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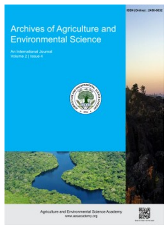

ORIGINAL RESEARCH ARTICLE

CrossMark

Impact of nutrient management on the yield performance of some aromatic fine rice (*Oryza sativa* L.) varieties in *Boro* season

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ABSTRACT

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, during November 2016 to April 2017 to study the impact of nutrient management on the performance of aromatic fine rice in *Boro* season. The experiment comprised three varieties *viz.*, BRRI dhan50, Basmati and BRRI dhan63; and seven nutrient managements *viz.*, poultry manure @ 5 t ha^{-1}, recommended dose of chemical fertilizers (i.e. 250, 126, 120, 100 and 10 kg N-P-K-S-Zn, respectively ha^{-1}), 25% less than recommended dose of chemical fertilizer + poultry manure @ 2.5 t ha^{-1}, 50% less than recommended dose of chemical fertilizer + poultry manure @ 5 t ha^{-1}, vermicompost @ 10 t ha^{-1}, 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1}, 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1}. The experiment was laid out in a randomized complete block design with three replications. The results revealed that variety, nutrient management and their interaction exerted significant influence on yield components and yield of aromatic fine rice in *Boro* season. The highest grain yield (4.09 t ha^{-1}), straw yield (6.20 t ha^{-1}) and harvest index (39.37%) were obtained in BRRI dhan63 while the lowest grain yield (3.44 t ha^{-1}) and harvest index (36.54%) were found in Basmati. In case of nutrient management, the highest grain yield (4.31 t ha^{-1}) was recorded in recommended dose of chemical fertilizers (i.e. 250, 126, 120, 100 and 10 kg N-P-K-S-Zn, respectively ha^{-1}) which was as good as 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1}and 25% less than recommended dose of chemical fertilizer + poultry manure @ 2.5 t ha^{-1} while the lowest one (2.74 t ha^{-1}) was found in vermicompost @ 10 t ha^{-1}. In case of interaction, the highest grain yield (5.30 t ha^{-1}) was obtained in BRRI dhan63 along with 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1} while the highest straw yield (7.20 t ha^{-1}) was produced in BRRI dhan63 fertilized with recommended dose of chemical fertilizers (i.e. 250, 126, 120, 100 and 10 kg N-P-K-S-Zn, respectively ha^{-1}). Therefore, it can be concluded that BRRI dhan63 can be grown with 50% less than recommended dose of chemical fertilizer + vermicompost @10 t ha^{-1} in *Boro* season to obtain the highest grain yield.

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INTRODUCTION

Bangladesh is one of the most important rice growing countries of the world. In respect of area and production, Bangladesh ranks fourth among the rice producing countries of the world following China, India and Indonesia (FAO, 2009). About 77.07% of cropped area of Bangladesh is used for rice production, with annual production of 34.71 million ton from 11.42 million ha of land (BBS, 2016). *Boro* rice covers about 41.94% of total rice area in the country (BBS, 2016). Aromatic rice contributes a small portion (10%) but an important subgroup of rice production. Total aromatic rice production is about 0.297

million tons in 2013 from 0.158 million ha of land in Bangladesh. Sarkar *et al.* (2014) reported that Bangladesh has a bright prospect for export of fine rice thereby earning foreign exchange. The yield of fine rice is lower than that of coarse and medium rice varieties. In recent years, aromatic rice has been introduced to the global market because of its taste, deliciousness and high price to boost up the economic condition of the rice grower in the developing countries like Bangladesh. Because of its natural chemical compounds which give it a distinctive scent or aroma when cooked, aromatic rice commands higher price than non-aromatic rice. The demand of aromatic rice for internal consumption and also for export is increasing day by day. For this reason, farmers are willing to grow aromatic fine rice to obtain higher economic return. So, it is high time to increase the production of aromatic fine rice through increasing the yield per unit area by following proper management system of crop cultures especially through developed variety and nutrient management. In Bangladesh, more than 37 aromatic rice cultivars are grown. Such common cultivars are Kataribhog, Chinigura, Chinisagar, Badshabhog, Rasulbhog, Radhunipagol, Kalizira, Tulshimala, Dulabhog, Basmati, BRRI dhan34, BRRI dhan37, BRRI dhan38, Binadhan-9 and Binadhan-13. Most of the scented rice varieties in Bangladesh are of traditional type, photoperiod sensitive, and cultivated during the *Aman* season. One variety is recommended for *Boro* season namely, BRRI dhan50 (Banglamoti) developed by the Bangladesh Rice Research Institute (BRRI) has gained huge popularity among farmers for its fragrance and relatively high productivity. Like other crops, the yield level of rice, the staple food grain of the country, is very low (2.876 t ha^{-1}) (BBS, 2016) compared to other rice growing countries like South Korea and Japan where the average yield is 6.00 and 5.22 t ha^{-1}, respectively (FAO, 2004). The reason for low yields are mainly associated with lack of improved varieties and judicious fertilizer management especially of organic manure like cowdung, vermicompost, poultry manure and/or their integration with inorganic fertilizers. In Bangladesh, nutrient stresses of soils are increasing day by day. The productivity of aromatic fine rice in Bangladesh is very low due mainly to proper nutrient management. The efficient nutrient management increases crop yield and at the same time reduces fertilization cost. Therefore, extensive research works are necessary to find out appropriate variety and optimum rate of poultry manure, vermicompost in combination with inorganic fertilizers to obtain satisfactory yield and quality of fine rice.

MATERIALS AND METHODS

Description of study site

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, during November 2016 to April 2017.This experimental site is located at 24˚75´ N latitude and 90˚50´E longitude having an altitude of 18m. The experimental site belongs to the Sonatala series of Old Brahmaputra Floodplain Agroecological Zone (AEZ-9) having non -calcareous dark grey floodplain soils (UNDP and FAO, 1988).

Experimental design and treatment details

The experiment consisted of three varieties *viz*. BRRI dhan50, Basmati and BRRI dhan63, and seven nutrient managements viz., poultry manure 5 t ha^{-1}, recommended dose of chemical fertilizers (i.e. 250, 126, 120, 100 and 10 kg N-P-K-S-Zn, respectively ha^{-1}), 25% less than recommended dose of chemical fertilizer + poultry manure @ 2.5 t ha^{-1},50% less than recommended dose of chemical fertilizer + poultry manure @ 5 t ha^{-1}, vermicompost @ 10 t ha^{-1}, 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1}, 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1}. The experiment was laid out in a randomized complete block design with three replications. At the time of final land preparation, respective unit plots were fertilized with different levels of vermicompost, poultry manure according to treatments. The manures were thoroughly mixed with the soil. The amount of nitrogen, phosphorus, potassium, sulphur and zinc required for each unit plot was calculated on ha^{-1} basis and applied in the form of urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate, respectively. Triple super phosphate, muriate of potash, gypsum and zinc sulphate was applied at final land preparation as per treatment. Urea was applied in three equal splits at 15, 30 and 45 days after transplanting (DAT).

Transplantation of seedlings and collection of data

Thirty-five days old seedlings were uprooted carefully without causing any mechanical injury to the root. Healthy seedlings were transplanted in the well puddled experimental plots on 21 December 2016. Intercultural operations were done for ensuring and maintaining normal growth of the crop when necessary. Prior to harvest five hills (excluding border hills) were selected randomly from each unit plot and uprooted to record data on crop characters and yield components. After sampling, the whole plot was harvested at maturity when 90% of the grains became golden yellow in color. BRRI dhan63 was harvested on 23 April, 2017 and BRRI dhan50 and Basmati were harvested on 30 April 2017. The harvested crops of each plot was separately bundled, properly tagged and then brought to threshing floor. Threshing was done manually. The grains were cleaned and sun dried to 14% moisture content. Straws were also dried properly. Finally grain and straw yields plot^{-1} were recorded and converted to t ha^{-1}. Harvest index (%) was calculated with the following formula:

$$\text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

Statistical analysis of data

Data were analyzed statistically using "Analysis of Variance" technique and differences among treatments means were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Varietal performance

Yield components and yield of aromatic fine rice were significantly influenced by variety (Table 1). BRRI dhan50 produced the highest plant height (69.43 cm), which was statistically identical to Basmati (67.48 cm) and the lowest one (66.30 cm) was found in BRRI dhan63. The variation in plant height among the varieties was probably due to heredity or varietal characters. Similar results were reported elsewhere (Paul *et al.*, 2016; Ray *et al.*, 2015 and Kirttania *et al.*, 2013). The highest number of total tillers hill^{-1} was produced by Basmati (10.47), which was statistically identical to BRRI dhan50 (10.33) and the lowest one (9.47) was found in BRRI dhan63. Shaha *et al.* (2014) reported that number of tillers hill^{-1} was influenced by variety. BRRI dhan50 and Basmati produced the highest and same number of effective tillers (9.00) and statistically identical panicle length (21.29 cm and 21.10 cm, respectively) while the lowest of these parameters were found in BRRI dhan63. Due to varietal characteristics production of effective tillers hill^{-1} varied significantly (Sarkar *et al.*, 2014). Shaha *et al.* (2014) reported that panicle length was influenced with variety. Basmati and BRRI dhan63 produced the highest and same number of non-effective tillers (1.47) and the lowest one (1.33) was found in BRRI dhan50. The highest number of grains panicle^{-1}(97.67) and number of total spikelets panicle^{-1}(107.8) was found in BRRI dhan50 while BRRI dhan63 produced the highest number of sterile spikelets panicle^{-1} (15.29), 1000-grain weight (20.96 g), grain yield (4.09 t ha^{-1}), straw yield (6.20 t ha^{-1}), biological yield (10.29 t ha^{-1}) and harvest index (39.37%). The lowest grain yield (3.44 t ha^{-1}) and harvest index (36.54%) were found in Basmati and the lowest straw yield (5.78 t ha^{-1}) was found in BRRI dhan50. Significant variation of grain and straw yields among the rice genotypes were reported elsewhere (Pal *et al.*, 2016, Mittra, 2005, Muniruzzaman, 2004 and Hossain *et al.*, 2003).

Effect of nutrient management

Nutrient management exerted significant influence on yield components and yield of fine rice varieties except panicle length and 1000-grain weight (Table 2). The highest plant height (69.00 cm) was produced in 25% less than recommended dose of chemical fertilizer + poultry manure @ 2.5 t ha^{-1}, which was statistically identical to 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1} and 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1}. The highest number of total tillers hill^{-1} (12.22) was produced in 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1} and the lowest one (9.55) was found in poultry manure 5 t ha^{-1}. Similar results were reported by Shaha *et al.* (2014). The highest number of effective tillers hill^{-1} (10.56) was produced in 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1} while 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1} produced the highest non-effective tillers hill^{-1} (2.00). The highest number of grains panicle (95.11) was produced in 50% less than recommended dose of chemical fertilizer + poultry manure @ 5 t ha^{-1} and the lowest one (91.11) was found in vermicompost @ 10 t ha^{-1}. Combined application of manures and fertilizers increased number of grains panicle^{-1} was reported elsewhere (Jahan *et al.*, 2017; Sarkar *et al.*, 2016; Parvez *et al.*, 2008 and Rahman *et al.*, 2007). The highest number of total spikelets panicle^{-1} (107.7) was recorded in 50% less than recommended dose of chemical fertilizer + poultry manure at 5 t ha^{-1} and the lowest one (99.78) was found in recommended dose of chemical fertilizers (i.e 250, 126, 120, 100 and 10 kg N-P-K-S-Zn, respectively ha^{-1}). The highest number of sterile spikelets panicle^{-1} (14.33) was produced in poultry manure 5 t ha^{-1} while the lowest one was found in 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1}. Recommended dose of chemical fertilizers (i.e. 250, 126, 120, 100 and 10 kg N-P-K-S-Zn, respectively ha^{-1}) produced the highest grain yield (4.31 t ha^{-1}). However, 25% less than recommended dose of chemical fertilizer + poultry manure 2.5 t ha^{-1} (4.15 t ha^{-1}) and 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1} (4.25 t ha^{-1}) were as good as treatment of recommended dose of chemical fertilizers (i.e. 250, 126, 120, 100 and 10 kg N-P-K-S-Zn, respectively ha^{-1} in respect of grain yield. The lowest grain yield (2.74 t ha^{-1}) was produced in poultry manure @ 5 t ha^{-1}(N_1) (2.87 t ha^{-1}) and vermicompost @ 10 t ha^{-1}. Similar results were reported by Shaha *et al.* (2014) and Sarkar *et al.* (2014). The highest straw yield (6.64 t ha^{-1}) was produced in 25% less than recommended dose of chemical fertilizer + poultry manure @ 2.5 t ha^{-1} and the lowest (5.04 t ha^{-1}) was found in vermicompost @ 10 t ha^{-1} which was at par with poultry manure @ 5 t ha^{-1} (5.08 t ha^{-1}). Combined application of inorganic fertilizers with organic manures produced the highest straw yield (Jahan *et al.*, 2017). The highest biological yield (10.80 t ha^{-1}) was found in 25% less than recommended dose of chemical fertilizer + poultry manure @ 2.5 t ha^{-1} which was at par with recommended dose of chemical fertilizers (i.e. 250, 126, 120, 100 and 10 kg N-P-K-S-Zn, respectively ha^{-1}), and 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1} while the lowest one (7.79 t ha^{-1}) was recorded in vermicompost @ 10 t ha^{-1}. The highest harvest index was produced by recommended dose of chemical fertilizers (i.e. 250, 126, 120, 100 and 10 kg N-P-K-S-Zn, respectively ha^{-1}) (40.36%) which was at par with 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1} (39.91%) and 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1} (39.85%) and the lowest one (35.24%) was found in vermicompost @ 10 t ha^{-1}.

Interaction effect of variety and nutrient management

Crop characters, yield components and yield of aromatic fine rice were significantly influenced by the interaction between variety and nutrient management (Table 3). The tallest plant (72.00 cm) was recorded in Basmati fertilized with 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1} while BRRI dhan63 fertilized with 50% less than recommended dose of chemical fertilizer + poultry manure @ 5 t ha^{-1}

Table 1. Effect of variety on crop characters, yield components and yield of aromatic fine rice in *Boro* season.

Variety	Plant height (cm)	Number of total tillers hill^{-1}	Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}	Panicle length (cm)	Number of grains panicle^{-1}	Number of total spikelets panicle^{-1}	Number of sterile spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
BRRI dhan50 (V_1)	69.43a	10.33a	9.00a	1.33b	21.29a	97.67a	107.8a	10.14b	21.38a	3.60b	5.78c	9.39b	38.39b
Basmati (V_2)	67.48a	10.47a	9.00a	1.47a	21.10a	92.81b	103.5b	10.67b	18.14b	3.44c	5.94b	9.38b	36.54c
BRRI dhan63(V_3)	66.30b	9.47b	8.00b	1.47a	20.33b	85.28c	101.0b	15.29a	20.96a	4.09a	6.20a	10.29a	39.37a
$S\bar{x}$	0.766	0.106	0.103	0.037	0.181	0.753	0.970	0.273	0.160	0.049	0.050	0.097	0.290
Level of significance	**	**	**	**	**	**	**	**	**	**	**	**	**
CV (%)	5.32	4.81	5.43	11.80	3.97	3.75	4.27	10.38	3.64	6.01	3.77	4.61	3.49

In a column, figures with same letter (s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT) ** =Significant at 1% level of probability.

Table 1. Effect of variety on crop characters, yield components and yield of aromatic fine rice in *Boro* season.

Nutrient management	Plant height (cm)	Number of total tillers hill^{-1}	Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}	Panicle length (cm)	Number of grains panicle^{-1}	Number of total spikelets panicle^{-1}	Number of sterile spikelets panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
N_1	64.56b	9.55c	8.33c	1.22cd	20.67	91.89ab	106.2ab	14.33a	20.13	2.87c	5.08d	7.95c	36.15cd
N_2	64.22b	10.80b	8.44c	1.33c	21.22	91.10b	99.78c	11.89bc	20.08	4.31a	6.37b	10.68a	40.36a
N_3	69.00a	10.89b	9.33b	1.55b	20.78	93.22ab	105.7ab	11.33bc	20.33	4.15a	6.64a	10.80a	38.48b
N_4	64.33b	9.33c	8.22c	1.11d	20.67	95.11a	107.7a	12.55b	20.17	3.72b	6.43ab	10.15b	36.72c
N_5	63.67b	8.22d	7.11d	1.11d	21.22	91.11bc	102.0bc	10.89c	20.14	2.74c	5.04d	7.79c	35.24d
N_6	67.11ab	12.22a	10.56a	1.66b	21.00	92.11ab	104.3abc	12.33b	20.07	4.25a	6.42ab	10.68a	39.91a
N_7	68.67a	10.67b	8.66c	2.00a	20.78	92.11ab	103.0abc	10.89c	20.18	3.92b	5.83c	9.75b	39.85a
$S\bar{x}$	1.17	0.162	0.157	0.056	0.277	1.15	1.48	0.416	0.245	0.075	0.076	0.149	0.422
Level of significance	**	**	**	**	NS	**	**	**	NS	**	**	**	**
CV (%)	5.32	4.81	5.43	11.80	3.97	3.75	4.27	10.38	3.64	6.01	3.77	4.61	3.49

In a column, figures with same letter (s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT) ** =Significant at 1% level of probability. Poultry manure @ 5 t ha^{-1} (N_1), N-P-K-S-Zn @ 250, 126, 120, 100, 10 kg ha^{-1} (recommended dose) (N_2), 25% less than recommended dose of chemical fertilizer + poultry manure @ 2.5 t ha^{-1}(N_3), 50% less than recommended dose of chemical fertilizer + poultry manure @ 5 t ha^{-1}(N_4), Vermicompost @ 10 t ha^{-1} (N_5), 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1}(N_6), 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1} (N_7).

Table 3. Interaction effects of variety and nutrient management on crop characters, yield components and yield of aromatic fine rice in *Boro* season.

Interaction (Variety × nutrient management)	Plant height (cm)	Number of tillers hill^{-1}	Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}	Panicle length (cm)	Number of grains panicle^{-1}	Total spikelets panicle^{-1}	Sterile spikelets panicle^{-1}	1000- grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest Index (%)
$V_1 \times N_1$	69.00abcd	9.00fg	8.000ef	1.00d	21.33	97.00cd	107.3 bc	10.33gh	21.50	2.98hij	4.78h	7.76gh	38.40def
$V_1 \times N_2$	65.67abcde	8.66fg	7.330f	1.33c	21.00	93.00cdef	104.3 bcd	11.33efg	21.23	4.50bc	6.43d	10.93b	41.16abc
$V_1 \times N_3$	71.00abc	11.00bc	9.670bc	1.33c	20.67	94.67cde	105.0 bcd	10.33gh	21.40	4.03de	6.97abc	11.00b	36.65fg
$V_1 \times N_4$	71.00abc	11.67ab	10.33ab	1.33c	21.00	108.0a	118.3 a	10.33gh	21.40	3.37fgh	6.73bcd	10.10c	33.33h
$V_1 \times N_5$	70.00abc	9.00fg	8.000ef	1.00d	22.33	97.00bcd	106.0 bc	9.00gh	21.43	2.97hij	4.93gh	7.90fgh	37.58ef
$V_1 \times N_6$	70.33abc	12.0a	10.67a	1.33c	21.67	103.0ab	112.3 ab	9.66gh	21.17	4.07de	5.77e	9.83cd	41.35ab
$V_1 \times N_7$	69.00abcd	11.00bc	9.000cd	2.00a	21.00	91.00defg	101.0 cde	10.00gh	21.50	3.30fgh	4.90gh	8.20fgh	40.24bcd
$V_2 \times N_1$	64.67cdef	10.33cd	9.000cd	1.33c	20.33	91.33defg	104.3 bcd	13.00def	18.17	2.80ij	5.60ef	8.40efg	33.33h
$V_2 \times N_2$	68.00abcd	12.3a	10.67a	1.67b	22.33	89.67efg	99.67 cde	10.00gh	18.40	3.67ef	5.48ef	9.15de	40.08bcde
$V_2 \times N_3$	71.67ab	10.00de	8.670de	1.33c	21.33	99.00bc	107.3 bc	8.33h	18.47	4.03de	6.33d	10.36bc	38.89bcdef
$V_2 \times N_4$	65.00bcdef	9.33ef	8.330de	1.00d	21.00	91.33defg	104.7 bcd	13.33cde	17.90	3.53fg	6.90abc	10.43bc	33.87h
$V_2 \times N_5$	63.00defgh	8.67fg	7.330f	1.33c	21.00	94.00cdef	103.0 cde	9.00gh	17.90	2.57j	4.90h	7.470h	34.38gh
$V_2 \times N_6$	72.00a	12.3a	10.67a	1.67b	21.00	90.33defg	101.3 cde	11.00fg	18.00	4.33cd	6.87abc	11.20b	38.68cdef
$V_2 \times N_7$	68.00abcd	10.33cd	8.330de	2.00a	20.67	94.00cdef	104.0 bcd	10.00gh	18.13	3.17ghi	5.50ef	8.670ef	36.55fg
$V_3 \times N_1$	60.00efgh	9.33ef	8.000ef	1.33c	20.33	87.33fgh	107.0 bc	19.67a	20.73	2.83ij	4.87h	7.69gh	36.74fg
$V_3 \times N_2$	59.00efgh	8.33g	7.330f	1.00d	20.33	81.00h	95.33 e	14.33bcd	20.60	4.77b	7.20a	11.97a	39.84bcde
$V_3 \times N_3$	64.33cdefg	11.67ab	9.670bc	2.00a	20.33	86.00gh	104.7 bcd	15.33bc	21.13	4.40bcd	6.63cd	11.03b	39.88bcde
$V_3 \times N_4$	57.00h	7.00h	6.000g	1.00d	20.00	86.00gh	100.0 cde	14.00cd	21.20	4.27cd	5.67ef	9.93c	42.95a
$V_3 \times N_5$	58.00gh	7.00h	6.000g	1.00d	20.33	82.33h	97.00 de	14.67bcd	21.10	2.70j	5.30fg	8.00fgh	33.75h
$V_3 \times N_6$	59.00fgh	12.33a	10.33ab	2.00a	20.33	83.00h	99.33 cde	16.33b	21.03	4.37bcd	6.63cd	11.00b	39.71bcde
$V_3 \times N_7$	69.00abcd	10.67cd	8.670de	2.00a	20.67	91.33defg	104.0 bcd	12.67def	20.90	5.30a	7.10ab	12.40a	42.74a
$S\bar{x}$	2.02	0.281	0.272	0.097	0.479	1.99	2.57	0.721	0.424	0.129	0.130	0.258	0.766
Level of sig.	**	**	**	**	NS	**	**	**	NS	**	**	**	**
CV (%)	5.32	4.81	5.43	11.80	3.97	3.75	4.27	10.38	3.64	6.01	3.77	4.61	3.49

In a column, figures with same letter (s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT) ** =Significant at 1% level of probability,* =Significant at 5% level of probability, NS = Not significant, BRRI dhan50 (V_1), Basmati (V_2) and BRRI dhan63(V_3) Poultry manure @ 5 t ha^{-1} (N_1), N-P-K-S-Zn @ 250, 126, 120, 100, 10 kg ha^{-1} (recommended dose) (N_2), 25% less than recommended dose of chemical fertilizer + poultry manure @ 2.5 t ha^{-1}(N_3), 50% less than recommended dose of chemical fertilizer + poultry manure @ 5 t ha^{-1}(N_4), Vermicompost @ 10 t ha^{-1} (N_5), 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1}(N_6), 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1} (N_7).

produced the shortest one (57.00 cm). The highest number of total tillers hill^{-1} (12.33) was obtained in BRRI dhan63 fertilized with 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1} which was similar to BRRI dhan50 fertilized with recommended dose of chemical fertilizers (i.e. 250, 126, 120, 100 and 10 kg N-P-K-S-Zn) and Basmati along with 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1}, BRRI dhan50 fertilized with 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1}, Basmati fertilized with 50% less than recommended dose of chemical fertilizer + vermicompost 10 t ha^{-1}, BRRI dhan63 fertilized with 25% less than recommended dose of chemical fertilizer + poultry manure 2.5 t ha^{-1}, BRRI dhan63 fertilized with 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1} and BRRI dhan63 fertilized with 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1} produced the highest (2.00) number of non-effective tillers hill^{-1}). The highest number of grains panicle^{-1}(108.0) and number of total spikelets panicle^{-1}(118.3) were recorded in BRRI dhan50 fertilized with 50% less than recommended dose of chemical fertilizer + poultry manure @ 5 t ha^{-1}. BRRI dhan63 with poultry manure @ 5 t ha^{-1} produced the highest number of sterile spikelets panicle^{-1} (19.67) while Basmati along with 25% less than recommended dose of chemical fertilizer + poultry manure @ 2.5 t ha^{-1} produced the lowest one (8.33). The highest grain yield (5.30 t ha^{-1}) was recorded in BRRI dhan63 fertilized with 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1} while the highest straw yield (7.20 t ha^{-1}) was produced in BRRI dhan63 fertilized with recommended dose of chemical fertilizers (i.e. 250, 126, 120, 100 and 10 kg N-P-K-S-Zn, respectively ha^{-1}). BRRI dhan63 fertilized with 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1} also produced the highest biological yield (12.40 t ha^{-1}) which was at par with BRRI dhan63 fertilized with recommended dose of chemical fertilizers (i.e. 250, 126, 120, 100 and 10 kg N-P-K-S-Zn, respectively ha^{-1}). BRRI dhan63 fertilized with 50% less than recommended dose of chemical fertilizer + poultry manure @ 5 t ha^{-1} produced the highest harvest index (42.95%) which was statistically identical with BRRI dhan63 fertilized with 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1} and (42.74%). Sarkar *et al.* (2014) reported similar trend in case of harvest index.

Conclusion

The results of this investigation revealed that the highest grain and straw yields were obtained in BRRI dhan63. Application of recommended dose of chemical fertilizers (i.e. 250, 126, 120, 100 and 10 kg N-P-K-S-Zn, respectively ha^{-1}) produced the highest grain yield (4.31 t ha^{-1}) which was at par with 25% less than recommended dose of chemical fertilizer + vermicompost @ 5 t ha^{-1} and 25% less than recommended dose of chemical fertilizer + poultry manure @ 2.5 t ha^{-1} while the lowest one (2.74 t ha^{-1}) was found in vermicompost @ 10 t ha^{-1}. BRRI dhan63 fertilized with 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1} produced the highest grain yield while the highest straw yield (7.20 t ha^{-1}) was produced in BRRI dhan63 fertilized with recommended dose of chemical fertilizers (i.e. 250, 126, 120, 100 and 10 kg N-P-K-S-Zn, respectively ha^{-1}). Therefore, it can be concluded that BRRI dhan63 can be grown with 50% less than recommended dose of chemical fertilizer + vermicompost @10 t ha^{-1} in *Boro* season to obtain the highest grain yield.

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