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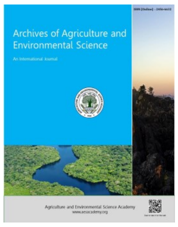

ORIGINAL RESEARCH ARTICLE

Impact of row arrangements, age of tiller seedlings and number of tiller seedlings hill^{-1} on the growth performance of transplanted *Aman* rice (cv. BR23)

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ABSTRACT

The experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh to see the effect of row arrangements, age of tiller seedlings and number of tiller seedlings hill^{-1} on growth of transplant *Aman* rice (cv. BR23). The experiment comprised three row arrangements viz. single, double and triple row; two ages of tiller seedling viz. 25 and 35 days and three levels of number of tiller seedlings hill^{-1} *viz.,* 2, 4 and 6 tiller seedlings hill^{-1}. The effect of row arrangement, age of tiller seedlings and number of tiller seedlings hill^{-1} were significant on plant height, number of leaves hill^{-1}, number of total tillers hill^{-1}, leaf dry weight, stem dry weight and total dry weight. The tallest plants at 70 DAT, the highest number of leaves and leaf dry weight were found at 25, 40, 55 and 70 DAT in single row arrangement which was as good as double row arrangement while shorter plant and the lowest number of leaves hill^{-1} were found in triple row arrangement. The highest stem and total dry matter production hill^{-1} were recorded in triple row arrangement and the lowest were found in single row arrangement. Wider spacing significantly increased plant height, total tiller production hill^{-1}, leaf production hill^{-1}and leaf dry matter production while closer spacing of triple rows enhance stem and total dry matter production hill^{-1}. Transplanted *Aman* rice (BR23) can be grown in single rows for the highest plant height, more tiller production, leaf production and leaf dry matter production hill^{-1}. In case of total dry matter production cv. BR23 can be grown in triple rows by transplanting 35-day old seedlings with 6 tiller seedlings hill^{-1}.

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INTRODUCTION

Food deficit is alarming in Bangladesh due to increase of population and often natural hazards such as flash flood or late flood. After recession of flood water farmers often keep their land fallow for unavailability of seedling. Separated tiller from unaffected field of higher topography could be planted as an alternative of nursery seedling. Rice has unique ability to tiller profusely as each leaf axil has the potential to produce a tiller (Kirttania *et al.,* 2013a,b). In rice, many of the late tillers do not produce panicles due to higher population (Hossain *et al*., 2011). Removal of excessive tillers from the mother hill^{-1} at early stage could help better development for remaining tillers. This technique of transplanting of separated tillers may be a promising alternative for growing post-flood transplant *Aman* rice (Mridha *et al*., 1991; Siddique *et al*., 1991). Paul *et al*. (2002) reported that tillers can be separated at 25 or 35 days after transplanting (DAT) without hampering grain yield. Planting density in transplant *Aman* rice culture is contributed by the number of seedlings hill^{-1} and also unit^{-1} area as well. Planting density row arrangement and age of tiller seedlings are the important determinants for proper growth of transplant *Aman* rice. The number of tillers and their growth is greatly affected both quantitatively and qualitatively by number of nursery seedling or the tiller seedling. The excessive or least number of seedlings may adversely affect the normal physiological activities of the rice plant. The excess number of tiller seedlings hill^{-1} may produce much higher number of tillers hill^{-1} resulting in mutual shading and lodging and thus favour the production of more straw instead of grain. While the least number of tiller seedling hill^{-1}may cause insufficient tiller growth thus keeping air, space and nutrient in soil unutilized (Rahman *et al*., 2015). Thus, the present study had been undertaken to see the effect of row arrangements, age of tiller seedlings and number of tiller seedlings planted hill^{-1}on the growth of transplanted *Aman* rice.

MATERIALS AND METHODS

The experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University Mymensingh, Bangladesh. The soil belongs to the Old Brahmaputa Floodplain (AEZ 9) having soil of sandy loam texture with pH 5.9-6.5. A modern high yielding variety of transplanted *Aman* rice BR23 (Dishari) was used as the test crop in the experiment. The experiment consisted of three levels of row arrangement viz. single row (row spacing 25cm), double row (row spacing 25-10-25cm), triple row (row spacing 25-10-10-25cm), two types of tiller seedlings viz. 25 days and 35 days old, and three levels of tiller seedlings hill^{-1}viz. 2, 4 and 6. There were 18 treatment combinations. The experiment was laid out in a three factor Randomized Complete Block Design with three replications. The area of each unit plot was 4.0m × 2.5m. Tillers were separated from 25 and 35 days after transplanting (DAT) from previously transplanted rice field and then transplanted in the main field according to experimental treatments. The experimental plots were fertilized with Urea, Triple Super phosphate (TSP), Muriate of Potash (MoP), Gypsum and Zinc sulphate at the rate of 200, 160, 140, 60 and 10kg ha^{-1}, respectively. The entire amount of TSP, MoP, Gypsum and Zinc sulphate were applied at final land preparation. Urea was top dressed in three equal installments at 10 days after transplanting, tillering stage and panicle initiation (PI) stage. The crop was properly weeded and irrigated whenever necessary. Four hills were randomly selected and marked with the bamboo sticks in each unit plot excluding border rows to record the data on plant height and tiller number. Plant height was measured from the base of the plant up to the tip of the longest leaf. Plant height, tiller number, total number of leaves, dry weight of stem and dry weight of leaves were recorded four times at 25, 40, 55 and 70 days after transplanting (DAT). For measurement of number of leaves hill^{-1}, stem dry weight, leaf dry weight and total dry matter, destructive sampling of four randomly selected hills was used. Plant samples were carefully uprooted each time and separated into leaf and stem. Number of leaves hill^{-1}were then counted and dried in the oven at 85± 5°C for 72 hours to a constant weight. Dry weight of leaves and stems were recorded separately with an electrical balance. Dry weight of leaves and stems were altogether regarded as total dry matter. Recorded data were analyzed statistically using Analysis of Variance (ANOVA) technique and the differences among treatment means were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Table 1. Effect of age of tiller seedling and number of tiller seedling hill^{-1} on plant height.

Age of tiller seedlings (Days)	Plant height			
	Days after transplanting			
	25	40	55	70
25	81.88a	95.06	114.91	125.38a
35	80.80b	94.71	114.41	123.10b

Figures in a column having the same letter or without letter do not differ significantly at the level whereas figures with dissimilar letters differ significantly as per DMRT.

Table 2. Effect of number of tiller seedling hill^{-1}on the production of total tillers hill^{-1}.

Number of tiller seedlings hill^{-1}	Number of total tiller hill^{-1}			
	Days after transplanting			
	25	40	55	70
2	7.52	9.93	11.47b	12.35b
4	7.97	10.39	12.11a	12.91a
6	7.97	10.47	12.30a	13.00a

Figures in a column having the same letter or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.

Table 3. Interaction between row arrangement and age of tiller seedling on the number of total tillers hill^{-1}.

Row arrangements	Age of tiller seedlings (Days)	Number of total tillers hill^{-1}			
		Days after transplanting			
		25	40	55	70
Single row	25	7.37	10.15	11.52	12.14c
	35	7.94	10.73	12.35	12.99b
Double row	25	7.57	9.69	11.09	12.00b
	35	8.14	10.75	12.81	13.83a
Triple row	25	7.60	9.98	11.44	12.46c
	35	8.31	10.26	12.57	13.11b

Figures in a column having the same letter or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.

Table 4. Effect of age of tiller seedling and number of tiller seedling hill^{-1}on the number of leaves hill^{-1}.

Age of tiller seedlings (Days)	Number of leaves hill^{-1} Days after transplanting			
	25	40	55	70
25	35.02b	38.03b	40.17b	40.86b
35	39.94a	46.12a	47.82a	48.65a
Number of tiller seedlings hill^{-1}				
2	35.78b	40.17b	41.61b	42.40b
4	37.45ab	42.36a	45.00a	45.52a
6	39.22a	43.70a	45.37a	46.34a

Figures in a column under each factor of treatment having the same letter or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.

Table 5. Interaction between row arrangement and number of tiller seedling hill^{-1}on the number of leaves hill^{-1}.

Row arrangements	Number of tiller seedlings hill^{-1}	Number of leaves hill^{-1} Days after transplanting			
		25	40	55	70
Single row	2	38.08	42.58	44.80b	45.37b
	4	40.46	42.79	47.32a	46.48ab
	6	42.71	46.13	47.42a	48.24a
Double row	2	36.71	39.42	40.25cd	40.87d
	4	36.17	43.58	45.71ab	46.50ab
	6	38.50	44.79	46.75ab	47.75a
Triple row	2	32.54	38.50	39.78d	40.96d
	4	35.73	40.70	44.98c	42.59cd
	6	36.64	40.19	43.93c	43.02c

Figures in a column having the same letter or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.

Table 6. Interaction between row arrangement and age of tiller seedlings on the number of leaves hill^{-1}.

Row arrangements	Age of tiller seedlings (Days)	Number of leaves hill^{-1} Days after transplanting			
		25	40	55	70
Single row	25	35.06bc	37.03d	40.89d	48.55b
	35	45.78a	50.64a	52.13a	52.51a
Double row	25	36.67bc	38.19cd	39.81d	40.46d
	35	37.58b	47.00b	48.67b	49.62b
Triple row	25	33.34c	38.86cd	49.81ab	40.56d
	35	36.47bc	40.73c	42.66c	43.81c

Figures in a column having the same letter or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.

Table 7. Interaction between age of tiller seedlings and number of tiller seedling hill^{-1} on the number of leaves hill^{-1}.

Age of tiller seedlings (Days)	Number of tiller seedlings hill^{-1}	Number of leaves hill^{-1} Days after transplanting			
		25	40	55	70
25	2	35.75bc	38.00cd	39.53c	40.28c
	4	32.90c	36.39d	40.14c	40.53c
	6	36.42b	39.69c	40.83c	41.76c
35	2	35.81bc	42.33b	43.69b	44.52b
	4	42.00a	47.33a	49.87a	50.51a
	6	42.03a	47.71a	49.90a	50.92a

Figures in a column having the same letter or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.

Table 8. Effect of row arrangement and number of tiller seedling hill^{-1} on the leaf dry weight hill^{-1}.

Row arrangement	Leaf dry weight (g hill^{-1})			
	Days after transplanting			
	25	40	55	70
Single row	4.71	7.22a	10.16a	12.21a
Double row	4.65	6.78b	9.04c	11.11b
Triple row	4.56	6.40b	9.69b	12.48a
Number of tiller seedlings hill^{-1}				
2	4.52b	6.72	9.16c	11.54b
4	4.36b	6.69	10.10a	12.05a
6	4.93a	6.99	9.64b	12.18a

Figures in a column under each factor of treatment having the same letter or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.

Table 9. Interaction between row arrangement and age of tiller seedlings on leaf dry weight hill^{-1}.

Row arrangements	Age of tiller seedlings (Days)	Leaf dry weight (g hill^{-1})			
		Days after transplanting			
		25	40	55	70
Single row	25	4.35	5.77d	9.96	11.91c
	35	5.07	6.68a	10.37	12.50ab
Double row	25	4.41	6.05cd	8.51	10.38b
	35	4.89	7.52b	9.58	11.84c
Triple row	25	4.35	6.26cd	9.52	12.06bc
	35	4.57	6.53c	9.86	12.89a

Figures in a column having the same letter or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.

Table 10. Interaction between age of tiller seedlings and number of tiller seedling hill^{-1} on leaf dry weight hill^{-1}.

Age of tiller seedlings (Days)	Number of tiller seedlings hill^{-1}	Leaf dry weight (g hill^{-1})			
		Days after transplanting			
		25	40	55	70
25	2	4.59ab	6.10bc	8.81c	11.12
	4	3.64c	5.45c	9.88ab	11.72
	6	4.88ab	6.53b	9.09bc	11.52
35	2	4.45b	7.04ab	9.50b	11.96
	4	5.09a	7.94a	10.11a	12.45
	6	4.98ab	7.45a	10.19a	12.83

Figures in a column having the same letter or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.

Table 11. Effect of age of tiller seedling and number of tiller seedling hill^{-1} on stem dry weight hill^{-1}.

Age of tiller seedlings (Days)	Stem dry weight (g hill^{-1})			
	Days after transplanting			
	25	40	55	70
25	5.04b	9.89b	21.48b	24.07b
35	6.53a	13.14a	23.25a	26.30a
Number of tiller seedling hill^{-1}				
2	5.36b	10.67b	21.48b	24.23b
4	5.74ab	11.63a	22.67a	25.54a
6	6.26a	12.06a	22.95a	25.78a

Figures in a column having the same letter or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.

Table 12. Interaction between row arrangement and age of tiller seedlings on stem dry weight $hill^{-1}$.

Row arrangements	Age of tiller seedlings (Days)	Stem dry weight $hill^{-1}$ (g $hill^{-1}$)			
		Days after transplanting			
		25	40	55	70
Single row	25	4.24	8.98d	21.56	23.67c
	35	5.78	13.54a	23.38	25.95b
Double row	25	5.45	10.02c	20.28	22.99d
	35	6.37	12.15b	22.47	25.95b
Triple row	25	5.44	10.66c	22.61	25.55b
	35	7.44	13.57a	23.90	27.35a

Figures in a column having the same letter or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.

Table 13. Interaction between age of tiller seedlings and number of tiller seedling $hill^{-1}$ on stem dry weight $hill^{-1}$.

Age of tiller seedlings (Days)	Number of tiller seedlings $hill^{-1}$	Stem dry weight (g $hill^{-1}$)			
		Days after transplanting			
		25	40	55	70
25	2	5.44b	10.08c	19.96d	22.51b
	4	4.31c	9.24d	22.32bc	24.76c
	6	5.38b	10.34c	22.16c	24.95c
35	2	5.29b	11.66b	22.99abc	25.96b
	4	7.17a	14.01a	23.02ab	26.32ab
	6	7.14a	13.77a	23.73a	26.61a

Figures in a column having the same letter or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.

Table 14. Effect of row arrangement and number of tiller seedling $hill^{-1}$ on total dry matter production $hill^{-1}$.

Row arrangements	Total dry matter production $hill^{-1}$			
	Days after transplanting			
	25	40	55	70
Single row	9.72b	18.56	30.63b	36.84c
Double row	10.56a	17.87	30.42b	35.38b
Triple row	10.90a	18.51	32.94a	38.93a
Number of tiller seedlings $hill^{-1}$				
2	9.89b	17.59c	30.63b	35.78b
4	10.10b	18.32b	32.77a	37.62a
6	11.19a	19.05a	32.89a	37.95a

Figures in a column under each parameter having the same letter or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.

Table 15. Interaction between row arrangement, age of tiller seedlings and number of tiller seedling hill^{-1} on total dry matter production hill^{-1}.

Row arrangements	Age of tiller seedlings (Days)	Number of tiller seedlings hill^{-1}	Total dry matter production hill^{-1} (g hill^{-1})			
			Days after transplanting			
			25	40	55	70
Single row	25	2	8.09gh	15.59ef	30.35bc	34.84fg
		4	6.87h	12.03g	33.57ab	36.38ef
		6	10.79cde	16.63ef	30.63b	35.52fg
	35	2	11.84abcd	21.25bc	30.68b	37.58de
		4	10.40def	23.64a	32.18ab	38.27cd
		6	10.32def	22.27ab	34.39b	38.44bcd
Double row	25	2	11.39bcd	16.19ef	27.32b	32.05h
		4	8.07gh	16.06f	29.22bc	33.98g
		6	10.10def	16.95ef	29.83bc	34.09g
	35	2	8.43fgh	16.84ef	30.22bc	36.19ef
		4	12.85ab	21.81bc	33.03a	36.19ef
		6	12.50abc	20.36cd	32.88ab	38.79bcd
Triple row	25	2	10.59cde	16.76ef	28.66cd	33.99g
		4	8.89efg	16.97ef	31.43b	39.07bcd
		6	9.89defg	17.03e	30.31b	39.78abc
	35	2	8.97efg	18.90d	32.58ab	39.99ab
		4	12.51ab	20.38cd	32.18ab	39.64abc
		6	13.56a	21.03bc	34.50a	41.09a

Figures in a column having the same letter or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.

RESULTS AND DISCUSSION

Effect of row arrangements: Plant height and number of leaves hill^{-1} were significantly (5% level of probability) affected by the row arrangements. At 70 days after transplanting (DAT), the tallest plants were observed in single row arrangement while the highest number of leaves were produced in single row arrangement at all dates of observations i.e., 25, 40, 55 and 70 DAT which was as good as double row arrangement (Figures 1, 3). The shortest plants and the lowest number of leaves were observed in triple row arrangement. Plant height and leaf production were reduced markedly in triple row arrangement due to severe competition among plant for light, air, space, water and nutrients in comparison with single and double row arrangements. Widely spaced crops received adequate light, space, air water and nutrients for the growth and thus produced more leaves in the single row arrangement. Transplant *Aman* rice cultivated in single rows showed the highest plant height due to wider spacing (Sarkar *et al*., 2002; Hossain *et al*., 2003). Wider spacing produced maximum number of total tillers than closer spacing in rice was also reported elsewhere (Ray *et al.,* 2015; Jahan *et al.,* 2017). Paul *et al*. (2003) reported that closer hill in triple rows produced less number of leaves compared to single and double rows. Leaf dry weight, stem dry weight and total dry weight hill^{-1} were significantly affected by row arrangements. The highest leaf dry weight hill^{-1} was observed in single row arrangement at 40 DAT while leaf dry weight decreased when number of rows increased. However, double and triple row exhibited similar behaviour in respect of leaf dry weight hill^{-1} at 40 and 55 DAT. The highest leaf dry weight was obtained in single row arrangement followed in order by triple and double row arrangements. The highest leaf dry weight was also obtained in single row arrangement followed by double row arrangement at 70 DAT. However, triple row arrangement gave similar results as that of single row arrangement regarding leaf dry weight. In case of stem dry weight at 25, 40, 55 and 70 DAT, triple row arrangement produced the highest stem dry weight compared with single and double row arrangement (Figure 5). Single row arrangement produced the lowest stem dry weight at all dates of observations. However, at 40, 55 and 70 DAT double row was similar to that of single row arrangement. Production of more tillers in triple row arrangement was mainly responsible for this increase in stem dry weight. The highest total dry matter production was found in triple row arrangement at 25, 55 and 70 DAT (Table 14). Production of total dry matter hill showed a decreasing trend in double and single row arrangements compared with triple row arrangements which were more pronounced at 70 DAT. At 70 DAT the total dry matter hill^{-1} was the highest in triple row arrangement followed in order by double and single row arrangements. Paul *et al*. (2003) observed similar results; in triple rows transplant *Aman* rice produced highest dry matter than single and double rows. Production of more tillers especially their leaves and stems altogether contributed to more total dry matter production hill^{-1} in the triple row arrangement.

Effect of age of tiller seedlings: Plant height, number of total tillers hill^{-1} and number of leaves hill^{-1} were significantly affected by age of tiller seedlings. At 40 and 70 DAT, the highest plant height was obtained when 25-day old tiller seedlings were transplanted the lowest plant height was obtained when 35-day old tiller seedlings were transplanted (Table 1). Similar results was reported by Rahman *et al.* (2013) who reported that *Aman* rice produced taller plant by transplanting 25-day old tiller seedling compared to 35-day old tiller seedlings. This reduction in plant height was mainly due to the availability of short vegetative growth period for 35-day old tiller seedlings in comparison with 25-day old tiller seedlings. The highest number of total tillers hill^{-1} was produced at 25, 40, 55 and 70 DAT when 35 day old tiller seedlings were transplanted. There was a reduction in the production of total tillers hill^{-1} when 25 day old tiller seedlings were transplanted at 25, 40, 55 and 70 DAT (Figure 2). Biswas *et al.* (1987) stated that optimum time of tiller separation was 35-days after transplanting. In case of leaf production hill^{-1}, the maximum leaves were found by transplanting 35-day old tiller seedlings and the lowest leaves were produced by transplanting 25-day old tiller seedlings at all dates of observations. Number of leaves hill^{-1} incased with increase the age of tiller seedlings (Table 4). Leaf dry weight hill^{-1}, stem dry weight and total dry weight were influenced by age of tiller seedlings. The highest leaf dry weight was found at all dates of observations when age of tiller seedlings was 35-days. The lowest leaf dry weight was found at 25, 40, 55 and 70 DAT when age of tiller seedlings was 25-days. The highest stem dry weight was produced at all dates of observations when age of tiller was 35-days and the lowest was produced when age of tiller was 25-days (Figure 4) Older seedling produced higher dry matter was reported by Kirtannia *et al.* (2013). Biswas *et al.* (1987) reported that 35-day old tiller seedlings gave highest development of plant. The highest total dry matter production was found at 25, 40, 55 and 70 DAT when age of tiller seedlings was 35-days while the lowest total dry matter was recorded when age of tiller seedlings was 25-days (Figure 6).

Effect of number of tiller seedlings hill^{-1}: Number of tillers hill^{-1} was significantly affected by the number of tiller seedlings hill^{-1} at 55 and 70 DAT (Table 2). The highest number of tillers hill^{-1} was obtained when 6 tiller seedlings were transplanted hill^{-1} which was at par with 4 tiller seedlings were transplanted hill^{-1} while the lowest one was recorded in 2 tiller seedlings were transplanted hill^{-1}. Number of leaves hill^{-1} was significantly affected by the number of tiller seedlings hill^{-1} planted at all dates of observations. Maximum production of leaves hill^{-1} was observed at 25, 40, 55 and 70 DAT when 6 tiller seedlings were transplanted hill^{-1}. However, 4 tiller seedlings hill^{-1} was as good as 6 tiller seedlings hill^{-1}. The lowest leaves production was found at all dates observations when 2 tiller seedling were transplanted hill^{-1} (Table 4). Production of leaves hill was found to decrease progressively with increasing the number of tiller seedlings hill^{-1}. Leaf dry weight hill^{-1}, stem dry weight hill^{-1} and total dry matter production hill^{-1} were significantly affected by number of tiller seedlings hill^{-1}. The highest leaf dry weight hill^{-1} were found at 25 and 70 DAT when 6 tiller seedlings hill^{-1} and at 55 DAT when 4 tiller seedlings were transplanted hill^{-1} (Table 8). Leaf dry weight at 70 DAT with 4 tiller seedlings hill^{-1} was as good as of 6 tiller seedlings hill^{-1}. The highest stem dry weight was recorded at all date of observations when 6 tiller seedlings hill^{-1}were transplanted hill^{-1}(Table 11). The highest total dry matter production hill^{-1} was found at 25, 40, 55 and 70 DAT when 6 tiller seedlings were transplanted hill^{-1}. However, at 55 and 70 DAT, when 4 tiller seedlings hill^{-1} were planted as good as 6 tiller seedlings hill^{-1} in respect of total dry matter production. The lowest one was found in all dates of observations when 2 tiller seedlings were transplanted hill^{-1}. However, at 25 and 40 DAT, 4 tiller seedlings hill^{-1} was as good as 2 tiller seedlings hill^{-1} in respect of lowest total dry matter production (Table 14). Total dry matter production hill^{-1} was found to increase with increasing the number of tiller seedlings hill^{-1} was found at 25, 40, 55 and 70 DAT when 2 tiller seedlings were transplanted hill^{-1}. In general, increased leaf dry weight hill^{-1} was obtained with increase in the number of tiller seedlings hill^{-1}. Paul *et al*. (2003) reported that the highest total dry matter production in intact hill compared to separated mother hill.

Effect of different interactions: Number of total tillers hill^{-1} was significantly (5% level of probability) affected by the interaction between row arrangements and age of tiller seedlings at 70 DAT. The highest total tillers hill^{-1} was produced in double row arrangement when 35-day old tillers were planted (Table 3). In all row arrangements 35-day old tiller seedlings performed better than 25-day old tiller seedlings in respect of production of total tillers hill^{-1}. Number of leaves produced hill^{-1} was significantly influenced at 55 and 70 DAT. Maximum leaves were produced in single row arrangement at 55 and 70 DAT when 6 tiller seedlings were transplanted hill^{-1}. However, at 55 DAT in single row arrangement with 4 tiller seedlings hill^{-1} was as good as 6 tiller seedlings hill^{-1} and at 70 DAT similar results were found in double row arrangement with 6 tiller seedlings hill^{-1}. The lowest production of leaves was found in triple and double row arrangements at 55 and 70 DAT when 2 tiller seedlings were transplanted hill^{-1}. However, at 55 DAT similar results were found in double row arrangement when 2 tiller seedlings were transplanted hill (Table 5). Interaction between row arrangements and age of tiller seedlings had significant effect on number of leaves hill^{-1} at 25, 40, 55 and 70 DAT. Maximum leaves were produced in single row arrangement when 35-day old tiller seedlings were transplanted. The production of leaves was found to be reduced in triple row arrangement at 25 DAT when age of tiller seedlings was 25 days. At 40 DAT, the production of leaves was found to be reduced in single row arrangement by transplanting 25-day old tiller seedlings. At 55 DAT, minimum leaves were produced in single row arrangement by transplanting 25-day old tiller seedlings, which was identical to double row arrangement by transplanting 25-day old tiller seedlings. At 70 DAT, minimum leaves were produced in double row arrangement by transplanting 25-day old tiller seedlings which was similar to that of triple row arrangement by transplanting 25-day old tiller seedlings (Table 6). Number of leaves produced hill^{-1} was significantly affected due to the interaction between age of tiller seedlings and number of tiller seedlings hill^{-1} at all dates of observations. Maximum leaves were produced at all dates of observations by transplanting 35-day old tiller seedlings with 6 tiller seedlings hill^{-1}. However, similar result was found at 25, 40, 55 and 70 DAT by transplanting 35 day old tiller seedlings with 4 tiller seedlings hill^{-1} .The lowest production of leaves was found by transplanting 25 day old tiller seedlings with 4 tiller seedlings hill^{-1} at 25 and 40 DAT and at 55 and 70 DAT with 2 tiller seedlings hill^{-1}. However, at 55 and 70 DAT similar results were found by transplanting 25- day old tiller seedlings with 4 and 6 tiller seedlings hill^{-1} (Table 7).

Leaf dry weight hill^{-1} was significantly affected at 40 and 70 DAT by the interaction between row arrangements and age of tiller seedlings. The highest leaf dry weight hill^{-1} was found in single row arrangement at 40 DAT when age of tiller was 35 days and the lowest was in single row arrangement when age of tiller was 25 days. At 70 DAT the highest leaf dry weight was obtained in triple row arrangement when age of tiller seedlings was 35 days and the lowest was in double row arrangement when age of tiller was 25 days (Table 9). Leaf dry weight hill^{-1} was found to be significantly affected by the interaction between age of tiller seedlings and number of tiller seedlings hill^{-1} at 25, 40 and 55 DAT but was not significantly affected at 70 DAT. At 25 DAT the highest leaf dry weight was found by transplanting 35-day old tiller seedlings with 4 tiller seedlings hill^{-1} and the lowest was found by transplanting 25-day old tiller seedlings with 4 tiller seedlings hill^{-1}. At 40 DAT the highest leaf dry weight was found by transplanting 35-day old tiller seedlings with 4 tiller seedlings hill^{-1} which was similar to that of transplanting 35-day old tiller seedlings with 6 tiller seedlings hill^{-1}. At 70 DAT the highest leaf dry weight was found by transplanting 35-day old tiller seedlings with 6 tiller seedlings hill^{-1} which was similar to that of same old tiller seedlings with 4 tiller seedlings hill^{-1}. The lowest was found by transplanting 25-day old tiller seedlings with 2 tiller seedlings hill^{-1} (Table 10).

Stem dry weight hill^{-1} was not significantly influenced by the interaction between row arrangements and age of tiller seedlings at 25 and 55 DAT while it was significantly influenced at 40 and 70 DAT. The highest stem dry weight was observed in triple row arrangement when age of tiller was 35 days at 40 and 70 DAT. However, at 40 DAT similar result was found in single row arrangement when age of tiller was 35 days. The lowest was found in single and double row arrangements at 40 and 70 DAT when age of tiller was 25-days (Table 12). Stem dry weight hill^{-1} was significantly influenced at 25, 40, 55 and 70 DAT due to the interaction between age of tiller seedlings and number of tiller seedlings hill^{-1}. The highest stem dry weight was produced by transplanting 35-day old tiller seedlings at 25 and 40 DAT with 4 tiller seedlings hill^{-1}. However, similar result was observed by transplanting same age of tiller seedlings with 6 tiller seedlings hill^{-1}. At 55 and 70 DAT the highest stem dry weight was obtained hill^{-1} transplanting 35-day old tiller seedlings with 6 tiller seedlings hill^{-1} and similar result was obtained at same age of tiller seedlings with 4 tiller seedlings hill^{-1}. The lowest was found by transplanting 25-day old tiller seedlings at 25 and 40 DAT with 4 tiller seedlings hill^{-1} and with 2 tiller seedlings hill^{-1} at 55 and 70 DAT (Table 13).

Total dry matter production hill^{-1} was significantly affected at all dates of observations due to interaction between row arrangements, age of tiller seedlings and number of tiller seedlings hill^{-1} 25, 40, 55 and 70 DAT. The maximum total dry matter hill^{-1} was produced in triple row arrangement by transplanting 35 day old tiller seedlings with 6 tiller seedlings hill^{-1} at all dates of observations except 40 DAT. At 40 DAT the highest total dry matter was produced by transplanting 35 day old tiller seedlings with 4 tiller seedlings hill^{-1} The lowest total dry matter was produced in single row arrangement by transplanting 25 day old tiller seedlings with 4 tiller seedlings hill at 25 and 40 DAT and in double row arrangement at 55 and 70 DAT by transplanting 25 day old tiller seedlings with 2 tiller seedlings hill^{-1} (Table 15).

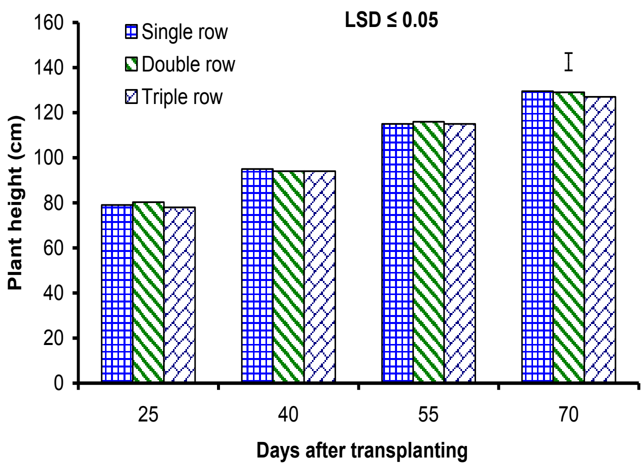

Figure 1. *Effect of row arrangements on plant height.*

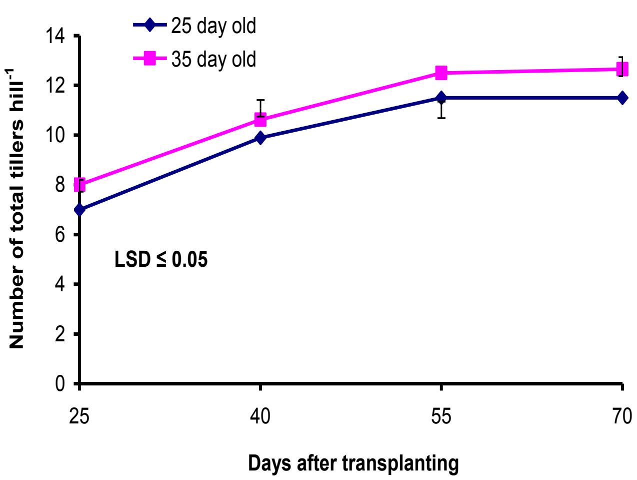

Figure 2. *Effect of row arrangements on number of total tillers hill^{-1}.*

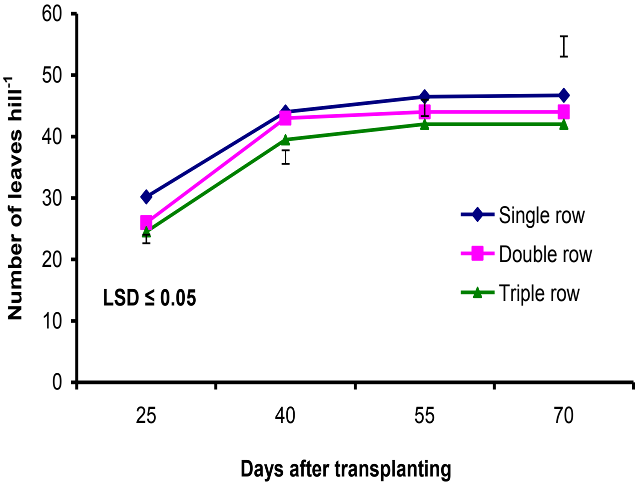

Figure 3. *Effect of row arrangements on number of leaves hill*$^{-1}$.

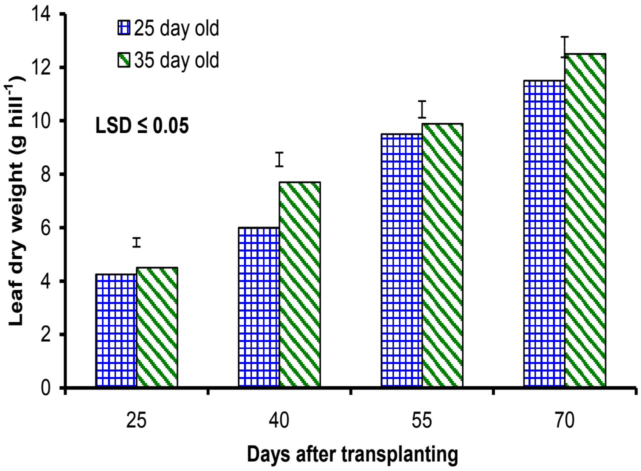

Figure 4. *Effect of age of tiller seedlings on leaf dry weight.*

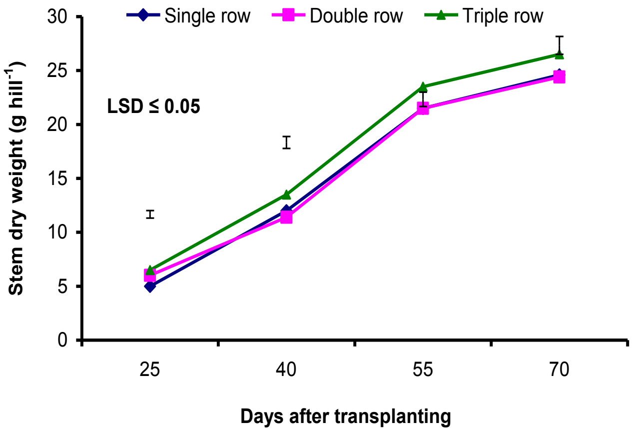

Figure 5. *Effect of row arrangements on stem dry weight hill*$^{-1}$.

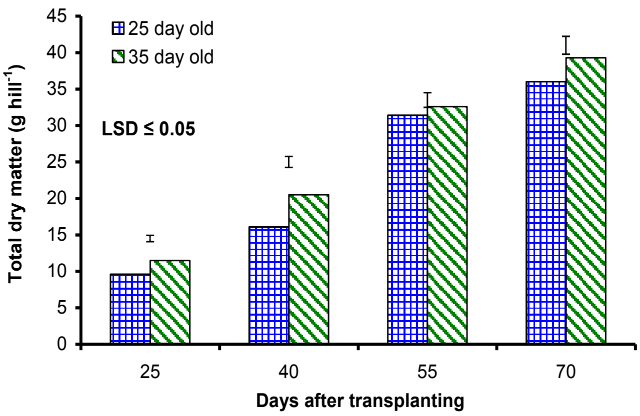

Figure 6. *Effect of age of tiller seedlings on total dry matter production hill*$^{-1}$.

Conclusions

From the above results it can be concluded that transplanted *Aman* rice (cv. BR23) can be grown in single rows for tallest plant, highest tiller production, leaf production and leaf dry matter production hill^{-1}. In case of total dry matter production cv. BR23 can be grown in triple rows by transplanting 35-day old seedlings with 6 tiller seedlings hill^{-1}.

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