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Journal of Science Foundation, July 2013, Vol. 11, No.2 ISSN 1728-7855

Growth and Yield of Basmati Rice as Affected by Planting Date in Boro Season

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Abstract

The experiment was conducted at the Bangladesh Rice Research Institute Farm, Gazipur, in Boro season. BasmatiPNR, Basmati370, Basmati375 and Basmati-D were transplanted started from 10 December, and continued up to 25 January in the following year, at an interval of 15 days. Forty day old seedlings were transplanted spaced at 20 cm × 15 cm, to find out the optimum planting time and to select the Basmati varieties having high yield potential. The tallness of plants, number of tillers and dry matter were increased with the advancement of planting dates. On the country, number of panicles, grains panicle^{-1}, panicle length, grain yield and growth duration decreased as delayed planting dates. The short stature BasmatiPNR and tall plant of Basmati375 exhibited higher number of panicles, grains panicle^{-1} and heavier individual grain which contributed to increase grain yield. Thus, high yield potential varieties BasmatiPNR and Basmati375 to be planted in optimum time on 10 December, to obtain maximum grain yield of rice in Boro season. *[Journal of Science Foundation, 2013;11(2):37-42]*

Key Words: Optimum Planting Date, Basmati Rice, Boro season

[Cited as: Mannan MA, Bhuiya MSU, Akhand MIM, Rana MM, Zahan A.. Growth and Yield of Basmati Rice as Affected by Planting Date in Boro Season. Journal of Science Foundation 2013;11(2):37-42]

Introduction

Production of rice has been given the highest priority in the world to feed the hungry people of ever-increasing population (Bhuiyan *et al.*, 2004). Rice grows well all the year round and even under wide range of environmental conditions (Islam *et al*., 1999). Farmers cultivate coarse and fine rice to meet up their food requirement. The coarse rice is used for daily consumption and fine quality rice like Basmati grain is used in festival or in special occasions. The Basmati grains are long slender and contained aroma which is an expensive and the price is 2-3 times higher than that of coarse rice (Biswas *et al*., 1992). The Basmati grains have gained a wider acceptance in international markets (Yoshihashi, 2005). However, the choice of grain depends on the consumers' income and well-off people preferred long slender Basmati grain (BRRI 2000). In Bangladesh the demand of Basmati fine rice has been increasing, as the country is being approaching self-sufficiency in rice production (BRRI, 2004).

The growth and yield of Basmati rice greatly depend on planting time as maximum expression of genetical characters depends on environmental factors (BRRI, 2001). Most of the photoperiod sensitive fine rice varieties are suitable for growing in Aman season and gives better quality grain. But the grain yield of Aman rice is comparatively lower than Boro crop. So, to obtained higher grain yield sometimes farmers cultivate these Basmati rice in Boro season (BRRI, 2003). But there is risk of yield loss to cultivate photoperiod sensitive rice in Boro season. Because, rice seeded beyond November, there is chance not to flower until photo-induction occurred (Singh and Singh, 2000). The

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technological information for growing photoperiod sensitive Basmati fine rice in Boro season is still lacking. Based on the above facts the present study was undertaken to determine the optimum planting date and to find out the Basmati varieties having high yield potential for growing in Boro season.

Methodology

The experiment was conducted at the Bangladesh Rice Research Institute Farm, Gazipur, in Boro season. BasmatiPNR, Basmati370, Basmati375 and Basmati-D were grown from 10 December and continued up to 25 January, at an interval of 15 days. Forty-day old seedlings were transplanted spaced at 20 cm × 15 cm, using 2-3 seedlings hill^{-1}. The treatments were distributed in a split-plot design, placing planting date in the main plot and rice varieties in the sub plot and replicated thrice. Fertilizers were applied @ 80-60-40-10-4 kg N, P_2O_5, K_2O, S and Zn ha^{-1}, respectively through urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate during final land preparation except urea. Urea was top-dressed in three equal splits at 20 date after transplanting (DAT), 35 DAT and at 5 days before panicle initiation (BRRI, 2004). The crop field was kept weed free by two hands weeding at different growth stages. Five destructive sample hills were collected from each individual plot out side of the harvested area to measure different growth parameters. The plant height, number of tillers and dry matter were recorded at 15 day intervals started from 30 DAT from the sample hills. The dry matter was determined in an oven dry basis for 72 hours. For grain yield, five square meter areas was harvested from the center of the each plot. The grain yield was adjusted to 14% moisture content and expressed in ton ha^{-1}. The straw was dried in the sun until complete drying.

Results and Discussion

Plant height, tiller number and dry matter

The variation of plant height, tiller number and dry matter of rice varied significantly at different growth stages due to transplanting in different dates. These growth parameters gradually increased with the advancement of planting dates and the highest response was observed in the crop of late planted on 25 January. Probably, the highest response was found in late planted crop was due to gradual rise of air temperature which was favourable for crop growth (Table 1). This fact well agrees with the results obtained by Gomosta *et al.* (2001) that have found stunted crop growth in early planted crop due to low temperature in Boro season.

Table 1: Effect of planting date on the plant height, tiller number and dry matter of Basmati rice varieties in Boro season (Average of two years)

Planting date	Plant height (cm) at different DAT and at maturity				Tiller number (m^{-2}) at different DAT			Dry matter (t ha^{-1}) at different DAT		
	30 DAT	45 DAT	60 DAT	Maturity	30 DAT	45 DAT	60 DAT	30 DAT	45 DAT	60 DAT
10 Dec	37.56c	57.47c	69.04c	107.85c	114c	260c	347c	0.21d	1.01d	2.42d
25 Dec	49.84b	60.09bc	76.10b	108.56b	168b	329b	383b	0.41c	1.67c	2.85c
10 Jan	51.16a	62.29b	79.67a	109.28ab	191a	339ab	391ab	0.51b	1.92b	3.23b
25 Jan	51.67a	57.24a	81.17a	110.35a	193a	350a	399a	0.62a	2.25a	3.90a
Mean	47.56	61.77	76.50	109.01	167	320	380	0.44	1.71	3.11
Level of significance	0.01	0.01	0.01	0.05	0.01	0.01	0.01	0.01	0.01	0.01
CV (%)	4.9	4.0	2.4	2.9	8.3	6.6	2.5	10.2	3.7	5.6

*Figures in a column followed by different letters differ significantly but with common letter(s) do not differ significantly at 5 % levels of significance.

The Basmati375 and Basmati370 showed the tallness while BasmatiPNR exhibited short stature plant at different growth stages even at maturity (Table 2). Higher number of tillers was observed in Basmati-D followed by BasmatiPNR while; lower number of tillers was found in Basmati370 and Basmati375 at different growth stages (Table 2). Similarly, the maximum dry matter production was found in the high tiller productive variety Basmati-D followed by Basmati375 while the lowest amount of dry matter was recorded in BasmatiPNR irrespective of growth stages (Table 2).The interaction effect of planting date and variety on plant height, tiller number and dry matter was insignificant.

Table 2: Plant height, tiller number and dry matter production of Basmati rice varieties in Boro season (Average of two years)

Varieties	Plant height (cm) at different DAT and at maturity				Tiller number (m^{-2}) at different DAT			Dry matter (t ha^{-1}) at different DAT		
	30DAT	45DAT	60DAT	Maturity	30DAT	45DAT	60DAT	30DAT	45DAT	60DAT
BasmatiPNR	39.75c	55.10c	65.85c	87.50c	166a	303b	372b	0.40c	1.62c	3.02b
Basmati370	52.70a	69.85a	84.15a	123.10a	143b	285b	348c	0.44b	1.72b	3.12ab
Basmati375	52.55a	70.20a	84.60a	123.65a	142b	292b	348c	0.45b	1.76ab	3.21a
Basmati-D	47.55b	61.70b	78.65b	110.70b	173a	336a	400a	0.48a	1.86a	3.29a
Mean	48.14	64.21	78.31	111.24	156	304	367	0.44	1.74	3.16
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CV (%)	5.0	4.7	3.6	2.1	9.5	7.0	8.4	7.0	7.6	6.3

*Figures in a column followed by different letters differ significantly but with common letter(s) do not differ significantly at 5 % level of significance.

Yield and yield components

The yield and yield components parameters are varied significantly due to shifting of transplanting date from December to January. Seedling transplanted in early season on 10 December gave significantly higher grain yield than the late-planted one (Fig. 1).

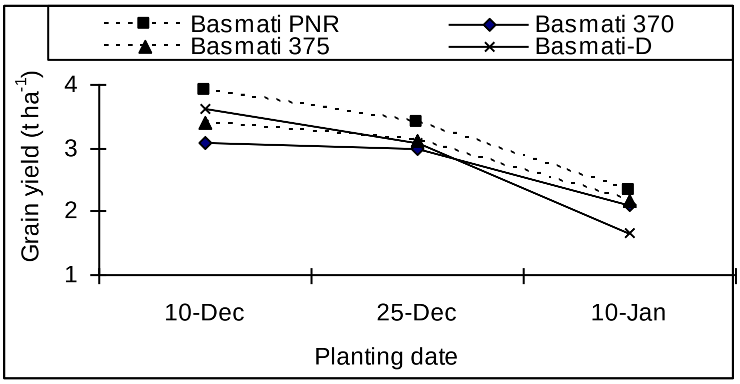

Fig. 1: Grain yield of Basmati rice as affected by planting date in Boro season (Average of two years)

The higher number of panicles, more grains per panicle, low spikelet sterility, heavier individual grain weight and longer growth duration of early transplanted crop on 10 December enhanced to increase grain yield of rice. As the transplanting delayed these parameters are gradually decreased (Table 3).

On the contrary, spikelet sterility increased as transplanting delayed and the highest sterility was found in the late planted crop, resulting lower grain yield. These findings are in conformity with the results obtained by BRRI (2003). However, Yoshida (1981) reported that the 1000-grain weight is a stable varietals character, which remained unaffected due to the manipulation of planting date (BRRI, 2003).

The significant interaction of planting date and variety indicated that BasmatiPNR showed higher number of panicles, more grain panicle^{-1}, heaver individual grain and shorter growth duration irrespective of planting dates that reflected on the grain yield increased. On the contrary, the lower grain yield was found in Basmati370 in December planted crop and Basmati-D in January planting due to less number of grains per panicle and high spikelet sterility (Table 3). Probably, timely transplanted crop flowered in favorable temperature in March and received ample solar radiation during grain filling period which enhanced to produce higher grain yield (Table 3). These findings are in conformity with the results obtained by Salam *et al*. (2004). Transplanting beyond 25 December, sharply decreased grain yield. Less number of panicles was observed in late planted crop (10 January). Probably; this was due to lack of photo induction. This fact well agrees with the results of BRRI (2003). Further delayed transplanting after 10 January, most of the tiller did not bear panicle and only a few panicle emerged, but all the spikelets were steriles, as a result the yield was zero. These findings are in conformity with the results obtained by Bhuiyan and Salam (2003). Shifting transplanting from 10 December to 25 December, the yield reduction was higher in Basmati-D followed by BasmatiPNR (44.00-24.67 kg ha^{-1} day^{-1}) shown in Table 3.

Table 3: Interaction effect of planting date and varieties on grain yield and yield components of Basmati rice in Boro season (Average of two years)

Treatments interaction: Planting date x variety		Panicle number (m^{-2})	Panicle length (cm)	Grains panicle^{-1}	Sterility (%)	1000 grain wt(g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Growth duration (days)
Dec 10	BasmatiPNR	305ab	22.01ab	67 a	19d	20.13a	3.9 a	3.66abc	149 d
	Basmati370	306ab	22.30a	65 ab	28bcd	19.17cd	3.08 cd	3.93ab	151 c
	Basmati375	277bc	22.11ab	65 ab	24cd	19.47bcd	3.41bc	4.05a	154 b
	Basmati-D	348a	20.44ab	67 a	24cd	17.30e	3.62 ab	4.10a	158 a
Dec 25	BasmatiPNR	291bc	21.77ab	61 abc	25bcd	20.02ab	3.41bc	3.44bc	144 g
	Basmati370	264bcd	21.49ab	61 abc	31bc	19.11cd	3.0d	3.63abc	144 g
	Basmati375	266bcd	21.22ab	61 abc	28bcd	19.71abc	3.11cd	3.77abc	146 ef
	Basmati-D	291bc	20.42ab	61 abc	32bc	17.35e	3.08cd	4.0a	148 de
Jan 10	BasmatiPNR	241cde	21.05ab	50 bc	33abc	19.53abcd	2.33e	3.33c	140 h
	Basmati370	219de	21.40ab	51 abc	36ab	18.98d	2.09e	3.43c	141 h
	Basmati375	227de	21.07ab	53 abc	36ab	19.49abcd	2.11e	3.66abc	142 h
	Basmati-D	206e	19.88b	49 c	44a	16.98e	1.67f	3.83abc	146 f
P value	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
CV (%)	-	9.89	5.74	13.85	20.40	2.0	6.85	6.87	0.76

*Figures in a column followed by different letters differ significantly but with common letter(s) do not differ significantly at 5% level of significance

On the contrary, yield reduction was less in Basmati370 (5.33-6.00 kg ha^{-1} day^{-1}). The drastic yield reduction (>100 kg ha^{-1} day^{-1}) was found in Basmati-D when transplanting was shifted from 25 December to 10 January. Late planted beyond 10 January, the crop showed the grain yield which was zero. The results confirmed the findings of Salam *et al*. (1992). However, Zaman (1981) cautioned the restriction of seeding date of photo-sensitive rice varieties within November for photoperiodic induction and to obtain satisfactory yield.

Straw yield

Straw yield of rice was varied significantly due to shifting of transplanting date. Early-planted on 10 December crop showed significantly higher amount of straw yield over the late-planted one (Table 3). The straw yield decreased with the advancement of the planting dates. Probably, the low straw yield of late planted crop was due to shorter growth duration. The high dry matter productive variety Basmati-D exhibited the highest amount of straw yield, while short stature plant Basmati PNR gave less amount of straw yield.

Flowering behaviour and growth duration

Early planted (10 December) crop started flowering from 06 March and continued up to 16 March and matured 10 days earlier than 25 December planted crop. Similarly, 25 December transplanted crop started flowering from 12 March and ended on 22 March. With the advancement of transplanting date 10 January planted crop the started flowering from 22 March and continued up to 04 April. The growth duration of rice decreased with the advancement of planting dates. The longer duration of early planted crop was due to low temperature spelled at early vegetative growth stage which delayed crop establishment and to produce new tillers, resulting prolonged vegetative growth that increased total growth duration. These findings are in conformity with the results obtained by Pathak *et al*. (2003) in Boro season. BasmatiPNR and Basmati370 matured earlier while, Basmati-D matured late irrespective of transplanting dates. In early planting (10 December) of Basmati370 matured 3-6 days earlier than the Basmati-D. Similar findings were also reported by BRRI (2001). However, it is important to select high yield potential photoperiod sensitive or insensitive fine rice varieties having cold tolerance at the early vegetative stage to obtained higher grain yield.

Thus, BasmatiPNR and Basmati375 could be planted on early December to obtained higher grain yield and planting not be allowed beyond 10 January in Boro season.

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