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Variety and Seedling Age Affects Fine Rice Yield

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ABSTRACT The research was conducted with the aim of determining effects of seedling age on the yield of four fine rice varieties viz., Kalizura, Tulshimala, BRRI (Bangladesh Rice Research Institute)-37 and BRRI-38. The seedling of different ages such as 15, 25, 35 and 45 days were transplanted on the same day maintaining 25 cm × 15 cm spacing. The experiment was laid out in a randomized complete block design with three replications. The yield and yield contributing characters were influenced by seedling age, variety and their interaction. BRRI-38 gave the highest number of effective tillers hill^{-1}, panicle length, total spikelets panicle^{-1}, grains panicle^{-1}, 1000-grains weight and grain yield. Likewise, yield and yield contributing characters were the highest in 35 days old seedling. On the other hand, the variety (BRRI-38) with the same age as of seedlings 35 days old seedlings was found superior to other interactions, but, in the production of grains panicle^{-1} and 1000-grains weight there was no significant effect in this interaction. From the findings it may be inferred that BRRI-38 with 35 days old seedlings produced the highest grain yield.

Keywords : rice variety, seedling age, grain yield

Gradually rice production area is decreasing day by day due to high population pressure. By the year 2030, population of Bangladesh will reach up to 191 million and demand of cereal has been projected to reach 43.8 million tons (BARC, 1993). According to Bangladesh Bureau of Statistics (2001) the average yield of rice in Bangladesh is very poor (1.97 t ha^{-1}) compared to that of other agriculturally advanced countries. Whereas, about 80% of the total cultivated land of is used for rice production (AIS, 1992) and it is the only source of cash income for many families of Bangladesh (BARC, 1983). Therefore, attempt should be taken to increase the yield unit^{-1} area.

Findings from research work of Hossain & Haque (1988) were that the number of basal tillers hill^{-1} increased with 30 day old than 60 day old seedlings. Variety was more or less influenced 1000-grain weight. Srivastva & Tripathi (1998) observed that increase in grain yield in local check in comparison to hybrid might be attributed to the increased effective tillers m^{-2}, fertile grains panicle^{-1} panicle length and 1000-grain weight. Bangladesh Rice Research Institute (BRRI, 1995) found that among BR14, Pajam, BR5 and Tulshimala, Tulshimala produced the highest number spikelets and BR14 produced the lowest one. A study was carried out by Kamal *et al.* (1998) with nine modern varieties (MV) and six local improved varieties (LIV) and found that among the MV, BR11 gave the highest grain yield (5.73 t ha^{-1}) followed by BR10, BR23, Binashail and BR4.

The age of seedling had a significant effect on number of grains panicle^{-1} (Hariom *et al.*, 1989). It also observed that the 40 days old seedlings gave higher number panicles than 20 or 60 days old seedlings (Rashid *et al.*, 1990). Number of panicles m^{-2}, number of grain panicle^{-1} and 1000-grain weight was the highest at 30 days old seedlings (Raju *et al.*, 1989). Earlier transplanted rice performed better when the seedling age was reduced from 40 to 30 days. Young seedlings (20 and 30 days old), irrespective of dates of transplanting, proved better than older (40 days) seedlings, when other varieties were kept constant (Hundal *et al.*, 1999).

Recently some works on fine rice have already been done and still some more in progress. Nowadays, the farmers of our country cultivate MV rice but their cultivation techniques are traditional. As a result the yield is low. Among the cultivation techniques, seedling age and varieties are

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the most important components, manipulation of which could lead for optimizing yield. Therefore, the present research work was undertaken to fulfill the following objectives.

- To see the performance of the potential fine rice varieties
- To find out optimum seedling age to obtain maximum production

MATERIALS AND METHODS

A description of the experimental period, location, climatic condition, treatments, design, data collection and analysis etc. are included in this section.

Experiment site

The experiment was conducted at the premises of Bangladesh Agricultural University during the period from July to December 2001.The experimental site is situated latitudinally between 24°42'30" and 24°42'15" north and longitudinally between 90°26'45" and 90°27'east. The elevation of the site is about 15 m. The experimental area belongs to the agro-ecological zone of the Old Brahmaputra River Floodplain (Agro Ecological Zone 9). The experimental field was a medium low land, fairly leveled with silty loam texture soil having a pH value about 6.42. The general soil type of the experimental site was non-calcareous dark gray floodplain.

Treatment

There were two sets of treatment for the experiment; one was for variety and another one was for seedling age. Four varieties such as Kalizira (V_1), BRRI-38 (V_2), BRRI-37 (V_3) and Tulshimala (V_4) were selected for the experiment. Among them Kalizira (V_1) and Tulshimala (V_4) were the indigenous variety and BRRI-38 (V_2) and BRRI-37 were high yielding variety. These four varieties with four different seedling ages i.e. 15 days (D_1), 25 days (D_2), 35 days (D_3) and 45 days (D_4) were transplanted in the experimental plots. Seedlings were transplanted in the well puddle experimental plots on 25 August 2001. The booting stage of Kalizira and Tulshimala was started at 20 October. For BRRI-38 (V_2) and BRRI-37 (V_3) this stage was started at 03 November. However, Kalizira and Tulshimala were harvested at maturity on 27 November and BRRI-38 (V_2) and BRRI-37 (V_3) were harvested at maturity on 12 December, 2001.

Experimental design and lay out

In the experiment, a randomized complete block design was followed with three replications. Treatment combinations were assigned at random within a block. Separate randomization was carried out for other blocks. Each plot size was 4.0 m × 2.5 m, total number of plot was 48 and the individual plot and the block were separated for irrigation and drainage by 0.5 m and 1.0 m channel, respectively.

Land preparation and other activities

The experimental plot was well prepared for the transplanting of seedlings using modern technology. Fertilizer at the rate of 120, 100, 70, 60, and 10 kg ha^{-1} of urea, triple super phosphate, muriate of potash, and zinc sulphate respectively at the time of land preparation and different stages of plant growth. Uprooting of seedlings was done avoiding any mechanical injury to the roots. Seedlings of 15, 25, 35 and 45 days old were transplanted in the well paddled experimental plots maintaining proper spacing (2.5 cm × 15 cm) and plant density. Different intercultural operations such as gap filling, weed control, irrigation and drainage and plant protection measures were done properly. Harvest and post-harvest operation were performed considering of varieties.

Data collection and analysis

To get the effective tillers $hill^{-1}$ only the ear bearing tillers were counted from each sample and then average of 10 hills was taken and length of panicle was measured from each panicle in cm. from the first node to the tip of panicle and then averaged. Ten panicles were randomly selected from the each harvested hills. The total grains were counted and average of 10 samples was taken. It included grains and sterile spikelets. Ten panicles were randomly selected from each sample. The grains were

counted and average of 10 samples was taken. Thousand grains were randomly selected from each plot and then it was dried in an oven up to 14% moisture content and weighed in an electric balance. The grain was threshed from the plants, cleaned, dried and then weighed. The yield of grain in kg plot^{-1} was adjusted to 14% moisture content and then it was converted into t ha^{-1}. It also included the yield of 10 sample hills. The collected data were statistically analyzed using "Analysis of Variance Technique" with the help of computer package program MSTAT and the significance of mean differences were judged by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Climatic Condition

The average air temperature during growth stage was 29.24 (℃) and 22.19 (℃) was at ripening stage. Relative humidity was 85.76 (%) and 82.55 (%) respectively for growth stage and ripening stage. The average rainfall was heavy (266.0 mm month^{-1}) during vegetative growth stage but it was very low (5.25 mm month^{-1}) at maturity stage. On the other hand, sunshine was more (10 hrs day^{-1}) at the time of maturity than the time of vegetative growth (7.41 hrs day^{-1}).

RESULTS AND DISCUSSION

Effects of variety

There was significant difference on the number of effective tillers hill^{-1} due to varieties. It was found that BRRI-38 produced the highest and Kalizira produced the lowest number of effective tillers hill^{-1} (Table 1). However, all the varieties statistically differed from each other. The longest panicle (23.02 cm) was observed in BRRI-38 followed by BRRI-37 (22.44 cm). The shortest panicle length (20.76 cm) was obtained from Tulshimala. Panicle length of a variety is a specific varietal character. So, variations of panicle length amongst the tested varieties were conspicuous (Table 1). Result showed that highly significant variation on total spikelets panicle^{-1} due to the effect of variety. BRRI-38 obtained the highest number of spikelets panicle^{-1} which was followed by BRRI-37 with number of spikelets panicle^{-1}. Kalizira possessed the lowest number of spikelets panicle^{-1}. This variation occurred due to differences in varietals characters (Table 1). The highest number of grains panicle^{-1} was obtained from BRRI-38, which was statistically identical to BRRI-37 in respect of grains panicle^{-1}. The lowest number of grains panicle^{-1} produced by Kalizira. Tulshimala exhibited slightly higher number of grains panicle^{-1} but statistically dissimilar with both of BRRI-38 and BRRI-37 (Table 1). Hossain *et al.* (1991) observed also varietal variation in number of grains panicle^{-1}. It was evident from the result that BRRI-38 produced the highest 1000-grain weight followed BRRI-37 and Tulshimala. The lowest 1000-grain weight was produced by Kalizira (Table 1). It was found from the result that BRRI-38 produced the highest grain yield (3.80 t ha^{-1}). The lowest grain yield was obtained from Kalizira (3.25 t ha^{-1}) followed by Tulshimala (3.35 t ha^{-1}) and BRRI-37 (3.56 t ha^{-1}). The highest grain yield from BRRI-38 was mainly due to higher number of effec-

Table 1. Effects of variety on yield and yield contributing characters at harvest

Variety	Effective tiller hill^{-1} (no.)	Panicle length (cm)	Spikelet panicle^{-1} (no.)	Grains panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})
Kalizira (V_1)	8.54 d	21.65 c	159.20 d	140.09 c	12.92 d	3.25 d
BRRI Dhan 38 (V_2)	13.97 a	23.02 a	177.44 a	156.50 a	16.89 a	3.80 a
BRRI Dhan 37 (V_3)	13.72 b	22.44 b	173.36 b	155.03 a	15.37 b	3.56 b
Tulshimala (V_4)	13.20 c	20.76 d	170.03 c	147.28 b	14.30 c	3.35 c
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01
CV (%)	1.51	1.99	0.50	3.57	3.33	1.50

Figures in a column with same letter (s) do not differ significantly as per DMRT whereas figures with dissimilar letters differ significant

tive tillers, longer panicle, higher percentage of grains and higher 1000-grain weight (Table 1). This result was in agreement with that Ahmed (1987) and Alam (1988) who found that a variety could give high yield even with the finer grain size if there would be genetic potentiality. The probable reasons for variation in yield might be due to the heredity of the variety.

Effects of seedling age

The highest (14.02) and the lowest (9.46) number of effective tillers hill^{-1} was observed from 35 and 45 day old seedlings respectively. On the other hand, 10 and 25 day old seedlings produced medium production of effective tillers hill^{-1} (Table 2). Panicle length was significantly influenced by age of seedlings (Table 2). The longest panicle (23.82 cm) was obtained from 35 days old seedlings followed by 25 days old seedlings (23.09 cm). The shortest panicle (21.60 cm) was found from 45 days old seedlings. Seedling age had highly significant effect on total spikelet panicle^{-1}. It was revealed from the results that 35 day old seedlings produced the highest number of spikelets panicle^{-1} compared to 15, 25 and 45 days old seedling. The lowest number of spikelet panicle^{-1} was recorded from 45 days old seedlings (Table 2). This result somewhat support the results found by Tsai and Lai (1987) who reported that younger seedlings produced more spikelet panicle^{-1} than other seedlings. The highest number of grains panicle^{-1} was produced by 35 days old seedlings and the lowest number of grains panicle^{-1} was in 45 day old seedlings. The 25 day old seedlings produced the slightly higher number of grains panicle^{-1} that was statistically different with 35 old seedlings and other one (Table 2). This variation was due to the contribution of panicle length and number of fertilized and sterile spikelets panicle^{-1}. Seedling age also played significant effect on 1000-grains weight. The highest 1000-grains weight was obtained from 35 day old seedlings which were followed by 25 day old seedlings and 15 day old seedlings but both were statistically dissimilar to value of 35 day old seedling. The lowest value obtained in 45 day old seedlings (Table 2). The highest grain yields (3.90 t ha^{-1}) was obtained from 35 day old seedlings followed by 25 days old seedling (3.65 t ha^{-1}), which was statistically dissimilar with each other. The lowest grain yield (3.20 t ha^{-1}) was observed at 45 day old seedlings (Table 2). Islam and Ahmed (1991) and Sanbagavalli *et al.* (1999) observed that 30 days old seedlings gave higher yield than 20 or 40 days old seedlings. On the other hand, Panikar *et al.* (1978) reported that 21, 25 and 35 day old seedlings produced identical yield.

Effects of interaction

In the case of production of effective tillers hill^{-1}, BRRI Dhan38 with 35 day old seedlings (V_2D_3) produced the highest production which was statistically differed to all other treatment combinations. The lowest number of effective tiller hill^{-1} was obtained from Kalizira with 45day old seedlings (V_1D_4) interaction that also differed significantly to each other (Table 3). There was a significant effect of interaction of varieties and seedling ages in the case of panicle length. The longest panicle (25.18 cm) was

Table 2. Effects of seedling age on yield and yield contributing characters at harvest

Seedling Age	Effective tiller hill^{-1} (no.)	Panicle length (cm)	Spikelet panicle^{-1} (no.)	Grains panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})
15 days (D_1)	12.65 c	21.60 c	171.40 c	151.50 c	14.87 c	3.31 c
25 days (D_2)	13.32 b	23.09 b	177.80 b	158.53 b	15.01 c	3.65 b
35 days (D_3)	14.02 a	23.82 a	182.81 a	163.66 a	15.30 a	3.90 a
45 days (D_4)	9.46 d	19.36 b	148.03 d	125.21 d	14.30 d	3.20 d
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01
CV (%)	1.51	1.99	1.50	3.57	3.33	1.50

Figures in a column with same letter (s) do not differ significantly as per DMRT whereas figures with dissimilar letters differ significant

Table 3. Effects of interaction on yield and yield contributing characters at harvest

Interaction Variety x Age of seedling	Effective tiller hill^{-1} (no.)	Panicle length (cm)	Spikelet panicle^{-1} (no.)	Grains panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})
Kalizira × 15 days (V_1×D_1)	8.80 j	21.50 f	160.43 g	142.58	12.83	3.10 i
Kalizira × 25 days (V_1×D_2)	9.10j	22.30 de	170.75 f	150.39	13.10	3.40 f
Kalizira × 35 days (V_1×D_3)	9.50 i	22.80 c-e	175.38 e	156.65	12.90	3.60 d
Kalizira × 45 days (V_1×D_4)	6.75 k	20.00 g	130.25 j	110.75	12.85	2.90 k
BRRI Dhan38 × 15 days (V_2×D_1)	14.50 d	23.15 c	178.90c-e	155.58	16.90	3.60 d
BRRI Dhan38 × 25 days (V_2×D_2)	15.20 bc	24.20 b	184.28 b	163.71	17.10	4.00 b
BRRI Dhan38 × 35 days (V_2×D_3)	16.10 a	25.18 a	190.30 a	171.52	17.16	4.30 a
BRRI Dhan38 × 45 days (V_2×D_4)	10.10 h	19.58 g	156.30 gh	135.21	15.99	3.30 g
BRRI Dhan37 × 15 days (V_3×D_1)	13.50 f	22.15 ef	175.68 de	155.68	15.25	3.35 fg
BRRI Dhan37 × 25 days (V_3×D_2)	15.00 c	23.10 cd	180.28 bd	162.35	15.75	3.70 c
BRRI Dhan37 × 35 days (V_3×D_3)	15.50 b	24.21 b	182.19 bc	168.19	15.90	4.00 b
BRRI Dhan37 × 45 days (V_3×D_4)	10.90 g	20.30 g	155.31 h	133.90	14.58	3.20 h
Tulshimala × 15 days (V_4×D_1)	13.80 ef	19.60 g	170.58 f	152.16	14.50	3.20 h
Tulshimala × 25 days (V_4×D_2)	14.00 e	22.75 c-e	175.90 de	157.69	14.10	3.50 e
Tulshimala × 35 days (V_4×D_3)	15.00 c	23.10 cd	183.38 bc	158.28	14.80	3.70 c
Tulshimala × 45 days (V_4×D_4)	10.10 h	17.58 h	150.28 i	120.98	13.80	3.00 j
Level of significance	0.01	0.01	0.01	NS	NS	0.01
CV (%)	1.51	1.99	1.50	3.57	3.33	1.50

Figures in a column with same letter (s) do not differ significantly as per DMRT whereas figures with dissimilar letters differ significant

obtained from BRRI-38 with 35 day old seedlings and the shortest (17.58 cm) panicle was recorded from Tulshimala with 45 day old seedlings. Both the lowest and highest value was not statistically similar with all other combinations (Table 3). It was evident from the result that BRRI-38 with 35 day old seedlings (V_2×D_3) produced the highest number of total spikelets panicle^{-1} that was statistically differed with all other combinations. The lowest spikelet number was recorded from Kalizira with 45 day old seedlings (V_1×D_4), which was also statistically dissimilar in all other combinations (Table 3). Number of filled spikelets/grains panicle^{-1} was not influenced by this interaction between variety and seedling age (Table 3). The interaction of seedling age and variety exerted no significant effect on 1000-grain weight (Table 3). The interaction of seedling age and plant spacing was significant in respect of grain yield. The highest grain yield (4.30 t ha^{-1}) was obtained from BRRI-38 with 35 day old seedlings which statistically differed to all other interaction. The lowest grain yield (2.90) was obtained from Kalizira with 45 day old seedlings that were also statistically dissimilar with other interaction (Table 3).

CONCLUSION

Parameters related to yield and yield contributing characters were influenced by variety, seedling age and their interaction. Effective tillers hill^{-1}, panicle length, total spikelets panicle^{-1}, grain panicle^{-1}, 1000-grain weight and grain yield were markedly different for the variety. BRRI Dhan 38 produced the best performance in the production of yield and yield contributing characters. Effective tillers hill^{-1}, panicle length, total spikelets panicle^{-1}, grain panicle^{-1}, 1000-grain weight and grain yield were found the highest

from 35 day old seedlings. All the yield and yield contributing characters was the lowest with 45 day old seedlings. The interaction results of variety and seedling age differed significantly. In the case of grains panicle^{-1} and 1000-grain weight (g) the interaction results were statistically non significant.

However, the highest grain yield was obtained from BRRI Dhan 38. The effect of interaction of variety and seedling age also differed significantly for grain yield. The highest grain yield was obtained from BRRI Dhan 38 with 35 day old seedlings in the climatic condition of Bangladesh. At long last, it may be suggested to practices BRRI Dhan 38 with 35 day old seedlings to get the better yield.

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