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Seasonal Effect of Seedling Age on the Yield of Rice

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Abstract : An experiment was carried out at the net house of the Department of Agronomy, Bangladesh Agricultural University, Mymensingh using four seedling ages – 30, 45, 60 and 75 days, for transplant rice during July to November 1995 in transplant Aman (T. Aman) season and during November 1995 to May 1996 in Boro season. The highest grain yield was obtained from 45-days old seedlings in both seasons. Regression models prepared for T. Aman and Boro seasons separately could explain the yield variations 77.1% and 68%, respectively due to seedling age.

Key words: Seasonal effect, seedling age, yield, rice

Introduction

The yield of rice is a function of genotype and environment. Best choice of agronomic practices can greatly ensure appropriate crop environment for proper crop growth, development and yield. Islam (1986) has reviewed the probable ways of rice yield manipulation in Bangladesh through agronomic means where the seedling age factor has been emphasized. Besides other factors, the yield of transplant rice is largely determined by seedling age. Again, determination of seedling age for a particular variety depends on the season of cultivation, in addition to other associated factors (Islam, 1986). Accordingly, the Bangladesh Rice Research Institute (BRRI) has recommended seedling age of rice for transplantation based on growing season such as 20-30 days for Aus season, 20-35 days for T. Aman season and 40-45 days for Boro season (BRRI, 1991; 1992). Researchers' recommendations are often violated by the farmers (Hossain *et al*., 1989) and the case of seedling age is no exception (Salam *et al*., 1989). It has been reported that farmers' practices even included the use of 80-days old seedlings for transplanting Boro rice (Hossain *et al*., 1983). Researchers, in many occasions, found insignificant yield reduction due to transplantation of older seedlings, such as 50 days (Balasubramaniyan, 1985; 1987), 55 days (Patel *et al*., 1987; Ramasamy *et al*., 1985; Gill and Shahi, 1986), or 70 days (Islam, 1980). The foregoing discussion indicates that manipulation of seedling age, both at farmers' and researchers' levels, for achieving satisfactory yield is a continuing process, and this is necessary with the development of new varieties and concepts (Islam, 1986). The present study was, therefore, undertaken to investigate the effect of seedling age on rice yield in two different growing seasons and explain the yield variations.

Materials and Methods

A two-season (Transplant Aman and Boro) repeated experiment was carried out at the net house of the Department of Agronomy, Bangladesh Agricultural University (BAU), Mymensingh during July, 1995 to May, 1996. The experiment was set in *chari* (big earthen pot) having surface area of 0.204 m^2. The soil was collected from the cultivated land of the Agronomy Field Laboratory of BAU which belongs to Sonatola series of non-calcareous dark grey floodplain soil type under the Old Brahmaputra Alluvial Flood plain agroecological zone. The soil was sandy loam having a pH of 6.4 and contained total nitrogen 0.09 %, available phosphorus 16 ppm, exchangeable potassium 0.24 m.e. per 100 g, sulphur 13 ppm, and organic carbon 0.92 %. The experiment included four-seedling ages-30, 45, 60 and 75 days.

In T. Aman season, seedlings were raised in a wet nursery bed in the net house. The sprouted seeds of the test variety, BR3, were sown in the nursery bed on 1st July 1995. When the seedlings were 30 days old, the first transplanting was made on 31st July, 1995 using 2 seedlings $hill^{-1}$ maintaining a spacing of 20 x 17 cm^2. This arrangement provided six hills in a unit *chari*. The seedlings were transplanted on 15 August, 30 August and 14 September, 1995 at seedling age of 45, 60 and 75 days, respectively. In the Boro season, seeds of BR3 were sown in the seedbed on 1st November 1995. The seedlings were transplanted in accordance with the seedling age on 1st December, 16th December and 31st December 1995, and 15th January 1996.

The crop was fertilized, in both the seasons, with N, P, K, S and Zn at the rates of 80, 60, 40, 30 and 5 kg ha^{-1}, respectively, as urea, TSP, MP, Gypsum and Zinc oxide. The whole quantity of fertilizers except urea was applied during land preparation. Urea was top dressed in three equal splits-on 15, 30 and 45 days after transplanting. The cultural operations included weeding and watering were done when needed. A 3-5 cm water level was maintained in the *chari* during the crop growth period. The crop was harvested at maturity during the period from 14 October to 14 November, 1995 in T. Aman season, and from 7th to 31st May, 1996 in Boro season.

Data were collected for measuring growth and development indicators, and yield and yield parameters.

The sterility percentage, biological yield and harvest index were calculated following the procedures developed by Gomez and Gomez (1983).

$$\text{Sterility (\%)} = \frac{\text{Unfilled spikelets}}{\text{Total spikelets}} \times 100$$

The biological yield and harvest index were calculated as follows:

$$\text{Biological yield} = \text{Grain yield} + \text{Straw yield}$$

$$\text{Harvest index (HI)} = \frac{\text{Grain yield}}{\text{Biological yield}}$$

The collected data were analyzed statistically and the mean differences were adjudged by Duncan's New Multiple Range Test (Gomez and Gomez, 1983).

Results and Discussion

In both the seasons, plant height increased with seedling age up to 45 days and decreased thereafter (Table 1). However, differences in plant height due to seedling age up to 60 days in T. Aman season and that between 45 and 60 days in Boro season were not significant. The number of total tillers and

Table 1: Effect of seedling age on plant height and number of tillers of BR3 rice grown in T. Aman and Boro seasons.

Seedling age (days)	Plant height (cm)		Total tillers m^{-2} (no.)		Panicle bearing tillers m^{-2}(no.)		Panicle non-bearing tillers m^{-2}(no.)	
	T. Aman	Boro	T. Aman	Boro	T. Aman	Boro	T. Aman	Boro
30	96.3a	83.3b	476.0a	382.0a	284.0ab	348.0a	191.0	34.0
45	97.0a	90.2a	328.0b	427.0a	309.0a	363.0a	20.0	54.0
60	89.2a	87.7a	357.0b	377.0a	302.0a	338.0a	55.0	39.0
75	78.8b	64.8c	310.0b	181.0b	241.0b	152.0b	152.0	29.0
$\bar{x}$	1.99	1.01	20.22	21.93	13.17	17.81	-	-
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	NS	NS
CV %)	5.39	3.02	13.47	15.72	11.35	14.52	107.10	46.36

Means in a column having common letter (s) do not differ significantly at 5% level of significance; NS means not significant.

Table 2: Effects of seedling age on some yield contributing characters of BR3 rice grown in T. Aman and Boro seasons

Seedling age (days)	Panicle length (cm)		Total spikelets $panicle^{-1}$ no.		Grains $panicle^{-1}$ (no.)		Sterility (%)		1000 grains weight (g)	
	T. Aman	Boro	T. Aman	Boro	T. Aman	Boro	T. Aman	Boro	T. Aman	Boro
30	21.2a	21.8b	88.2b	117.7b	51.00b	94.33a	41.83a	19.00b	25.47	23.65b
45	20.7ab	22.7b	112.3a	120.7ab	82.50a	94.17a	27.33b	21.83b	25.95	23.20b
60	19.3b	21.8b	77.5b	110.7b	60.6b	70.33b	21.00b	37.83a	26.03	24.38
75	19.8ab	24.2a	79.2b	133.8a	56.50b	93.00a	28.50b	30.50a	26.33	23.37b
$\bar{x}$	0.35	0.22	2.90	4.90	3.06	4.50	1.85	1.77	-	0.24
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	NS	0.05
CV (%)	4.20	2.41	7.96	9.95	11.95	12.52	15.31	15.89	3.10	2.52

Means in a column having common letter(s) do not differ significantly at 5% level of significance; NS means not significant.

Table 3: Effects of seedling age on the yield of BR3 rice grown in T. Aman and Boro seasons

Seedling age (days)	Grain yield (t ha^{-1})		Straw yield (t ha^{-1})		Biological yield(t ha^{-1})		Harvest index	
	T. Aman	Boro	T. Aman	Boro	T. Aman	Boro	T. Aman	Boro
30	3.20b	5.21d	8.59a	6.02ab	11.79b	11.78b	0.27b	0.45
45	4.85a	6.73a	8.55a	8.02a	13.40a	14.75a	0.37a	0.47
60	3.35b	5.09b	5.47b	6.82a	8.82c	11.91b	0.39a	0.43
75	3.27b	3.33c	4.63b	4.15b	7.90c	7.49c	0.41a	0.45
$\bar{x}$	78.08	171.9	264.7	468.9	253.9	438.3	0.013	-
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	NS
CV (%)	5.22	8.27	9.52	18.36	5.94	9.35	10.73	6.29

Means in a column having common letter(s) do not differ significantly at 5% level; NS means not significant.

panicle bearing tillers varied significantly due to seedling age, but not the non-bearing tillers, in both the seasons. During harvest, the highest number of total tillers (476 m^{-2}) resulted from 30-days old seedlings in T. Aman season. This number was significantly superior to the rest produced by 45 to 75-days old seedlings (Table 1). In Boro season, tiller production due to 30, 45 and 60-days old seedlings was statistically similar and superior to that produced by 75-days old seedlings. In case of panicle bearing tillers, the pattern of total tiller production was reflected in Boro season, whereas in T. Aman season panicle bearing tillers number was statistically similar due to seedling age of 30-60 days (Table 1). This result contradicts the findings of Roy and Sattar (1992), who stated that tillering reduced with the increase in seedling age from 20 to 80 days. This was perhaps due to environmental differences between the experimental sites. The panicle length during T. Aman season was longer due to seedling ages of 30, 45 and 75 days, whereas in Boro season longer panicles were produced by 75-days old seedling (Table 2). The spikelet number $panicle^{-1}$ during T. Aman season was significantly the highest for 45-days old seedlings, whereas the numbers resulting from rest of the seedling ages were statistically similar (Table 2). During Boro season, 75-days old seedlings produced the highest number of spikelets $panicle^{-1}$ that were statistically similar to those produced by 45-days old seedlings. The number of grains $panicle^{-1}$ during T. Aman season followed the similar pattern of spikelets $panicle^{-1}$. However, in Boro season, the 30-days old seedlings produced higher grains with similar performance to 45 and 75-days old seedlings. The findings are in agreement with Mejos and Pava (1980), who stated that significant decrease in spikelets $panicle^{-1}$ might not be observed due to increase in seedling age.

The highest proportion of sterility was observed with 30-days old seedlings in T. Aman season, whereas the older seedlings (60 and 75 days old) showed significantly higher sterility in Boro season (Table 2). The findings of Murty and Sahu (1979) agreed with the results of Boro season. The 1000 grain weight did not differ significantly due to seedling age in T. Aman season whereas the weight was significantly highest from 60-days old seedlings in Boro season (Table 2).

Grain yield was the highest from 45-days old seedlings in both the seasons. Grain yields from seedling age 30, 60 and 75 days in T. Aman season and 30 and 60 days in Boro season were insignificant. Wagh *et al.* (1988) also reported the highest grain yield due to 45-days old seedlings. The pattern of biological yield was similar to that of grain yield. The harvest index increased progressively with increasing seedling age in T. Aman season, whereas it varied insignificantly in Boro season (Table 3).

The grain yield due to seedling age could better be predicted by the following regression models prepared separately for T. Aman and Boro season. The Model-1 could explain 77.1% of the yield variations, whereas the Model-2 for Boro season could explain 68% of the yield variations due to seedling age.

Model-1

$Y = -27793.3 + 1952.34\ x - 37.4029\ x^2 + 0.225251\ x^3$

$[R^2 = 0.771, n = 24]$
Where,
Y = Predicted yield in T. Aman (t ha^{-1})
x = Seedling age (days) in T. Aman

Model-2
$Y = -19602.3 + 1515.081 x - 27.474 x^2 + 0.151341 x^3$
$[R^2 = 0.68, n = 24]$
Where,
Y = Predicted yield in Boro (t ha^{-1})
x = Seedling age (days) in Boro

Based on the results, it may be concluded that 45-days old seedlings may be used to get higher grain yield in both T. Aman and Boro seasons in the case of BR3 rice variety under tested area. However, for drawing more realistic conclusion, further study is necessary.

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