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ORIGINAL RESEARCH ARTICLE

Integrated nutrient management practices affect the growth performance of aromatic fine rice varieties in *Boro* season

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ABSTRACT

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University during November 2016 to April 2017 to investigate the effect of nutrient management on the growth performance of some aromatic rice varieties in *Boro* season. The experiment was laid out in a randomized complete block design with three replications considering two factors *viz*. varieties and nutrient management. This 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} and 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1}. The results revealed that variety, nutrient management and their interaction exerted significant influence on growth characters of aromatic fine rice in *Boro* season. The highest plant height (55.14 cm, 66.14 cm) at 70 and 85 DAT, dry matter $hill^{-1}$ (15.39 g) at 85 DAT and chlorophyll content (39.29) at 55 DAT was recorded from BRRI dhan63. While, Basmati produced the highest leaf area index (0.60) at 60 DAT and the highest number of total tillers $hill^{-1}$ (11.52, 10.81, 9.619) was obtained from BRRI dhan50 at 55, 70, 85 DAT. In case of nutrient management practices, 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1} produced the highest plant height (45.22cm, 55.22cm, 65.67 cm) at 55, 70, 85 DAT, leaf area index (0.70) at 60 DAT and chlorophyll content (41.56) at 55 DAT, respectively. Again, from the interaction, it was observed that all the growth parameters were significantly influenced and increased with suitable variety along with proper nutrient management. Therefore, from this study, it can be decided that BRRI dhan63 fertilized along with 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1} might be the best possible combination for proper growth of plant.

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INTRODUCTION

Bangladesh is one of the most important rice growing countries of the world, Rice is the staple food for more than two billion Asian people and four hundred millions of people in Africa and Latin America. (IRRI, 2010). In respect of area and production, Bangladesh ranks third among the rice producing countries of the world following China, India and Indonesia (FAO, 2021). Rice is consumed as the staple food in Bangladesh and has been given the highest priority in meeting the demands of its ever-increasing population (Paul *et al*., 2021a; Paul *et al*., 2021b). Based on the seasons of rice cultivation in Bangladesh, it has three distinct classes namely *Aus*, *Aman* and *Boro*, which are cultivated during the period of April to July, August to December and January to May, respectively. The area under rice production is about 11.71 million hectares with an annual production of 37.61 million metric tons (BBS, 2021a). *Boro* rice cultivation land increases 0.52% than previous year and covers an area of about 4.79 million hectares of land with a production of 19.89 million metric tons (BBS, 2021b) which accounts for 55 percent of the country's total rice production.

In Bangladesh, more than 37 aromatic rice cultivars are grown but most of the scented rice varieties in Bangladesh are of traditional type, photoperiod sensitive, and cultivated during the *Aman* season but *Boro* season rice cultivar are few in number (Kabir *et al*., 2004; Paul *et al*., 2021b). Aromatic rice of Bangladesh is popular in Bangladesh and worldwide on account of its high export potential and its taste as well as better eating qualities (Rathiya *et al*., 2017; Teli *et al*., 2018). It covers about 2% of the national rice acreage of Bangladesh (Roy *et al*., 2018), and demand for internal consumption and also for export is increasing day by day due to change in the consumer's preference for better quality rice (Kumar *et al*., 2017). But, the average yield in Bangladesh is very low with an average yield of 3.04 t ha^{-1} (Sinha *et al*., 2018). The reason for low yields is 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 (Chandio and Yuansheng, 2018; Laila *et al*., 2022).

In Bangladesh, nutrient stresses of soils are increasing day by day (Sarker *et al*., 2021b). Nutrient management at proper dose influence crop growth and at the same time reduces fertilization cost (Sapkota *et al*., 2021). The productivity of aromatic fine rice in Bangladesh is very low due to mainly improper nutrient management. Organic manure like cowdung, vermicompost, poultry manure and/or their integration with inorganic fertilizers provides essential plant nutrient elements, increases cation exchange capacity and improves water holding capacity, it has been used as soil additive to decrease the practice of mineral fertilization (Tejada and Gonzalez, 2009; Paul *et al*., 2021c). It accelerates the nutrient availability and working as a substitute of chemical fertilizer to some extent (Sharma *et al*., 2008; Guera, 2010, Ray *et al*., 2015; Biswas *et al*., 2016). 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 growth and yield of fine rice. Therefore, the present study was undertaken to find out appropriate variety for *Boro* and combined nutrient management of poultry manure, vermicompost and chemical fertilizers on for better crop growth.

MATERIALS AND METHODS

Details about the experimental site

The research work was conducted at the Agronomy Field laboratory, Bangladesh Agricultural University, Mymensingh, during the period from November 2016 to April 2017. Geographically the experimental site is located at 24°75' N latitude and 90°50' E longitude at an altitude of 18 m. The site belongs to the non-calcareous dark grey floodplain soil under the Old Brahmaputra Floodplain Agroecological Zone (AEZ 9) (UNDP and FAO, 1988). The parent material of the experimental site was old Brahmaputra River borne deposits.

Experimental design and treatment protocol

The experiment was laid out in a randomized complete block design with three replications considering two factors *viz*. varieties and nutrient management. 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} and 50% less than recommended dose of chemical fertilizer + vermicompost @ 10 t ha^{-1}.

Seedling transplanting and fertilization

Thirty-five days old seedlings were transplanted on 21 December 2016 in the well puddle plot. Three seedlings were transplanted in each hill with a spacing of 25 cm × 15 cm. The land was fertilized as per treatment specifications. 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 were applied at final land preparation as per treatment requirements. Urea was applied in three equal splits at 15, 30 and 45 days after transplanting (DAT).

Data collection

Growth parameters which were recorded at 15 days interval were plant height, number of tillers hill^{-1}, dry matter production and chlorophyll content but leaf area index (LAI) were determined at 60 DAT. Five hills were marked by bamboo stick excluding boarder rows to collect data on plant height and tiller number.

Total dry matter hill^{-1}

To determine total dry matter, two hills were randomly taken excluding border rows and central 1m × 1m harvest area at all sampling dates and were cleaned, de-rooted and leaves were separated from the culms. Collected samples were dried in an electric oven for 72 hours maintaining a constant temperature of 70° C. After drying, weight of each sample was recorded.

Leaf Area Index (LAI)

To determine leaf area index, leaf samples were collected from the plot. Leaf blades were separated and leaf area was measured by using an Area Meter at the Professor Muhammad Hussain Central Laboratory, Bangladesh Agricultural University, Mymensingh. Finally, LAI was calculated by the following standard formula (Hunt, 1978) as shown below:

LAI=LA/P

Where, LA = Leaf Area and P= Ground Area.

Measurement of leaf chlorophyll content

For determination of Soil-Plant–Analysis Development (SPAD) value, chlorophyll meter values (SPAD) were taken using a portable SPAD meter (Model SPAD-502, Minolota crop, Ramsey, NJ) at 25, 40, 55, 70 and 85 DAT. The instrument measures transmission of red light 650nm, at which chlorophyll absorbs light, and transmission of infrared light at 940 nm, at which no absorption occurs. On the basis of these two transmission values, the instrument calculates a SPAD value that is well correlated with chlorophyll content (Zhu *et al.*, 2012).

Statistical analysis

Data were compiled and tabulated in proper form, then statistically analyzed to find out the significance of variation resulting from the experimental treatments. 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

Plant height

Results revealed that plant height was significantly influenced due to varieties at 70 and 85 DAT. Plant height in all the varieties increased progressively with the advancement of time from 25 to 85 DAT. BRRI dhan63 was observed as the tallest plant at all days of saplings. The tallest plant stature (55.14 cm, 66.14cm) was recorded from BRRI dhan63 at 70 and 85 DAT (Figure 1). The variation in plant height among the varieties was probably due to heredity or varietal characters. Similar results were reported elsewhere (Kirttania *et al.*, 2013; Ray *et al.*, 2015; Islam *et al.*, 2021). Plant height was significantly influenced by nutrient management irrespective of growth stages. It was found that treatment 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1} produced the tallest plant stature (45.22cm, 55.22cm, 65.67 cm) at 55, 70 and 85 DAT, respectively, which was statistically identical to treatment 25% less than recommended dose of chemical fertilizer + poultry manure 2.5 t ha^{-1} (Figure 2). Similar results were found elsewhere (Sarkar *et al.*, 2014; Sarkar *et al.*, 2021a) who reported that combination of inorganic fertilizers and organic manures produced the highest plant height. The interaction of variety and nutrient management had a significant effect on plant height at 25, 40 and 55 DAT at 1% level of probability. That the tallest plant stature (35.00cm, 46.67 cm) was observed at 40, 55 DAT from BRRI dhan63 along with 50% less than recommended dose of chemical fertilizer+ poultry manure at 5 t ha^{-1} (Table 1). It was reported that interaction between variety and combined application of inorganic fertilizers and organic manures produced the highest plant height (Sarkar *et al.*, 2014).

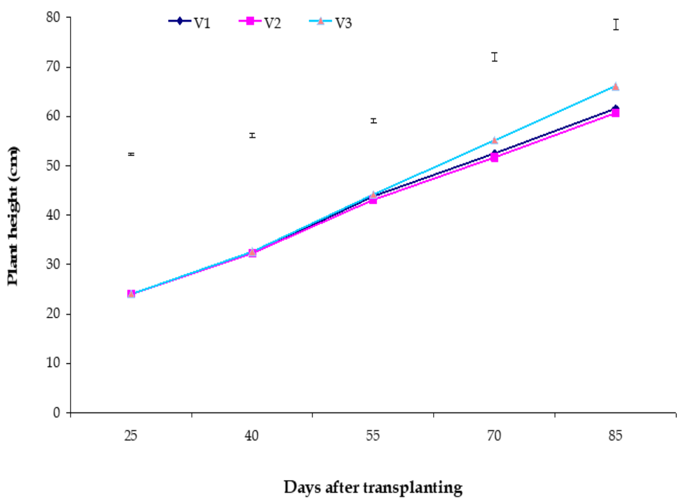

Figure 1. *Effect of variety on plant height at different days after transplanting.*

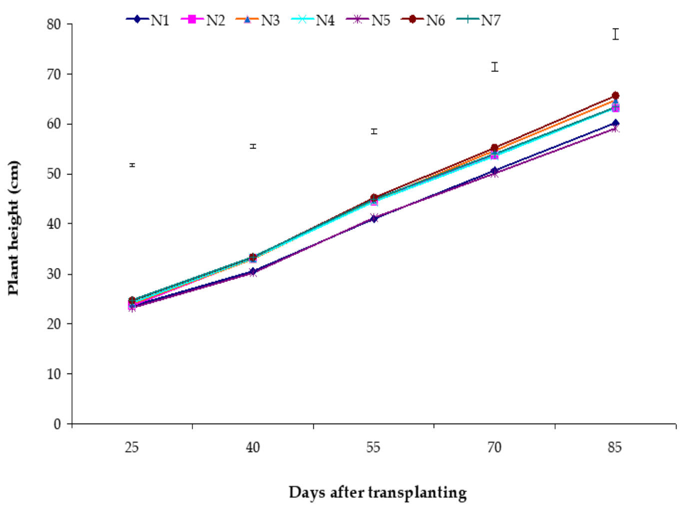

Figure 2. *Effect of nutrient management on plant height at different days after transplanting.*

Table 1. Interaction effects of variety and nutrient management on plant height in aromatic fine rice at different days after transplanting in *Boro* season.

Variety × nutrient management	Plant height (cm)				
	Days after transplanting (DAT)				
	25	40	55	70	85
$V_1 \times N_1$	22.67c	30.33e-g	40.00 de	49.67	59.33
$V_1 \times N_2$	24.00a-c	35.00a	46.33ab	54.00	62.33
$V_1 \times N_3$	22.67c	31.67c-g	42.67cd	52.00	62.33
$V_1 \times N_4$	24.67a-c	32.33a-f	43.33a-d	52.33	61.67
$V_1 \times N_5$	24.33a-c	31.67c-g	44.00a-c	52.33	60.33
$V_1 \times N_6$	25.00ab	33.67a-d	45.67a-c	54.33	63.33
$V_1 \times N_7$	25.00ab	31.33d-g	44.67a-c	53.00	61.67
$V_2 \times N_1$	23.00 c	30.33e-g	40.00 de	50.00	59.33
$V_2 \times N_2$	24.33a-c	31.67c-g	43.67a-c	51.67	60.00
$V_2 \times N_3$	24.67a-c	34.33a-c	45.67a-c	54.67	64.33
$V_2 \times N_4$	25.00ab	32.00bc-g	43.33a-d	51.67	60.33
$V_2 \times N_5$	22.67c	29.67fg	39.33 e	48.00	57.33
$V_2 \times N_6$	24.67a-c	33.33a-d	44.67a-c	53.33	62.67
$V_2 \times N_7$	23.67bc	34.67ab	45.00a-c	52.67	60.67
$V_3 \times N_1$	25.00ab	31.00d-g	43.00b-d	52.33	62.00
$V_3 \times N_2$	22.67c	32.67a-e	43.33a-d	55.33	67.33
$V_3 \times N_3$	24.67a-c	33.00a-e	45.67a-c	57.33	67.67
$V_3 \times N_4$	23.00c	35.00a	46.67a	56.67	67.67
$V_3 \times N_5$	22.67c	29.33g	40.33 de	50.00	59.67
$V_3 \times N_6$	24.33a-c	33.00a-e	45.33a-c	58.00	71.00
$V_3 \times N_7$	25.67a	34.33a-c	45.00a-c	56.33	67.67
$S\bar{x}$	0.583	0.823	1.02	1.84	2.27
Level of significance	**	**	**	NS	NS
CV (%)	4.20	4.41	4.05	6.01	6.25

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; V_1 = BRRI dhan50, V_2 = Basmati, V_3 = BRRI dhan63; N_1 = Poultry manure 5 t ha^{-1}, N_2 = N-P-K-S-Zn @ 250, 126, 120, 100, 10 kg ha^{-1} (recommended dose), N_3 = 25% less than recommended dose of chemical fertilizer + poultry manure 2.5 t ha^{-1}, N_4 = 50% less than recommended dose of chemical fertilizer + poultry manure 5 t ha^{-1}, N_5 = Vermicompost 10 t ha^{-1}, N_6 = 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1}, N_7 = 50% less than recommended dose of chemical fertilizer + vermicompost 10 t ha^{-1}.

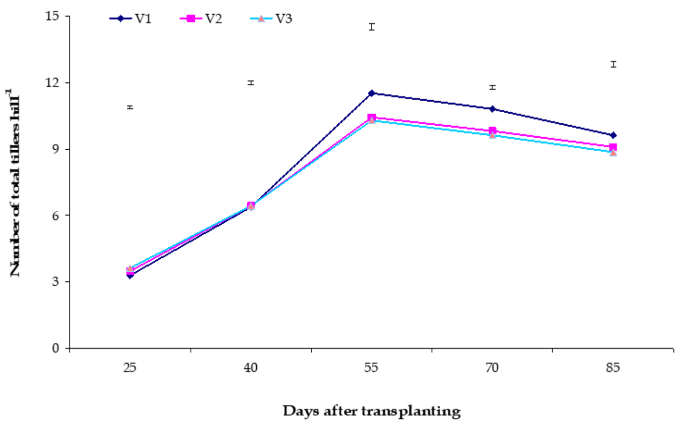

Figure 3. *Effect of variety on number of tillers hill^{-1} at different days after transplanting.*

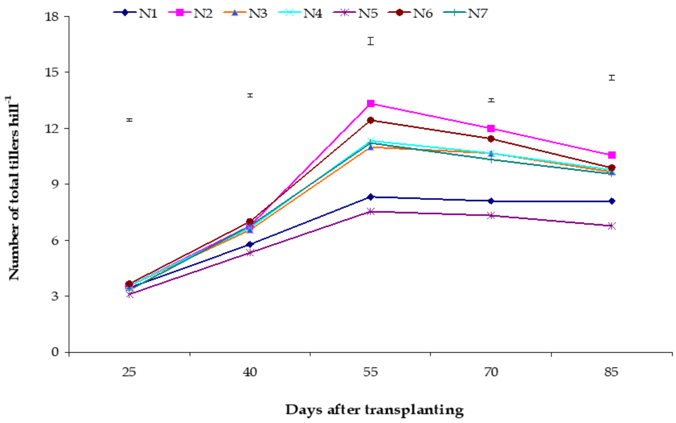

Figure 4. *Effect of nutrient management on number of tillers hill^{-1} at different days after transplanting.*

Number of tillers hill^{-1}

Number of tillers hill^{-1} significantly influence by variety except 40 DAT, nutrient management, interaction between variety and nutrient management at all sampling dates (25, 40, 55, 70 and 85 DAT). The tiller production was increased with the advancement of time and reached maximum at 55 DAT and there after decreased. The highest number of total tillers hill^{-1} (11.52, 10.81, 9.619) was recorded from BRRI dhan50 at 55, 70 and 85 DAT respectively (Figure 3). Roy *et al.* (2020b) reported that number of tillers hill^{-1} was influenced with variety. The results showed that treatment recommended dose of chemical fertilizers produced the highest number of total tillers hill^{-1} (13.33), which was at par with 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1} at 55 DAT (Figure 4). The highest number of total tillers hill^{-1} occurred due to the absorption of more nutrient, moisture and also for availability of more sunlight. The lowest number of total tillers hill^{-1} occurred due to lack of proper nutrient uptake. Similar results were reported elsewhere (Roy *et al.* 2020b; Laila *et al.*, 2022). The highest number of total tillers hill^{-1} (15.00) was obtained from BRRI dhan50 along with 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1} at 55 DAT (Table 2).

Table 2. Interaction effects of variety and nutrient management on number of tillers hill^{-1} in aromatic fine rice at different days after transplanting in *Boro* season.

Variety × nutrient management	Number of total tillers hill^{-1}				
	Days after transplanting (DAT)				
	25	40	55	70	85
$V_1 \times N_1$	3.33bc	5.33ef	8.33fg	8.00hi	8.00ef
$V_1 \times N_2$	3.66ab	7.33ab	15.33a	14.33a	11.67a
$V_1 \times N_3$	3.00c	6.00de	10.33cde	9.670ef	9.00de
$V_1 \times N_4$	3.00c	6.33bcd	11.33cd	10.67cd	10.00cd
$V_1 \times N_5$	3.00c	5.67def	9.00ef	8.33gh	7.66fg
$V_1 \times N_6$	4.00a	8.00a	15.00a	14.00a	11.33ab
$V_1 \times N_7$	3.00c	6.00cde	11.33cd	10.67cd	9.66cd
$V_2 \times N_1$	3.33bc	6.00cde	9.67def	9.00fg	9.00 de
$V_2 \times N_2$	3.33bc	6.33cd	11.33cd	10.33de	10.00cd
$V_2 \times N_3$	3.67ab	6.67bcd	12.00bc	12.33b	10.33bc
$V_2 \times N_4$	4.00a	7.00bc	11.67bc	10.67cd	9.66cd
$V_2 \times N_5$	3.00c	5.00f	6.33h	6.33j	6.00 h
$V_2 \times N_6$	3.33bc	6.66bcd	10.67cde	10.00de	9.33cd
$V_2 \times N_7$	3.66ab	7.33ab	11.33cd	10.00de	9.33cd
$V_3 \times N_1$	3.66ab	6.00cde	7.00gh	7.330i	7.33fg
$V_3 \times N_2$	3.66ab	6.66bcd	13.33b	11.33c	10.00cd
$V_3 \times N_3$	4.00a	7.00bc	10.67cde	10.00de	9.67cd
$V_3 \times N_4$	3.67ab	6.66bcd	11.00cd	10.67cd	9.67cd
$V_3 \times N_5$	3.33bc	5.33ef	7.33gh	7.33i	6.66gh
$V_3 \times N_6$	3.67ab	6.33cd	11.67bc	10.33de	9.00 de
$V_3 \times N_7$	3.33bc	7.00bc	11.00cd	8.00hi	9.66cd
$S\bar{x}$	0.182	0.296	0.553	0.274	0.381
Level of significance	**	**	**	**	**
CV (%)	9.10	8.00	8.91	4.71	7.18

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; V_1 = BRRI dhan50, V_2 = Basmati, V_3 = BRRI dhan63; N_1 = Poultry manure 5 t ha^{-1}, N_2 = N-P-K-S-Zn @ 250, 126, 120, 100, 10 kg ha^{-1} (recommended dose), N_3 = 25% less than recommended dose of chemical fertilizer + poultry manure 2.5 t ha^{-1}, N_4 = 50% less than recommended dose of chemical fertilizer + poultry manure 5 t ha^{-1}, N_5 = Vermicompost 10 t ha^{-1}, N_6 = 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1}, N_7 = 50% less than recommended dose of chemical fertilizer + vermicompost 10 t ha^{-1}.

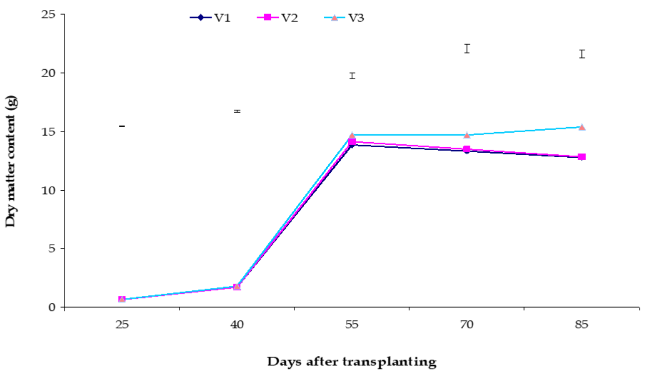

Figure 5. *Effect of variety on total dry matter production hill^{-1} at different days after transplanting of aromatic fine rice in Boro season.*

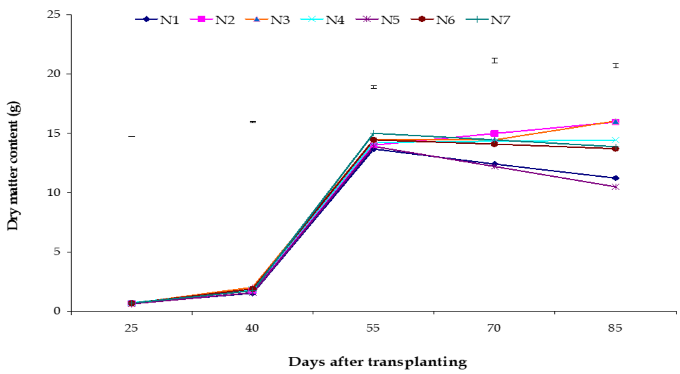

Figure 6. *Effect of nutrient management on total dry matter production hill^{-1} at different days after transplanting of aromatic fine rice in Boro season.*

Total dry matter production hill^{-1}

Total dry matter production hill^{-1} was significantly influenced by varieties, nutrient management, the interaction between variety and nutrient management at all DATs. Results showed that the total dry matter accumulation increased with the increase of time and initially increase of dry matter production was slow. BRRI dhan63 produced the highest dry matter hill^{-1} (15.39 g) followed by BRRI dhan50 (12.78 g) which was as good as Basmati (12.84 g) at 85 DAT (Figure 5). Similar results were reported by Sumon *et al.* (2018) who reported that dry matter production hill^{-1} differed due to varietal characteristics. Total dry matter production hill^{-1} increased progressively with the advancement of time due to nutrient management. At 85 DAT, the highest total dry matter accumulation (16.03 g) was recorded from 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 (Figure 6). Similar results were reported by Roy *et al.* (2020a). Total dry matter increased progressively with the advancement of time due to varieties and nutrient management at 25 DAT up to 85 DAT. At 85 DAT, the interaction BRRI dhan63 along with recommended dose of chemical fertilizers performed the best in terms of total dry matter production (20.04g) (Table 3).

Table 3. Interaction effects of variety and nutrient management on total dry matter production hill^{-1} in aromatic fine rice at different days after transplanting in *Boro* season.

Variety × nutrient management	Dry matter production hill^{-1} (g) Days after transplanting (DAT)				
	25	40	55	70	85
$V_1 \times N_1$	0.67cdefg	1.29gh	13.00f	11.15i	9.32j
$V_1 \times N_2$	0.67defg	1.56efg	14.00cde	16.44ab	18.86b
$V_1 \times N_3$	0.62fgh	1.91abcd	13.67def	13.76efgh	13.85ef
$V_1 \times N_4$	0.69bcde	1.81abcde	14.67bc	14.61cde	14.55de
$V_1 \times N_5$	0.69bcde	1.63def	14.00cde	12.55h	11.08i
$V_1 \times N_6$	0.65defg	2.03abc	13.67def	11.22i	8.76j
$V_1 \times N_7$	0.63efg	1.78abcde	14.00cde	13.51efgh	13.01fg
$V_2 \times N_1$	0.67cdefg	1.34fgh	14.00cde	12.90gh	11.80ghi
$V_2 \times N_2$	0.73abc	1.65de	13.33ef	11.15i	8.95j
$V_2 \times N_3$	0.57hi	2.04ab	14.67bc	15.16bcd	15.69d
$V_2 \times N_4$	0.69bcde	1.71cde	14.00cde	14.45cdef	14.89de
$V_2 \times N_5$	0.48j	1.31gh	13.33ef	11.03i	8.720j
$V_2 \times N_6$	0.71bcd	1.76bcde	14.67bc	15.76bc	16.85c
$V_2 \times N_7$	0.64efg	2.10a	15.00b	14.00defg	12.99fg
$V_3 \times N_1$	0.61gh	1.86abcde	14.00cde	13.17fgh	12.51gh
$V_3 \times N_2$	0.52ij	1.91abcd	14.67bc	17.35a	20.04a
$V_3 \times N_3$	0.77a	2.05ab	15.00b	14.44cdef	18.54b
$V_3 \times N_4$	0.68cdef	1.95abcd	14.00cde	13.93defgh	13.85ef
$V_3 \times N_5$	0.66defg	1.69de	14.33bcd	13.00gh	11.67hi
$V_3 \times N_6$	0.62fgh	1.79abcde	15.00b	15.25bcd	15.50d
$V_3 \times N_7$	0.74ab	1.25h	16.00a	15.80bc	15.59d
$S\bar{x}$	0.018	0.097	0.282	0.424	0.395
Level of significance	**	**	**	**	**
CV (%)	5.09	9.65	3.43	5.31	5.01

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; V_1 = BRRI dhan50, V_2 = Basmati, V_3 = BRRI dhan63; N_1 = Poultry manure 5 t ha^{-1}, N_2 = N-P-K-S-Zn @ 250, 126, 120, 100, 10 kg ha^{-1} (recommended dose), N_3 = 25% less than recommended dose of chemical fertilizer + poultry manure 2.5 t ha^{-1}, N_4 = 50% less than recommended dose of chemical fertilizer + poultry manure 5 t ha^{-1}, N_5 = Vermicompost 10 t ha^{-1}, N_6 = 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1}, N_7 = 50% less than recommended dose of chemical fertilizer + vermicompost 10 t ha^{-1}.

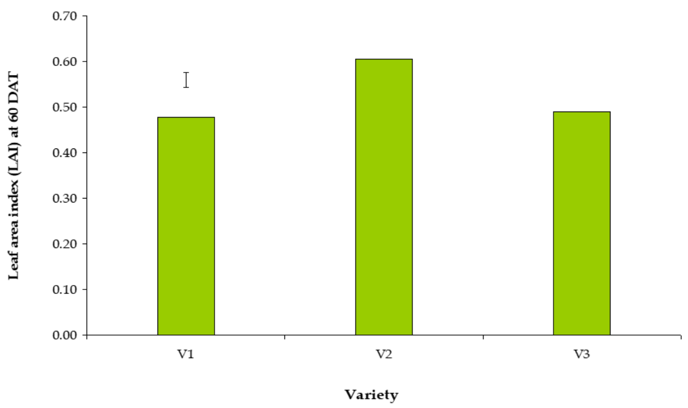

Figure 7. *Effect of variety on leaf area index at 60 DAT in aromatic fine rice in Boro season.*

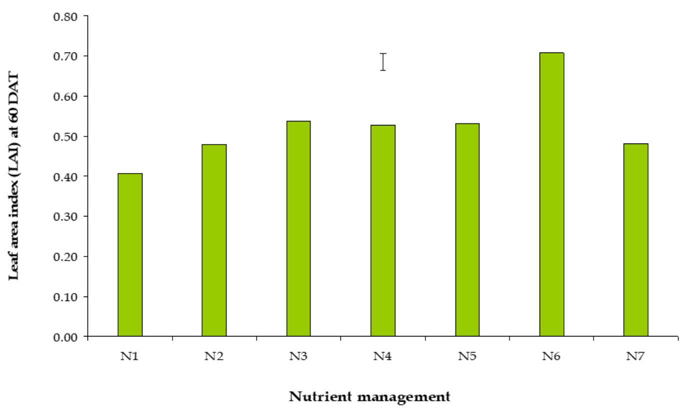

Figure 8. *Effect of nutrient management on leaf area index at 60 DAT in aromatic fine rice in Boro season.*

Leaf area index (LAI)

Leaf area index differed significantly due to variety, different nutrient management and interaction between variety with different level of nutrient management at 60 DAT. Basmati produced the highest leaf area index (0.60) and the lowest leaf area index (0.47) was recorded from BRRI dhan50, which was statistically identical to BRRI dhan63 at 60 DAT (Figure 7). Leaf area index significantly varying from variety to variety was reported by Ray *et al.* (2015). The highest leaf area index (0.70) was obtained from 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1} and the lowest leaf area index (0.40) was observed in poultry manure 5 t ha^{-1} at 60 DAT (Figure 8). Similar results were reported by Sarkar *et al.* (2016) and Nila *et al.* (2018). The interaction between Basmati along with 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1} produced the highest leaf area index (1.05) at 60 DAT (Figure 9). Ray *et al.* (2015) noticed that the interaction effect of different varieties and N-levels had also significant effect on LAI.

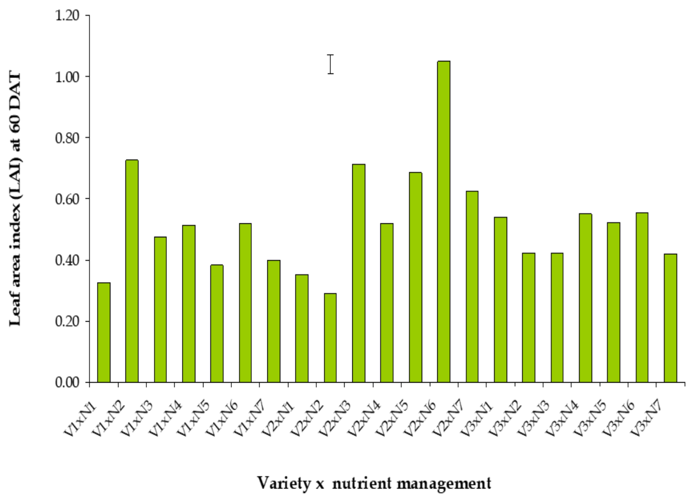

Figure 9. *Effect of interaction of variety and nutrient management on leaf area index at 60 DAT.*

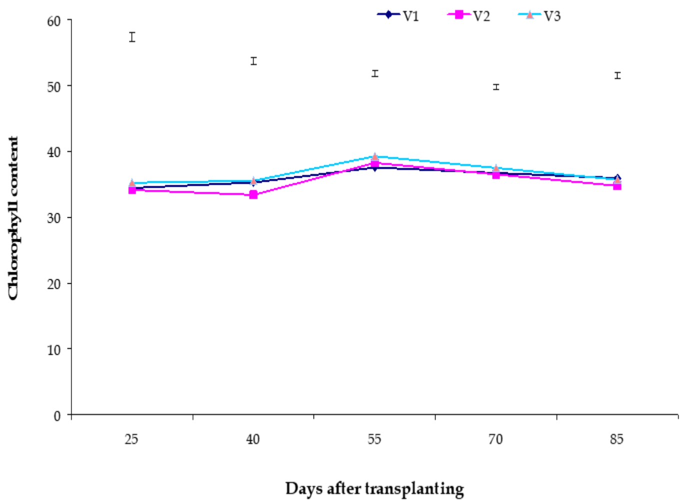

Figure 10. *Effect of variety on chlorophyll content at different days after transplanting of aromatic fine rice in Boro season.*

Table 4. Interaction effects of variety and nutrient management on chlorophyll content in aromatic fine rice at different days after transplanting in *Boro* season.

Variety × nutrient management	Chlorophyll content				
	Days after transplanting (DAT)				
	25	40	55	70	85
$V_1 \times N_1$	30.10h	33.30def	33.50kl	33.60g	34.10fghi
$V_1 \times N_2$	41.40a	35.23cd	37.30fghi	37.43bcde	37.50abcd
$V_1 \times N_3$	37.43bc	36.77bc	36.00hijk	36.03cdef	36.10bcdef
$V_1 \times N_4$	32.00efgh	35.47cd	39.47defg	38.10abcd	36.70abcdef
$V_1 \times N_5$	30.13h	33.23def	39.87cdef	38.30abc	36.67abcdef
$V_1 \times N_6$	34.47cdef	33.57def	41.63bcd	37.47bcde	33.27ghi
$V_1 \times N_7$	35.67bcde	39.63ab	35.20ijkl	36.33cdef	37.47abcd
$V_2 \times N_1$	30.53gh	30.47f	41.63bcd	39.38ab	37.13abcde
$V_2 \times N_2$	34.20cdefg	32.37def	39.63defg	37.23bcde	34.71efgh
$V_2 \times N_3$	33.43defgh	36.83bc	37.10ghij	35.78defg	34.43efghi
$V_2 \times N_4$	32.47efgh	33.57def	34.50jkl	34.63fg	34.83defgh
$V_2 \times N_5$	34.03cdefg	31.93ef	30.13m	31.30h	32.43hi
$V_2 \times N_6$	37.53bc	34.30cde	43.37b	39.47ab	35.57bcdefg
$V_2 \times N_7$	36.97bcd	34.37cde	41.70bcd	38.03abcde	34.33fghi
$V_3 \times N_1$	32.20efgh	31.10f	42.53bc	40.20a	37.80abc
$V_3 \times N_2$	32.63efgh	38.63b	45.90a	38.87ab	31.83i
$V_3 \times N_3$	41.63a	35.30cd	35.33ijkl	37.13bcde	38.93a
$V_3 \times N_4$	31.60fgh	31.73ef	38.33efgh	35.80defg	33.23ghi
$V_3 \times N_5$	37.33bc	33.13def	33.13l	35.60efg	38.03ab
$V_3 \times N_6$	32.33efgh	41.80a	39.67defg	37.43bcde	35.23cdefg
$V_3 \times N_7$	39.03ab	37.20bc	40.13cde	37.60bcde	35.07defgh
$S\bar{x}$	1.12	0.924	0.829	0.721	0.812
Level of significance	**	**	**	**	**
CV (%)	5.58	4.61	3.75	3.39	3.97

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; V_1 = BRRI dhan50, V_2 = Basmati, V_3 = BRRI dhan63; N_1 = Poultry manure 5 t ha^{-1}, N_2 = N-P-K-S -Zn @ 250, 126, 120, 100, 10 kg ha^{-1} (recommended dose), N_3 = 25% less than recommended dose of chemical fertilizer + poultry manure 2.5 t ha^{-1}, N_4 = 50% less than recommended dose of chemical fertilizer + poultry manure 5 t ha^{-1}, N_5 = Vermicompost 10 t ha^{-1}, N_6 = 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1}, N_7 = 50% less than recommended dose of chemical fertilizer + vermicompost 10 t ha^{-1}.

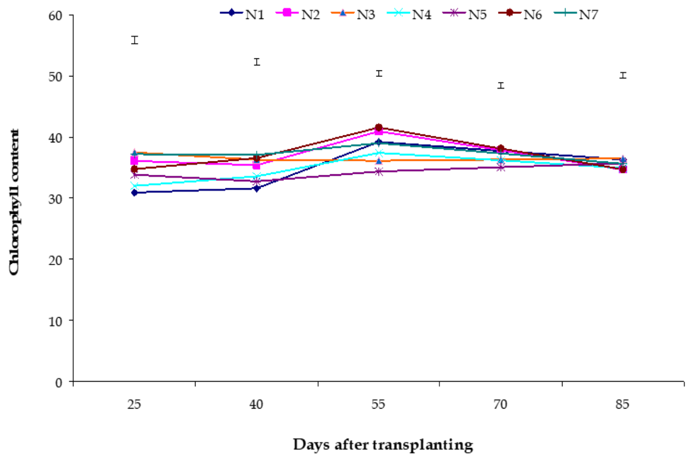

Figure 11. *Effect of nutrient management on chlorophyll content at different days after transplanting of aromatic fine rice in Boro season.*

Chlorophyll content

Varieties at all DATs except 25 DAT, nutrient management, interaction effect of variety and nutrient management had a significant effect on chlorophyll content. SPAD value increased progressively over time attaining the highest value at 55 DAT and then decreased irrespective of treatment differences. Similar trend of SPAD value was reported by Paul *et al.* (2017). Again, Paul *et al*. (2018) stated that SPAD value of leaf indicates the crop nitrogen status by influencing the physiological functions of plant. BRRI dhan63 produced the highest chlorophyll content (39.29) followed by BRRI dhan50 (37.57), which was as good as Basmati (38.29) at 55 DAT (Figure 10). At 55 DAT, the highest chlorophyll content (41.56) was obtained from 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1} which was at par with recommended dose of chemical fertilizers (Figure 11). In *Oryza sativa* L., Kundu *et al*. (2021) when organic potassium salts applied through the method of foliar application resulted in increased chlorophyll content. The interaction between BRRI dhan63 along with recommended dose of chemical fertilizers performed the best in terms of chlorophyll content (45.90) at 55 DAT. (Table 4).

Conclusion

Present experimental results showed that variety of BRRI dhan63 fertilized along with 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1} influenced growth traits of plant. According to the results obtained from the experiment, BRRI dhan63 performed well considering most of the growth parameters. Among the different nutrient managements, 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1} gave better performance. Again, it was observed that all the growth parameters were significantly increased with the application of appropriate variety along with definite nutrient management. Therefore, it can be concluded that, BRRI dhan63 fertilized along with 25% less than recommended dose of chemical fertilizer + vermicompost 5 t ha^{-1} might be the best possible combination suggested for the proper growth of plant.

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