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Effect of Row Arrangement and Tiller Separation on the Growth of Transplant Aman Rice

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Abstract: The effect of row arrangement, time of tiller separation and number of tillers kept hill^{-1} was investigated on growth of transplant aman rice (cv. BR23). The experiment comprised of three row arrangements viz., single, double and triple row; two times of tiller separation viz.,25 days after transplanting (DAT) and 35 DAT ; and three levels of number of tillers kept hill^{-1} viz., 2,4 and intact hills. The tallest plant and the highest number of tillers hill^{-1} were recorded in single row, intact hills and when tiller separation was done at 25 DAT. On the other hand the highest leaf area index and total dry matter were recorded in triple row and intact hills. Growing of transplant aman rice in triple rows with intact hills appears as the promising practice in respect of highest leaf area index and total dry matter production. In single row tillers can be separated at 25 DAT without hampering plant height and tiller production hill^{-1}.

Key words: Row arrangement, time, tiller separation, tillers kept hill^{-1}, growth, transplant aman rice

Introduction

Devastating flood very often washes away transplant aman rice in Bangladesh. Farmers can not retransplant their aman rice after the recession of flood water in the early or mid-September due to unavailability of seedlings. Separated tillers of transplant aman rice from a field not affected by flood may be used as seedlings to rehabilitate the damaged rice. Double transplanting practice has also been suggested for transplant aman areas where transplanting is delayed due to flood water inundation (Alim *et al.*, 1962). Tolerance of mother plants to tiller separation as influenced by row arrangement, time of tiller separation and number of tillers to be kept with mother plant, needs to be tested so that their vegetative growth and yield are not adversely affected. Rice has unique ability to tiller profusely as each leaf axil has the potential to produce a tiller (Langer, 1979). In rice, many of the late tillers do not produce panicles due to higher population (Nishikawa and Hanada, 1951; Hanada, 1979). Removal of some tillers from the mother hill may help better development of remaining tillers. Separated tillers can be used as tiller seedling to replant a new area especially in post flood situation.

So, the present experiment was undertaken to observe the effect of row arrangement, time of tiller separation and number of tillers to be kept with mother hills on the vegetative growth of transplant aman rice.

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from June to December 1998. The land was medium high with sandy loam texture having pH 5.9-6.5.

BR23 (Dishari), a modern variety of transplant aman rice, was used as the test crop in the experiment. The experiment consisted of three levels of row arrangements viz.,a) single row (row spacing 25 cm), b) double row (row spacing 25-10-25 cm), c) triple row (row spacing 25-10-10-25 cm) two times of tiller separation viz., a) 25 days after transplanting (DAT) , b) 35 days after transplanting (DAT) and three levels of number of tillers kept hill^{-1} a) 2 tillers hill^{-1}, b) 4 tillers hill^{-1} and c) intact hills.

The experiment was laid out in a split-plot design with row arrangements in the main plots and combination of time of tiller separation and number of tillers kept hill^{-1} in the sub-plots. The treatments were replicated thrice. Area of each unit plot was 4.0 x 2.5 m^2. Forty days old seedlings were uprooted from the nursery bed and were transplanted on 1st August 1998 with two seedlings hill^{-1}.

The land was fertilized with 90-70-50-25-6 kg ha^{-1} of N-P_2O_5-K_2O-S-Zn in the form of urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate, respectively. The entire amount of triple super phosphate, muriate of potash, gypsum and zinc sulphate were applied at final land preparation. Urea was top dressed in three installments at 10, 30 and 50 DAT (Panicle initiation stage). The crop was properly weeded and irrigated when ever necessary. Sumithion @ 400 ml acre^{-1} was applied to control green leaf hopper. At maximum tillering stage sheath blight was successfully controlled by proper drainage and applying Tilt (25 EC) @ 400 ml acre^{-1} at 10 day intervals.

Ten hills were randomly selected in each unit plot excluding border rows to record the data on vegetative growth. Plant height and number of tillers hill^{-1} were recorded at 15 day intervals beginning 25 DAT up to 100 DAT and at harvest. For measurements of leaf area index and dry matter, destructive sampling of five 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. For leaf area, randomly ten leaves were selected from plant samples and their length and breadth were measured. The area of each leaf blade was computed on the basis of their length - breadth as follows :

Leaf area = K x l x W.
where, K = adjustment factor
l = length of leaf blade, and
W = breadth of leaf blade.

The value of K varied with the slope of leaf which, in turn, was affected by the growth stage of the leaf. Here, the value of K was 0.75 which was used for all the stages of growth. Leaf area leaf^{-1} was multiplied by leaf number hill^{-1} to obtain leaf area hill^{-1}. Finally LAI was calculated as suggested by Radford (1967) and Hunt (1978).

Leaf area index (LAI) : Ratio of leaf area to its ground area

Leaves and stems were then dried in oven at 85 ± 5^{0}C for 72 hours to a constant weight. The collected data were analyzed statistically and mean differences were adjudged with Duncan's Multiple Range Test (DMRT).

Results and Discussion

Plant height: Plant height was significantly influenced by row arrangement at 40 and 85 DAT (Table 1). Plant height showed a decreasing trend as the number of rows increased and it was the minimum in double row arrangement at 40 DAT. However, triple row arrangement gave the plants of similar height as that of single row arrangement. This trend of plant height was found at 85 DAT. In single row arrangement plant received adequate space, light, air, water and nutrients for their proper growth and thus plant height was increased. In double row and triple row arrangement, plant heights were relatively less due to competition among plants for the previously mentioned growth factors. This

Table 1: Effect of row arrangement, time of tiller separation and number of tillers kept hill^{-1} on the plant height at different days after transplanting

Treatments	Plant height (cm)						
	Days after transplanting						
	25	40	55	70	85	100	At harvest
Row arrangement							
Single row	64.44	82.77a	85.88	93.60	103.60a	118.91	120.41
Double row	63.59	78.80b	84.18	90.88	97.27b	120.18	118.78
Triple row	63.86	79.40b	85.08	94.20	103.13ab	117.99	118.80
Time of tiller separation							
25 DAT	64.54	79.04b	85.34	94.81	103.15a	119.48	120.36
35 DAT	64.09	81.06a	84.75	90.95	97.52b	118.57	118.30
Number of tillers kept hill^{-1}							
2	64.81	76.20b	79.21c	85.68	95.14b	116.91b	118.30
4	64.02	79.42b	84.58b	92.49	98.87b	118.85ab	119.14
Intact hills	64.07	85.35a	91.34a	100.48	107.00a	121.32a	120.55

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

Table 2: Effect of row arrangement, time of tiller separation and number of tillers kept hill^{-1} on the tiller production at different days after transplanting

Treatments	Tiller production hill^{-1}						
	Days after transplanting						
	25	40	55	70	85	100	At harvest
Row arrangement							
Single row	10.11a	8.76a	12.13a	11.72a	9.51a	8.76a	10.56a
Double row	9.47ab	8.12a	11.56a	12.24a	8.31ab	7.93b	9.06ab
Triple row	5.86b	7.11b	9.46b	8.24b	6.99b	7.31b	7.95b
Time of tiller separation							
25 DAT	9.04	8.87a	11.50	10.38	8.49a	8.09	8.93b
35 DAT	9.26	7.13b	10.93	9.75	8.05b	7.91	9.45a
Number of tillers kept hill^{-1}							
2	8.86	5.71c	9.42c	9.71	8.06a	7.73	8.87b
4	9.36	7.21b	10.45b	9.75	7.86b	8.00	9.04b
Intact hills	9.22	11.08a	13.38a	10.74	8.89a	8.26	9.66a

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

Table 3: Effect of row arrangement, time of tiller separation and number of tillers kept hill^{-1} on the leaf area index at different days after transplanting

Treatments	Leaf area index					
	Days after transplanting					
	25	40	55	70	85	100
Row arrangement						
Single row	1.77b	3.01b	4.66	5.31b	5.44b	5.04b
Double row	2.32a	3.60a	5.19	5.39b	5.78ab	5.07ab
Triple row	2.34a	3.83a	5.47	6.24a	6.26a	5.74a
Time of tiller separation						
25 DAT	2.20	3.68a	5.18	5.68	5.94	5.12
35 DAT	2.08	3.28b	5.03	5.61	5.72	5.18
Number of tillers kept hill^{-1}						
2	2.08	2.40c	4.48b	4.89b	5.78	4.98
4	2.11	2.93b	4.76b	5.67a	5.86	5.37
Intact hills	2.24	5.11a	4.08a	6.37a	5.89	5.10

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

Table 4: Effect of row arrangement, time of tiller separation and number of tillers kept hill^{-1} on the production of total dry matter at different days after transplanting

Treatments	Total dry matter (t ha^{-1})				
	Days after transplanting				
	25	40	55	70	85
Row arrangement					
Single row	0.91b	1.79b	3.80	5.77	6.83b
Double row	1.07a	2.06a	4.02	6.20	6.34ab
Triple row	1.18a	2.20a	4.18	6.45	6.78a
Time of tiller separation					
25 DAT	1.04	2.11a	4.04a	6.14	6.32
35 DAT	1.06	1.93b	3.60b	6.14	6.32
Number of tillers kept hill^{-1}					
2	1.06	1.51b	3.53b	5.79b	6.02b
4	1.03	1.60b	3.78b	6.27a	6.42a
Intact hills	1.07	2.94a	4.87a	6.35a	6.51a

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

finding agreed with Dutta (1999).

Plant height was significantly affected by time of tiller separation at 40, 85 DAT and at harvest (Table 1). At 40 DAT plant height was higher when tiller separation was done at 35 DAT compared with tiller separation at 25 DAT. But at 85 DAT and at harvest, plant height was higher in the crop where tiller separation was done at 25 DAT. Early separation of tillers at 25 DAT resulted in reduced plant height which was more prominent at 40 DAT. But later on this separation shock was recovered at 85 DAT and at harvest where tiller separation at 25 DAT produced taller plants. Mollah *et al.* (1992) reported that late tiller separation reduced plant height significantly to early tiller separation.

Plant height varied significantly due to number of tillers kept hill^{-1} except 25 DAT. Maximum plant height was recorded in intact hills, medium and minimum heights were found where 4 tillers and 2 tillers were kept hill^{-1}, respectively. At 40, 85 and 100 DAT the plant height was statistically identical where 2 and 4 tillers were kept hill^{-1}. Such shorter plant height might be due to splitting shock reducing the vegetative growth (Mamin *et al.*, 1999).

Tiller production: Number of tillers produced hill^{-1} was significantly influenced by row arrangement (Table 2). The highest and the lowest number of tillers were found in single row and triple row arrangement, respectively. However, double row arrangement was as good as single row arrangement in respect of production of tillers hill^{-1}. Thompstone (1953) reported that wider space

produced more tillers hill^{-1}. It was evident that as the number of rows increased thereby increasing the plant density, competition among plants for various growth factors mentioned earlier was severe which curtailed the number of tillers hill^{-1}.

There was a significant effect of time of tiller separation on tiller number hill^{-1} at 40, 85 DAT and at harvest (Table 2). In general, tiller separation at 25 DAT produced more tillers hill^{-1} which was more prominent at 40 and 85 DAT in the main field. Tiller separation at a later date i.e. at 35 DAT in the present study, caused a reduction in the production of tillers hill^{-1} in the main field. Mother plant subjected to tiller separation at 25 DAT can recover its separation shock quickly thereby producing higher tillers hill^{-1}.

Production of tillers hill^{-1} differed significantly due to number of tillers kept hill^{-1} (Table 2). Tiller number hill^{-1} differed at 40, 55, 85 DAT and harvest. The highest number of tillers hill^{-1} was found in intact hills. Tiller production hill^{+} decreased when tillers were separated from mother plants keeping 2 and 4 tillers hill^{-1}. Tiller production at 40 and 55 DAT decreased progressively compared to intact hills and became the lowest when 2 tillers were kept hill^{-1}.

Leaf area index: The LAI showed significant difference due to the effect of row arrangement at different sampling dates except at 55 DAT (Table 3). Results indicated that the LAI value continued to increase up to 85 DAT and after this the LAI declined in all row arrangements. LAI showed an increasing trend as the number of rows increased. Maximum and minimum LAI values were observed in triple and single row arrangements, respectively. In triple row, plant population as well as leaf production unit^{-1} area was higher compared to double and single rows, which was the probable cause of higher LAI.

LAI was significantly influenced by time of tiller separation at 40 DAT. Maximum LAI was recorded when tiller separation was done at 25 DAT. Leaf area index was significantly affected by number of tillers kept hill^{-1} at 40, 55 and 70 DAT. LAI showed an increasing trend due to higher number of tillers kept hill^{-1}. Higher LAI value was found in intact hills but lower LAI was observed at 55 DAT when 2 tillers were kept hill^{-1}.

Total dry matter: There was significant effect of row arrangement on total dry matter production at 40 and 85 DAT (Table 4). Maximum and minimum total dry matter were recorded in triple and single row arrangements respectively. The probable reasons of increased dry matter in the triple row might be due to higher number of total tillers unit^{-1} area. Total dry matter was significantly influenced by the time of tiller separation at 40 and 55 DAT. Maximum total dry matter was found when tillers were separated at 25 DAT. Minimum total dry matter was obtained when tillers were separated at 35 DAT. Due to delayed tiller separation total dry matter decreased which was more prominent at 40 and 55 DAT. Straw yield decreased significantly due to delayed tiller separation (Mollah *et al.*, 1992).

Total dry matter production differed significantly due to number of tillers kept hill^{-1}. At 40 and 55 DAT, maximum total dry matter was obtained when tillers were intact and minimum total dry matter was found when 2 tillers were kept hill^{-1}. This was statistically similar to 4 tillers kept hill^{-1}. On the other hand, sampling dates 70 and 85 DAT showed maximum total dry matter in intact hills which was statistically similar to 4 tillers kept hill^{-1}. Minimum total dry matter was observed when 2 tillers were kept hill^{-1}. The reduction of dry matter appears to be due to the reduction of tillers during separation. Roy *et al.* (1990) and Mamin *et al.* (1999) reported that straw yield always significantly higher in intact mother hills than splitted treatments which might be due to higher plant height, more tillers unit^{-1} area and undisturbed vegetative growth.

From the findings of the experiment it can be concluded that tallest plant and highest number of tillers hill^{-1} could be obtained in transplant aman rice by planting it in single row and by separating tillers at 25 DAT. Planting in triple rows with intact hills appeared as the promising practice in respect of highest leaf area index and total dry matter production.

References

Alim, A., J.L. Sen, M.T. Ullah and M.A. Chowdhury, 1962. Review of half a century of rice research in east Pakistan. Govt. of East Pakistan, EPG press Dhaka, pp: 119.

Dutta, D., 1999. A study into the effect of row arrangement and nitrogen level on the growth and yield of transplant aman rice. M.Sc. thesis. Dept. Agron. BAU. Mymensingh, Bangladesh.

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

Hunt, R., 1978. The fitted curve in plant growth studies, Math and Plant Physiology (Eds. Rose, D.A. and Edwas, D.A.C.) Aca. Press. London, pp: 283-298.

Langer, R.H.M., 1979. Tillering. In: How Grasses Grow (2nd ed.). Studies in Biology. No. 34, Edward Annold, London, pp: 67.

Mollah, M.I.U., S.M.A. Hossain, N. Islam and M.N.I. Miah, 1992. Some aspects of tiller separation in transplant aman rice. Bangla. Agron. J., 4: 45-49.

Mamin, M.S.I., M.Z. Alam, A.U. Ahmed, M.A. Rashid and F. Jameel, 1999. Effect of splitting tillers on the yield and yield components of transplanted aman rice. Ann. Bangla. Agric., 9:1-9.

Nishikawa, G. and K. Hanada, 1951. Studies in branching habit in crop plants. I. On the differentiation and development of tillering buds in low land rice seedling grown under different seeding space. Proc. Crop Sci. Soc. Japan, 28: 191-193.

Roy, S.K., P.K. Biswas and A. Quasem, 1990. Effects of tiller removal and replanted tillers on the yield of the main and the subsequent rice crops. Bangla. J. Agric., 15: 11-18.

Radford, P.J., 1967. Growth analysis formulae, their uses and abuses. Crop Sci., 7: 171-175.

Thompstone, 1953. Effect of spacing on the yield component of rice. Agric. J. India, 10: 26-53.