Yield and yield components of BRRIdhan 29 on different planting density

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Abstract: A field experiment was conducted at the experimental farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur during *boro* season (2009-10) to study the yield and yield components of BRRIdhan 29 grown at different planting density. The five planting densities constituted the experimental variables as T_1: 27 hills m^{-2} (25 cm x 15 cm), T_2: 40 hills m^{-2} (25 cm x 10 cm), T_3: 50 hills m^{-2} (20 cm x 10 cm), T_4 : 67 hills m^{-2} (15 cm x 10 cm) and T_5: 111 hills m^{-2} (15 cm x 6cm). The experiment was laid out in randomized complete block design (RCBD) with three replications where unit plots were 5m x 3m with a distance of plot to plot 1m and block to block 1.5 m. At maturity, 10 plant samples were uprooted to measure yield contributing characters and from center of each plot a 5 m^2 area was harvested to determine yield. Data revealed that population density of 40 hills m^{-2} produced grain yield of 5993 kg hac^{-1} which was the highest among all the treatments. Therefore, the standard planting density for BRRIdhan29 may be recommended as 40 hills m^{-2} for commercial production.
Key words: Yield, yield components, planting density.

Introduction

Rice alone provides 76% of the total calories and 66% of the protein in a typical Bangladesh diet of the people (Bhuiyan and Karim, 2002). But the increasing in production by increasing cropping area practically impossible today. The means for increasing rice yield per unit area can be explored by increasing technical management. Among cultural technology applications, the best planting space is the important one (Barari *et al.,* 2007). The growth, development, yield and yield components of rice are greatly influenced by plant spacing. Optimum plant spacing ensures plant to grow properly utilizing more solar radiation and nutrients. When the planting densities exceed optimum level, competition among plants for light and nutrients become severe. Consequently, the growth shows down and the grain yield decreases. Wider spacing can produces more tillers because at that condition soil, water and nutrients are sufficiently available which ultimately produced higher yield. Again in wider spacing low yield would result due to low plant population (Uddin, 1989). Like other crops, determining the desirable density has always been taken into account by rice researchers and producers as a limiting factor (Miller *et al.,* 1991). The effects of plant density on grain dimension were also identified during different panicle development stages (Mir *et al.,* 2011). The current research is intended to examine the performance of one of the most popular rice variety of the country (BRRIdhan 29) at a range of different population.

Materials and Methods

The field experiment was conducted at the experimental farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur under wet land condition during *boro* season (2009-10) to study the yield and yield components of BRRIdhan 29 on different plating density. The five planting densities constituted the experimental variables as T_1; at 27 hills m^{-2} (25 cm x 15 cm), T_2; at 40 hills m^{-2} (25 cm x 10 cm), T_3; at 50 hills m^{-2} (20 cm x 10 cm), T_4; at 67 hills m^{-2} (15 cm x 10 cm) and T_5; at 111 hills m^{-2} (15 cm x 6cm). The soil was silty clay of shallow red brown terrace type under Salna Series of Madhupur Tract containing a p^H of 6.5. The experiment was laid out in a complete block design (RCBD) with three replications where unit plots were 5m x 3m with a distance of plot to plot 1m and block to block 1.5 m. At the time of final land preparation cowdung was added @ 10 t hac^{-1} and K, S and Zn were applied @ 60, 12 and 3 kg ha^{-1} respectively. The rates of N were 124, 184, 230, 308 and 510 for the plant population of 27, 40, 50, 67 and 111 hills m^{-2} respectively and it was applied in four equal installments at basal, maximum tillering, panicle initiation and flowering stage. Thirty five days old one rice seedling was transplanted in each hill and gap filling was done after two weeks of transplanting with the same aged seedlings. Adequate intercultural practices were done to keep weed, insect-pest infestation at minimum level and a 2 to 4 cm standing water was maintained in the field until the varieties attained at hard dough stage. At maturity, 10 plant samples were uprooted to measure yield contributing characters and from center of each plot a 5 m^2 area was harvested to determine yield. Data recorded for different parameters were put to analysis of variance (ANOVA) and the means were compared using the Least Significant Different (LSD) test.

Results and Discussion

Plant height: At harvest plant height varied with planting density. Among different population density, the tallest rice plants were found in T_5 (101.79 cm) where 111 hills m^{-2} were incorporated and the shortest plants were observed in the T_1 treatment (86.73 cm) at 27 hills m^{-2} (Table 1). The reason behind the tallest plants observed in the T_5 treatment might be due to that over-crowing effect in this treatment caused stem elongation as because of lower penetration as because of lower penetration of solar radiation within the canopy. The result was in agreement with the findings of Singh (1990) that taller plant produced with increased plant density.

Tillers m^{-2}: It was observed in this study that highest plant tillers m^{-2} (710.4) was found in the T_5 (111 hills m^{-2}) treatment which was statistically identical with other densities and lowest tillers (382.5) was found in wider spacing (27 hills m^{-2}). These might be due to the difference in facilities for air, light and nutrient availability by wider and narrower spacing. But Karim *et al.* (2002) found that the highest number of tillers was found in wider spacing.

Effective tillers m^{-2}: At 27 hills m^{-2} spacing effective tillers m^{-2} was 347.4 which were increased up to population density of 67 hills m^{-2} (T_4) where the highest panicle density (443.2) was found. Going beyond this population density, effective tillers decreased. It might be due to that mortality percentage increased markedly after certain limit i.e. effective tillers decreased resulting lesser panicle production. The T_1 (27 hills m^{-2}) and T_5 (111 hills m^{-2}) treatments produced statistically similar panicles per unit area (347.4 and 352.8, respectively). The results were confronted with the result of Haque (2002) that higher number of effective tiller was found in wider spacing.

Panicle length: Panicle length was not much affected by plant population density. Higher population densities produced slightly longer panicles except T_5 which produced identical panicles as in T_1 (Table 1).

Table 1. Plant characters of BRRIdhan29 at harvest as affected by population density

Treatment	Plant height (cm)	Tillers m^{-2}	Effective tillers m^{-2}	Panicles length (cm)
T_1	86.73	382.5	347.4	24.67
T_2	94.39	466.7	384.0	25.15
T_3	94.50	526.7	408.3	25.09
T_4	94.09	578.4	443.2	25.76
T_5	101.79	710.4	352.8	24.76
CV (%)	3.61	7.67	7.33	2.61
LSD (0.05)	5.19	65.63	48.22	1.146

T_1, T_2, T_3, T_4, and T_5 = BRRI dhan 29 at 27, 40, 50, 67 and 111 hills m^{-2} respectively.

Spikelets panicles^{-1}: Total number of spikelets panicles^{-1} i.e. filled and unfilled spikelets per panicle were found to be influenced by population density that created a significant variation among the treatments. Spikelets panicle^{-1} varied between 140 in T_5 (111 hills m^{-2}) to 163.3 in T_4 (67 hills m^{-2}) from where it was evident that spikelets per panicle was increased with population density up to 67 hills m^{-2}. But when population density was further increased up to 111 hills m^{-2}, spikelet number decreased drastically (Table 2). It might be mentioned that incremental application of N and P fertilizers with increasing number of hills per unit area could not contribute much to spikelet formation beyond 67 hills m^{-2} (T_4) which was also evident in T_5 (111 hills m^{-2}).

Filled spikelets panicle^{-1}: It was found that number of filled spikelets panicle^{-1} decreased with increasing planting density. At 27 hills m^{-2} produced the highest (89.47) filled spikelets which was statistically identical with other densities except the higher density of 111 hills m^{-2} (T_5) which produced the lowest number of filled spikelets (61.39) (Table 2). The reasons might be due to that competition for growth resources was more in closer spacing, at the same time assimilate production as well as translocation was also poor in over crowded stands. This observation was in agreement with that of Sarker *et al.* (2002) who stated that wider spacing produced higher number of grain panicle^{-1}.

Ripening percentage: The ratio of the number of filled spikelets and the total number of spikelets per panicle marks the ripening percentage. In this study it was found that increasing planting density progressively decreased ripening percentage. The lowest ripening percentage (43.85%) was found in the treatment T_5 treatment (111 hills m^{-2}). The reduction of ripening percentage with increasing planting density might be due to nutrient deficit as well as inefficient photosynthetic activities.

1000 grain weight: Among the treatments containing different population densities of BRRIdhan 29, grain weight did not vary significantly with increasing population density, although T_4 and T_5 treatments, i.e. higher population densities produced lighter grains than the other treatments.

Table 2. Effect of planting density on yield and yield attributes of BRRIdhann29

Treatment	Spikelets panicle^{-1}	Filled spikelets panicle^{-1}	% Ripening	1000 grain weight (gm)	Grain yield (kg/hac)	Straw yield (kg/hac)	Harvest Index
T_1	141.4	89.47	63.10	20.49	5417	5861	0.48
T_2	155.9	83.81	55.17	20.49	5993	5766	0.51
T_3	153.6	73.33	47.33	20.23	5267	6483	0.45
T_4	163.3	73.49	45.01	19.62	5000	8252	0.38
T_5	140.0	61.39	43.85	19.33	4240	9092	0.32
CV (%)	7.46	16.16	13.27	1.28	11.77	13.27	
LSD (0.05)	18.84	21.57	12.71	0.497	1089	1515	

T_1, T_2, T_3, T_4, and T_5 = BRRI dhan 29 at 27, 40, 50, 67 and 111 hills m^{-2} respectively.

Grain yield: The highest yield was recorded in T_2 treatment (40 hills m^{-2}) and it was followed by T_1 treatment (27 hills m^{-2}). Grain yield decreased progressively with increasing population density beyond 40 hills m^{-2}. The lowest grain yield (4240 kg ha^{-1}) was observed in the T_5 treatment containing highest number of plants per unit area. The poorest performance of this treatment might be attributed to its lower number of spikelets m^{-2}, lower number of filled spikelets panicle^{-1}, lowest ripening percentage as well as production of lightest grains (Table 2). It was evident from results that T_5 treatment produced the highest number of tillers as well as comparable number of effective tillers per unit area (Table 1). However, assimilate translocation towards grains was probably poorest in this treatment as compared to other treatments. It was also evident by Gupta (1995) that high tillering ability is not always a good indicator of high productivity since panicle initiation happens only from the firstly emerged tillers (primary tillers).

Harvest index (HI): Among the different population density treatments of BRRIdhan 29, the lowest HI (0.32) was exhibited by T_5 treatment. It might be due to the fact that increased population density was able to produced TDM at a higher rate but dry matter partitioning was highly unfavourable towards grains. On the other hand, in T_3 (50 hills m^{-2}) treatment TDM production was the highest at harvest, at the same time grain yield was also higher with a moderate HI (0.45) (Table 2).

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