26 t ha^{-1}) was obtained in 25-day old tiller seedlings of BRRI dhan51 under control treatment (Table 7). The highest harvest index (54.76%) was obtained in 35-day old tiller seedlings of BRRI dhan51 fertilized with prilled urea in two splits and the lowest harvest index (44.04%) was obtained in 35-day old tiller seedlings of BRRI dhan49 fertilized prilled urea in two splits (Table 7).

Table 7. Effect of interaction of variety, age of tiller seedlings and nitrogen management on crop characters and yield of transplant *Aman* rice

Interaction (varietyX age of tiller seedlingsX nitrogen management)	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of non-effective tillers hill^{-1}	Panicle length (cm)	No. of grains panicle^{-1}	No. of sterile spikelets panicle^{-1}	No. of total spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
V_1 X A_1 X N_1	108.06	11.90 abc	10.10cd	1.80	26.80	113.51cde	17.59abcdef	131.10bcd	22.40de	3.08ef	3.63ab	46.09ab
V_1 X A_1 X N_2	110.44	6.60fg	5.00 f	1.60	25.42	123.23abcde	17.63abcdef	140.86abcd	24.07bcd	3.16def	3.91ab	44.76b
V_1 X A_1 X N_3	107.56	13.80ab	11.10abc	2.70	27.62	130.83abc	12.93def	143.76abcd	25.39abcd	4.06abcde	4.66ab	47.59ab
V_1 X A_1 X N_4	107.66	7.46efg	5.80ef	1.66	26.96	126.64abcd	14.07cdef	140.71abcd	25.42abcd	4.35abc	4.33ab	50.00ab
V_1 X A_1 X N_5	106.56	14.17ab	12.90ab	1.26	29.10	138.83ab	12.30f	151.13a	26.53ab	4.46ab	4.30ab	50.98ab
V_1 X A_2 X N_1	101.66	7.40efg	5.73ef	1.66	23.77	122.06abcde	17.78abcdef	139.84abcd	22.67cde	3.58bcdef	3.86ab	48.14ab
V_1 X A_2 X N_2	86.30	7.93efg	5.80ef	2.13	22.75	121.34abcde	16.99abcdef	138.33abcd	24.03bcd	3.41cdef	4.33ab	44.04b
V_1 X A_2 X N_3	94.50	11.33bcd	9.60cd	1.73	23.07	132.18ab	12.84def	145.02ab	25.69abc	3.96abcde	4.23ab	48.15ab
V_1 X A_2 X N_4	98.83	7.70efg	6.50ef	1.20	25.43	124.43abcde	17.27abcdef	141.70abcd	26.03ab	3.80bcdef	3.83ab	49.52ab
V_1 X A_2 X N_5	92.63	14.47a	13.23a	1.23	28.80	139.13a	12.80def	151.93a	26.00ab	4.46ab	5.00a	47.27ab
V_2 X A_1 X N_1	97.59	7.25efg	5.74ef	1.51	22.14	107.20e	21.53a	128.73bcd	24.13bcd	3.41cdef	3.26b	51.82ab
V_2 X A_1 X N_2	100.08	9.90cde	7.83de	2.06	22.68	106.47e	20.34ab	126.81d	20.79e	2.78f	3.51ab	45.32ab
V_2 X A_1 X N_3	95.52	13.07ab	10.60bc	2.46	25.13	131.53abc	12.53ef	144.06abc	25.58abc	4.36abc	3.96ab	52.64ab
V_2 X A_1 X N_4	92.73	8.60defg	6.93ef	1.66	22.89	120.40bcde	18.55abcd	138.96abcd	23.56bcde	3.86abcde	3.83ab	50.20ab
V_2 X A_1 X N_5	88.76	13.90ab	12.70ab	1.20	28.46	137.90ab	12.53ef	150.43a	25.53abc	4.50ab	4.63ab	49.30ab
V_2 X A_2 X N_1	87.96	9.20cdef	7.60de	1.60	22.06	138.83ab	15.03bcdef	153.87a	28.10a	4.5ab	4.98a	51.33ab
V_2 X A_2 XN_2	82.30	5.80g	4.46f	1.33	22.58	133.07ab	18.29abcde	151.36a	25.08abcd	4.16abcd	3.50ab	54.76a
V_2 X A_2 XN_3	85.93	7.00fg	5.53ef	1.46	21.81	112.06de	15.09bcdef	127.16cd	22.77cde	3.08ef	3.65ab	46.30ab
V_2 X A_2 X N_4	88.60	9.13cdef	6.73ef	2.40	22.13	121.56abcde	19.04abc	140.60abcd	23.44bcde	4.86a	4.16ab	47.35ab
V_2 X A_2 X N_5	92.13	13.87ab	12.83ab	1.03	28.80	137.30ab	12.36f	149.66a	25.76abc	3.66bcdef	4.51ab	49.96ab
CV (%)	7.93	8.15	9.83	31.29	5.57	8.93	22.46	7.29	7.67	8.15	9.49	11.72
Level of sig.	NS	**	**	NS	NS	*	*	**	*	**	*	*

In a column, figures having similar letter(s) do not differ significantly whereas the figures with dissimilar letter(s) differ significantly as per DMRT
NS indicates not significant
* indicates significant at 5% level of probability
** indicates significant at 1% level of probability
V_1 = BRRI dhan 49 , V_2 = BRRI dhan 51

A_1 = 25-day old tiller seedling
A2 = 35-day old tiller seedling;

N_1 = Control (no urea)
N_2 = Prilled urea(1/2 at15 DAT+1/2 at 30 DAT)
N_3 = Prilled urea (1/3 at15 DAT+1/3 at 30 DAT+1/3 at 45DAT)
N_4 = USG 1. 8 g,
N_5 = USG 2.7 g

Conclusion

The results revealed that BRRI dhan51 had better performance than BRRI dhan49 in terms of grain yield. Older tiller seedlings (35-day old) gave higher grain yield compared to younger ones. Application of 1.8 g USG four-hill^{-1} in every alternate row produced higher grain yield among the treatments. From the results it can, therefore, be concluded that 35-day tiller seedlings of BRRI dhan51 while fertilized with USG 1.8 g appears to be a management practice of rice in *Aman* season.

References

Ahmed, M.H., Islam, M.A., Kader, M.A. and Anwar, M.P. 2000. Evaluation of urea super granules as source of nitrogen in transplant *aman* rice. Pakistan J. Biol. Sci. 3(5): 735-737.

Anwar. M.P. Begum, M. 2004. Tolerance of hybrid rice variety sonarbangla1 to tiller separation. Bangladeshj. Crop science 13 (2): 39-44.

BBS (Bangladesh Bureau of Statistics). 2011. Statistical Year Book of Bangladesh Bureau of Statistics, Stat. Div., Minis. Plan., Govt. People's Repub. Bangladesh, Dhaka.pp.47-50.

Bhowmick, N. and Nayak, R.L. 2000. Response of hybrid rice *(Oryza sativa)* varieties to nitrogen, phosphorus and potassium fertilizers during dry season in West Bengal. Indian J. Agron. 45(2): 323- 326.

Biswas, P.K. and Salokhe, V.M. 2001. Effects of planting date, intensity of tiller separation and plant density on the yield of transplanted rice. The journal of Agricultural science 137: 279-287.

Biswas, P.K., Roy, S.K. and Quasem, A. 1987. Yield ability of tiller separated from standing transplanted *aman* rice and replanted. Intl. Rice Res. Newsl. 14 (2): 26.

BRRI (1988). Annual Report of BRRI, Joydevpur, Gazipur, Dhaka. pp. 8, 11-12.

Chowdhury, M.J.U., Sarker, A.U., Sarkar, M.A.R. and Kashem, M.A. 1993. Effect of variety and number of seedlings hill^{-1} on the yield and its components on late transplanted *aman* rice. Bangladesh J. Agril. Sci. 20 (2): 311-316.

Gomez, K.A. and Gomez, A.A. 1984. Duncan's, Muitiple Range Test. Statistical Procedures for Agril. Res. 2nd Edn. AWiley Inter-Science puboication, John Wiley and Sons, New York. pp. 202-215.

Hanada, K. 1979. Differentiation and development of tiller buds in rice plants. J. A. R. Q. 16:79-86.

Hossain, S.M.A. and Islam, M.S. 1986. Fertilizer management in Bangladesh. Advances in Agronomic Research in Bangladesh. Bangladesh Soc. Agron. Joydebpur, Bangladesh, pp. 48-54.

Khisha, K. 2002. An Evaluation of Madagascar System of Rice production in *aman* Season with Three High potential Rice Varieties. MS Thesis, Dept. Agron., Bangladesh Agril. Univ., Mymensingh. p. 98.

Langer, R.H.M. 1979. Tillering In: how grasses grow (2nd ed.). Studies in Biology. No.34, Edward Annold, London, p. 67.

Mridha, M.A., Nasiruddin, J.M. and Siddique, S.B. 1991. Tiller separation on yield and are covered in rice. Proc. of the 16th Ann. BAAS conf held on 5-7 July 1991, Dhaka. p.67.

Paul, S.K., Sarkar, M.A.R., and Ahmed, M. 2002. Effect of row arrangement and tiller separation on the yield and yield components of transplant *aman* rice. Pakistan Journal of Agronomy, 1 (1): 9-11.

Prasad, R. and De Datta S.K. 1979. Increasing fertilizer nitrogen efficiency in wetland rice. *In*: Nitrogen and Rice Intl. Rice Res. Inst., Los Banos, Philippines, pp: 465-479.

Rahman, M.A. 2003. Effect of levels of urea super granules and depth of placement on the growth and yield of transplant *aman* rice. MS (Ag.) Thesis, Dept. Agron., Bangladesh Agril, Univ., Mymensingh. 100 p.

Roy, B. 1985. Nitrogen use efficiency in transplanted rice with point placement methos. Oryza, 22: 53-56.

Sarkar, M.A.R., Paul, S.K. and Hossain, M.A. 2011. Effect of row arrangement, age of tiller seedlings and number of tiller seedlings hill^{-1}on performance of transplant *aman* rice. J. Agril. Sci. 6 (2): 59-68.

Shamsuddin, A.M., Islam, M.A. and Hossain, A. 1988. Comparative study on the yield and agronomic characters of nine cultivars of *aus* rice. Bangladesh J. Agric. Sci. 15 (1): 121-124.

Thakur, R.B. 1993. Performance of summer rice (*Oryza sativa*) to nitrogen. Indian J. Agron. 36: 229-230.

Tyeb, A., Paul, S.K. and Samad, M.A. 2013. Performance of variety and spacing on the yield and yield contributing characters of transplanted *Aman* rice. J. Agrofor. Environ. 7 (1): 57-6.