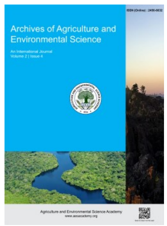
Archives of Agriculture and Environmental Science 6(3): 303-309 (2021)
https://doi.org/10.26832/24566632.2021.060306

e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: journals.aesacademy.org/index.php/aaes



ORIGINAL RESEARCH ARTICLE

Response of nitrogen and potassium fertilization on the growth performance of aromatic *Boro* rice

Newton Chandra Paul[1*], Shabuj Chandra Paul[2], Swapan Kumar Paul[2] and Md Abdus Salam[2]

[1]Department of Agronomy, Khulna Agricultural University, Khulna, BANGLADESH
[2]Department of Agronomy, Bangladesh Agricultural University, Mymensingh - 2202, BANGLADESH
[*]Corresponding author's E-mail: newtonpaul@kau.edu.bd

ARTICLE HISTORY

Received: 19 July 2021
Revised received: 23 August 2021
Accepted: 21 September 2021

Keywords

Aromatic rice
Growth
Nitrogen level
Potassium level

ABSTRACT

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, during December 2017 to May 2018 to study growth performance of aromatic *Boro* rice (cv. BRRI dhan50) in response to nitrogen and potassium fertilization. The experiment consisted of four levels of nitrogen *viz*., 0, 50, 100 and 150 kg ha^{-1}, and four levels of potassium *viz*., 0, 30, 60 and 90 kg ha^{-1}. The experiment was laid out in a randomized complete block design with three replications. The results revealed that nitrogen and potassium fertilization and their interaction exerted significant influence on growth performance of BRRI dhan50. Application of 100 kg N ha^{-1} produced the tallest plant (82.17 cm), the highest number of tillers hill^{-1} (10.08) and chlorophyll content (52.21) at heading stage. While, application of 90 kg K ha^{-1} produced the tallest plant (81.44 cm) at physiological maturity stage, the highest number of tillers hill^{-1} (9.66) and chlorophyll content (51.54) at heading stage. In case of interaction, the tallest plant (85.33 cm), the highest number of tillers hill^{-1} (10.83) and chlorophyll content (58.28) were obtained from 100 kg N ha^{-1} along with 90 kg K ha^{-1} at heading stage. Therefore, application of 100 kg N ha^{-1} along with 90 kg K ha^{-1} interaction appeared as the promising practice in aromatic rice (cv. BRRI dhan50) cultivation in terms of growth performance.

Citation of this article: Paul, N. C., Paul, S. C., Paul, S. K., & Salam, M. A. (2021). Response of nitrogen and potassium fertilization on the growth performance of aromatic *Boro* rice. *Archives of Agriculture and Environmental Science*, *6*(3), 303-309, https://dx.doi.org/10.26832/24566632.2021.060306

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important cereal food crop which feeds the world's half of the population providing 35-60% of the total caloric requirements (Tayefe *et al*., 2014). In Bangladesh, rice is consumed as staple food since it is the main source of food and has incredible influence on its agrarian economy (Sumon *et al*., 2018; Paul *et al*., 2021). Approximately, 36.60 million tons of rice is produced from 11.42 million hectares of land in Bangladesh (BBS, 2020) of which *Aus*, *Aman*, and *Boro* rice covers 1.10, 5.56, and 4.76 million hectares of land with the production of 2.76, 14.20, and 19.65 million tons of rice, respectively (BBS, 2020). Rice is classified as aromatic and non-aromatic rice by aroma. Aromatic rice is also named as fine rice, scented rice or fragrance rice which has great potential to attract rice consumer for its taste and deliciousness (Rathiya *et al*., 2017). Because of its aroma, grain dimension and cooking qualities, aromatic rice is preferred for consumption globally and fetches premium price in domestic and international markets which boosted up the economic condition of the rice grower (Khan *et al*., 2003; Singh *et al*., 2012). In Bangladesh, most of the photoperiod sensitive aromatic rice varieties are grown during *Aman* season (Kabir *et al*., 2004) and low yielding with an average yield of 3.04 t ha^{-1} (Sinha *et al*., 2018) which covers 2% of the national rice acreage of Bangladesh (Roy *et al*., 2018). BRRI dhan50 (Banglamati), a variety of aromatic rice is recommended for *Boro* season has gained huge popularity among the rice grower for its fragrance, price and relatively higher yield (Paul *et al*., 2020).
Growth and yield performance of rice depend on judicious

application of inorganic fertilizers. Since fertilizer is an expensive input, proper management needs to be determined to enhance growth, productivity and profit of the growers under given situation. Nitrogen is the single most limiting essential plant nutrient and key input for rice crop growth and yield which is required in higher amounts compared to other nutrients (Kumar *et al.*, 2017; Djaman *et al.*, 2018). Required amount of nitrogen plays a major role in tillering, photosynthesis, vegetative growth, biomass accumulation, effective tillering and spikelets formation which enhanced the grain yield of rice (Yoshida *et al.*, 2006; Ferdush *et al.*, 2020) as excessive nitrogen encourages the attack of insects and diseases (Ferdush *et al.*, 2020). Again, continuous supply of potassium to the crop is required for plant growth and fecundity (Rengel and Damon, 2008; Fageria *et al.*, 2011) since lack of it restricts the establishment, development and yield of rice plant (Rengel and Damon, 2008). Plants regulatory processes such as the grain quality of rice enhanced by potassium fertilization although it is not a part of any plant structure or compound (Liu *et al.*, 2011). Several studies reported that a regular supply of potassium is required which increased plant height, total tillers, effective tillers, dry matter accumulation, number of filled grains and yield of rice plant besides improving soil properties (Meena *et al.*, 2002; Mahfuza *et al.*, 2008; Islam *et al.*, 2015). In addition, the combined application of nitrogen and potassium fertilizer in an adequate amount provided the better growth characters and yield of rice plant (Yadanar *et al.*, 2018). Again, growth parameters like plant height, number of tillers hill^{-1} and chlorophyll content are the three important traits which are directly related to the yield of rice plant (Wang *et al.*, 2017; Senthilvalavan and Ravichandran, 2019). Though aromatic rice is one of the most vital crops of the world but enough information regarding its response to nitrogen and potassium fertilization are scarce in the world literature. Therefore, the proposed study was conducted to assess the effect of nitrogen, potassium and their interaction on growth performance of aromatic *Boro* rice (cv. BRRI dhan50).

MATERIALS AND METHODS

Description of the experimental site

The research work was conducted at the Agronomy Field laboratory, Bangladesh Agricultural University, Mymensingh, during December 2017 to May 2018. Geographically the experimental site (24°75' N latitude and 90°50' E longitude at an altitude of 18 m) belongs to the non-calcareous dark grey floodplain soil under the Old Brahmaputra Floodplain Agroecological Zone (AEZ 9) (UNDP and FAO, 1988). The field was a medium high land with well drained silty-loam texture having pH 6.8 and the total nitrogen, available phosphorus (P_2O_5), potassium and organic matter of the soil ranged from 0.13%, 16.3 ppm, 0.28% and 0.93%, respectively (Chakraborty *et al.*, 2020). The experimental site is under the sub-tropical climate. Weather information regarding monthly average temperature (°C), relative humidity (%), rainfall (mm) and sunshine (hrs.) prevailing at the experimental area during the period of the research work are presented in Figure 1.

Experimental treatments and design

The experiment comprised four levels of nitrogen *viz.* 0, 50, 100 and 150 kg N ha^{-1}, and four level of potassium *viz.* 0, 30, 60 and 90 kg K ha^{-1}. The experiment was laid out in a randomized complete block design with three replications. Each of the replication represented a block in the experiment. Each block was divided into 16 unit plots where 16 treatment combinations were randomly allocated. There were 48 unit plots in the experiment. The size of unit plot was 4.0 m × 2.5 m.

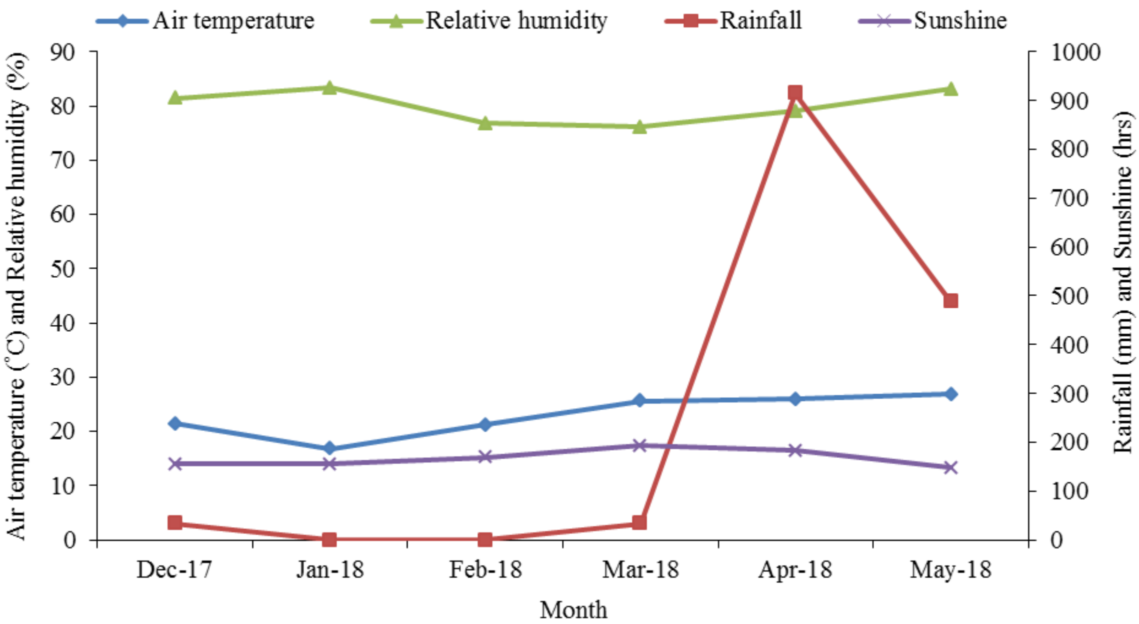


Figure 1. *Air temperature (°C), relative humidity (%), rainfall (mm) and sunshine (hrs.) condition in crop growing period.*

Crop husbandry

The experimental land was first opened with a tractor drawn disc plough and then puddled thoroughly by repeated ploughing and cross ploughing with a country plough and subsequently levelled by laddering. The field layout was done on 4th January 2018 according to experimental specification immediately after final land preparation. Weeds and stubble were cleared off from individual plots and finally plots were levelled so properly by wooden plank that no water pocket could remain in the puddled field. Thirty-five days old seedlings were transplanted on 6th January 2018 in the well puddle plot. 2-3 seedlings were transplanted hill^{-1} with a spacing of 25 cm × 15 cm. Nitrogen and potassium were applied as per treatment specifications and other nutrient such as phosphorus, sulphur and zinc were applied @ 25, 18 and 3.5 kg/ha, respectively as a recommended dose. At the time of final land preparation, respective unit plots were fertilized with different levels of fertilizers according to treatments. 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. Urea was applied in three equal splits at 15, 30 and 45 days after transplanting (DAT). Intercultural operations such as gap filling, weeding, irrigation and drainage, bund repairing and plant protection measures were done as and when necessary.

Data collection

Plant height, number of tillers hill^{-1} and chlorophyll content were recorded at maximum tillering, heading and physiological maturity stages. Five hills were randomly selected soon after transplanting and marked with bamboo sticks in each plot excluding border rows to record the data on plant height and number of tillers hill^{-1} at maximum tillering, heading and physiological maturity stages. Chlorophyll meter values (SPAD) were recorded using a portable SPAD meter (Model SPAD-502, Minolta crop, Ramsey, NJ) at maximum tillering, heading and physiological maturity stages. For recording SPAD values, five new fully expanded leaves that adjacent to a similar leaf about to emerge were selected. The mean data was taken from middle point of the five leaves plant^{-1} in between 9:00 and 10.00 am (Bithy *et al.*, 2020).

Statistical analysis

All the collected data were analyzed following the analysis of variance (ANOVA) technique and mean differences were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984) using a computer operated program package MSTAT (Power, 1985).

RESULTS AND DISCUSSION

Plant height

Effect of nitrogen: Plant height was significantly influenced by nitrogen fertilization at 1% level of probability at all growth stages (Figure 2). Plant height increased with increasing days after transplanting due to application of different levels of nitrogen fertilization from tillering to physiological maturity stage. At tillering stage, the tallest plant (50.75 cm) was recorded from 100 kg N ha^{-1} followed by 150 kg N ha^{-1} and 50 kg N ha^{-1}, and the shortest plant (47.22 cm) was obtained from 0 kg N ha^{-1}. It was found that treatment 100 kg N ha^{-1} produced the tallest plant (82.17 cm) followed by 150 kg N ha^{-1}, while the shortest plant (75.00 cm) was found from 0 kg N ha^{-1} at heading stage. At physiological maturity stage, the tallest plant (81.83 cm) was achieved from 100 kg N ha^{-1} which was at par with 150 kg N ha^{-1} and 50 kg N ha^{-1}, and the shortest plant (77.94 cm) was obtained from 0 kg N ha^{-1}. Nitrogen fertilization has significant influence on plant height and plant height increased with the application of nitrogen was reported elsewhere (Jisan *et al.*, 2014; Paul *et al.*, 2017; Rea *et al.*, 2019). In addition, Ferdush *et al.* (2020) reported that plants physiological processes such as cell division and cell elongation increased due to nitrogen fertilization which results in enhancement of plant height.

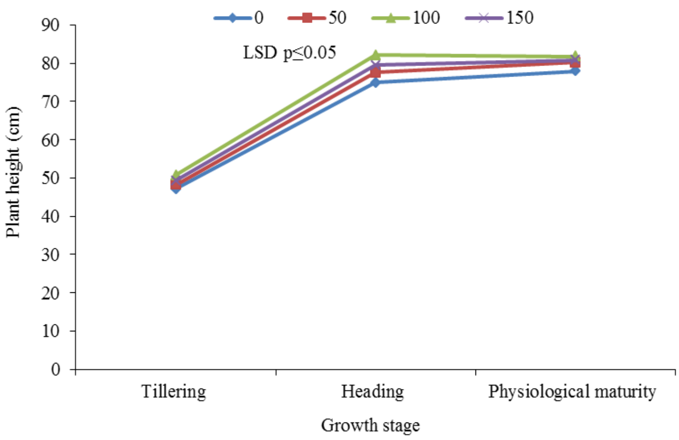


Figure 2. *Effect of level of nitrogen on plant height at different growth stages of aromatic Boro rice (cv. BRRI dhan50).*

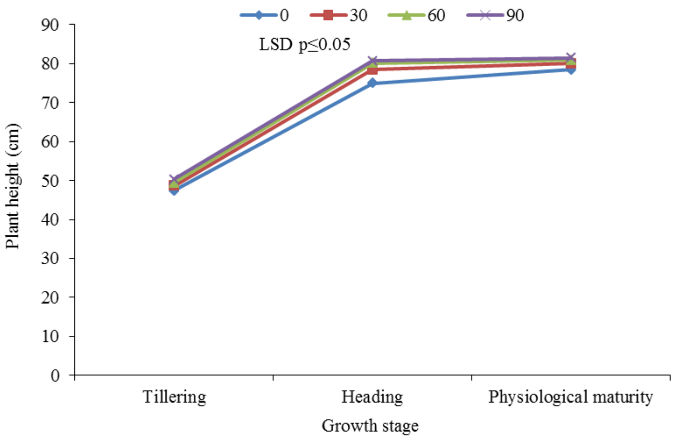


Figure 3. *Effect of level of potassium on plant height at different growth stages of aromatic Boro rice (cv. BRRI dhan50).*

Table 1. Interaction effects of level of nitrogen and level of potassium on plant height and number of tillers hill^{-1} at different growth stages of aromatic *Boro* rice (cv. BRRI dhan50).

Nitrogen × potassium (kg ha^{-1})	Plant height (cm)			Number of tillers hill^{-1}		
	Growth stage			Growth stage		
	Tillering	Heading	Physiological maturity	Tillering	Heading	Physiological maturity
0 × 0	45.33	69.33g	75.50	4.33 i	5.50 j	4.00 h
0 × 30	47.00	75.33e	78.50	6.00ef	6.16i	5.75 f
0 × 60	47.89	77.50d	79.75	6.11ef	6.50hi	5.66 f
0 × 90	48.67	77.83cd	78.00	6.22de	7.67g	6.00 f
50 × 0	47.67	73.17f	79.33	5.56 g	6.83h	5.00 g
50 × 30	47.67	78.33bcd	80.33	6.22de	8.17g	7.00 e
50 × 60	47.89	79.33bcd	80.50	6.33cde	9.33def	8.00 cd
50 × 90	49.89	79.50bcd	80.75	7.33b	9.67cde	8.33 c
100 × 0	49.78	79.50bcd	80.00	5.78 fg	9.33def	7.50 de
100 × 30	50.56	80.33b	80.83	7.22b	9.83bcd	8.00 cd
100 × 60	51.11	83.50a	82.25	7.44b	10.33abc	10.0a
100 × 90	51.56	85.33a	84.25	9.11a	10.83a	10.5a
150 × 0	46.56	77.83cd	79.00	5.22 h	8.83f	7.33 e
150 × 30	49.11	79.83bcd	80.50	6.33cde	9.00ef	8.00 cd
150 × 60	50.78	80.00bc	81.00	6.55cd	10.00bcd	8.50 c
150 × 90	50.89	80.33b	82.75	6.66c	10.50ab	9.25 b
$S\bar{x}$	0.922	0.730	1.18	0.116	0.21	0.198
Level of significance	NS	**	NS	**	*	**
CV (%)	3.27	1.61	2.55	3.11	4.33	4.63

In a column, figures with the 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= Non-significant.

Effect of potassium: Significant differences were observed among plant height due to potassium fertilization at all growth stages (Figure 3). Plant height increased significantly with increasing days due to different levels of potassium fertilization from tillering to physiological maturity stage. At tillering stage, the tallest plant (50.25 cm) was recorded from 90 kg K ha^{-1} which was at par with 60 kg K ha^{-1}, and the shortest plant (47.34 cm) was obtained from 0 kg K ha^{-1}. At heading stage, the tallest plant (80.75 cm) was achieved from 90 kg K ha^{-1} which was statistically identical to 60 kg K ha^{-1}, and the shortest plant (74.96 cm) was found from treatment 0 kg K ha^{-1}. It was found that treatment 90 kg K ha^{-1} produced the tallest plant (81.44 cm) which was at par with 60 kg K ha^{-1} and 30 kg K ha^{-1}, while the shortest plant (78.46 cm) was obtained from 0 kg K ha^{-1} at physiological maturity stage. Plant height increased with the application of potassium fertilization was the findings of Islam *et al.* (2015). On the other hand, Hartati *et al.* (2018) opined that continuous supply of increased level of potassium fertilizer increased the availability of high-K so that the plant height increased.

Effect of interaction between nitrogen and potassium: Plant height was significantly influenced by the interactions of nitrogen and potassium fertilization at heading stage at 1% level of probability (Table 1). The tallest plant (85.33 cm) was observed from 100 kg N ha^{-1} along with 90 kg K ha^{-1} which was statistically identical to 100 kg N ha^{-1} along with 60 kg K ha^{-1}, and the shortest plant (69.33 cm) was found from 0 kg N ha^{-1} along with 0 kg K ha^{-1} at heading stage. Several study stated that combined application of nitrogen and potassium fertilizer significantly increased the plant height of rice plant (Bahmaniar and Ranjbar, 2007; Yadanar *et al.*, 2018).

Number of tillers hill^{-1}

Effect of nitrogen: The results showed that the number of tillers hill^{-1} differed significantly at all growth stages due to nitrogen fertilization at 1% level of probability (Figure 4). At tillering stage, the highest number of tillers hill^{-1} (7.38) was recorded from 100 kg N ha^{-1} followed by 50 kg N ha^{-1}, and the lowest number of tillers hill^{-1} (5.66) was obtained from treatment 0 kg N ha^{-1}. The results showed that 100 kg N ha^{-1} produced the highest number of tillers hill^{-1} (10.08) followed by 150 kg N ha^{-1}, while the treatment 0 kg N ha^{-1} recorded the lowest number of tillers hill^{-1} (6.45) at heading stage. At physiological maturity stage, the highest number of tillers hill^{-1} (9.00) was achieved from 100 kg N ha^{-1} followed by 150 kg N ha^{-1}, and the lowest number of tillers hill^{-1} (5.35) was found from treatment 0 kg N ha^{-1}. The number of tillers hill^{-1} increased with increasing days after transplanting due to application of different levels of N fertilization up to physiological maturity stage. The highest number of tillers hill^{-1} occurred due to the absorption of major nutrients, moisture and also for availability of more sunlight during the growing season. Fertilizer dose of nitrogen significantly increased the number of tillers hill^{-1} of rice and similar trend in number of tillers hill^{-1} was reported elsewhere (Paul *et al.*, 2017; Roy and Paul, 2018; Jahan *et al.*, 2020).

Effect of potassium: Significant differences were observed for producing number of tillers hill^{-1} due to potassium fertilization at all growth stages (Figure 5). Tiller production per hill increased from tillering to physiological maturity stage. At tillering stage, the highest number of tillers hill^{-1} (7.33) was recorded from 90 kg K ha^{-1} followed by 60 kg K ha^{-1} and 30 kg K ha^{-1}, and the lowest number of tillers hill^{-1} (5.22) was obtained

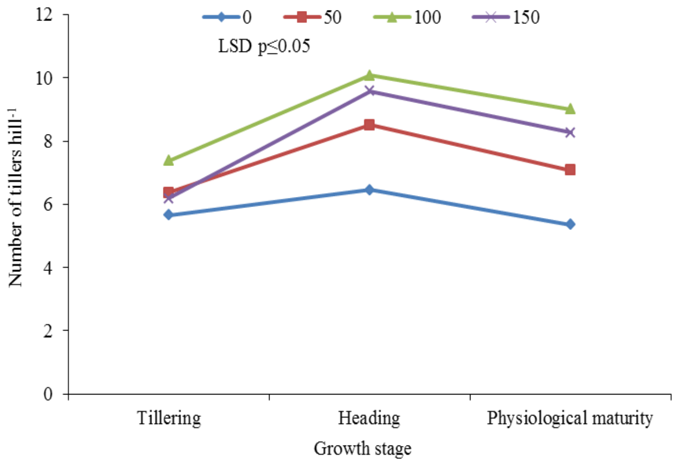


Figure 4. *Effect of level of nitrogen on number of tillers hill*$^{-1}$ *at different growth stages of aromatic Boro rice (cv. BRRI dhan50).*

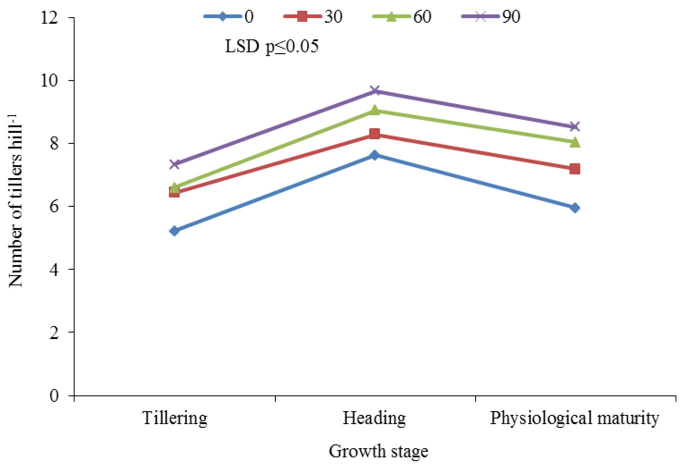


Figure 5. *Effect of level of potassium on number of tillers hill*$^{-1}$ *at different growth stages of aromatic Boro rice (cv. BRRI dhan50).*

from 0 kg K ha^{-1}. The results showed that 90 kg K ha^{-1} produced the highest number of tillers hill^{-1}(9.66) followed by 60 kg K ha^{-1}, while the treatment 0 kg K ha^{-1} recorded the lowest number of tillers hill^{-1} (7.62) at heading stage. At physiological maturity stage, the highest number of tillers hill^{-1}(8.52) was achieved from 90 kg K ha^{-1} followed by 60 kg K ha^{-1}, and the lowest number of tillers hill^{-1} (5.95) was found from 0 kg K ha^{-1}. Number of tillers hill^{-1} was significantly influenced and increased with the application of potassium fertilization (Hartati *et al.*, 2018). In addition, Islam *et al.* (2015) revealed that there is always a scope to increase tiller production with potassium fertilization beyond 80 kg ha^{-1}.

Effect of interaction between nitrogen and potassium: Interaction between nitrogen and potassium fertilization had significant effect at all growth stages in terms of number of tillers hill^{-1}(Table 1). At tillering stage, the highest number of tillers hill^{-1}(9.11) was recorded from 100 kg N ha^{-1} along with 90 kg K ha^{-1} followed by 100 kg N ha^{-1} along with 60 kg K ha^{-1}, 100 kg N ha^{-1} along with 30 kg K ha^{-1} and 50 kg N ha^{-1} along with 90 kg K ha^{-1}, and the lowest number of tillers hill^{-1} (4.33) was obtained from 0 kg N ha^{-1} along with 0 kg K ha^{-1}. It was observed that the highest number of tillers hill^{-1}(10.83) was found from 100 kg N ha^{-1} along with 90 kg K ha^{-1} which was at par with 100 kg N ha^{-1} along with 60 kg K ha^{-1} and 150 kg N ha^{-1} along with 90 kg K ha^{-1}, while the lowest number of tillers hill^{-1} (5.50) was obtained from 0 kg N ha^{-1} along with 0 kg K ha^{-1} at heading stage. At physiological maturity stage, the highest number of tillers hill^{-1}(10.50) was achieved from 100 kg N ha^{-1} along with 90 kg K ha^{-1} which was statistically identical to 100 kg N ha^{-1} along with 60 kg K ha^{-1}, and the lowest number of tillers hill^{-1} (4.00) was obtained from 0 kg N ha^{-1} along with 0 kg K ha^{-1}. The number of tillers hill^{-1} increased significantly due to application of different levels of N along with K fertilizer from heading to physiological maturity stage. Yadanar *et al.* (2018) reported that the number of tillers hill^{-1} increased significantly with the combined application of nitrogen and potassium fertilizer.

Leaf chlorophyll content (SPAD Value)

Effect of nitrogen: Chlorophyll content varied significantly due to nitrogen fertilization at all growth stages (Figure 6). Chlorophyll content increased progressively with the advancement of time from tillering to heading stage due to N fertilization and then decreased at physiological maturity stage. At tillering stage, the highest chlorophyll content (39.02) was observed from 100 kg N ha^{-1} followed by 150 kg N ha^{-1} and 50 kg N ha^{-1}, and the lowest chlorophyll content (32.63) was obtained from 0 kg N ha^{-1}. At heading stage, the highest chlorophyll content (52.21) was recorded from 100 kg N ha^{-1} followed by 150 kg N ha^{-1}, and the lowest chlorophyll content (38.85) was found from 0 kg N ha^{-1}. At physiological maturity stage, the highest chlorophyll content (43.76) was achieved from 100 kg N ha^{-1} followed by 150 kg N ha^{-1}, and the lowest chlorophyll content (35.63) was observed from 0 kg N ha^{-1}. Paul *et al.* (2018) stated that leaf chlorophyll content (SPAD Value) indicate the greenness of leaves influencing the physiological functions and used as an indirect indicator of crop nitrogen status.

Effect of potassium: Chlorophyll content was significantly influenced by potassium fertilization at all growth stages at 1% level of probability (Figure 7). Chlorophyll content increased progressively with the advancement of time from tillering to heading stage due to K fertilization and then decreased at physiological maturity stage. At tillering stage, the highest chlorophyll content (38.85) was observed from 90 kg K ha^{-1} followed by 60 kg K ha^{-1}, and the lowest chlorophyll content (33.21) was found from 0 kg K ha^{-1}. At heading stage, the highest chlorophyll content (51.54) was recorded from 90 kg K ha^{-1} followed by 60 kg K ha^{-1}, and the lowest chlorophyll content (41.52) was obtained from 0 kg K ha^{-1}. At physiological maturity stage, the highest chlorophyll content (43.15) was achieved from 90 kg K ha^{-1} which was statistically identical to 60 kg K ha^{-1}, and the lowest chlorophyll content (35.14) was observed from 0 kg K ha^{-1}. Kundu *et al.* (2021) reported that foliar application of organic potassium salts resulted in enhanced chlorophyll content of rice (*Oryza sativa* L.).

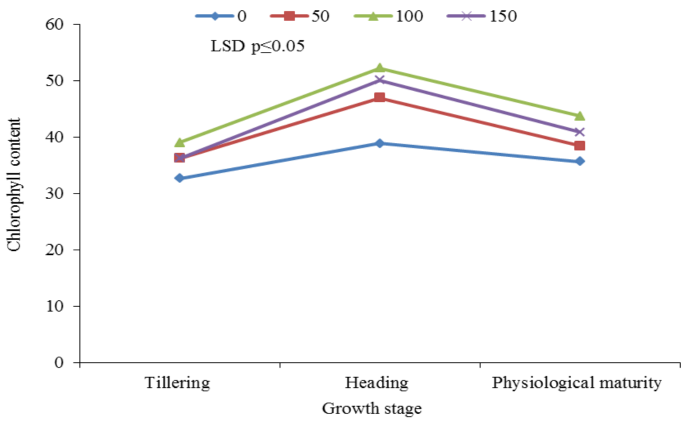


Figure 6. *Effect of level of nitrogen on leaf chlorophyll content at different growth stages of aromatic Boro rice (cv. BRRI dhan50).*

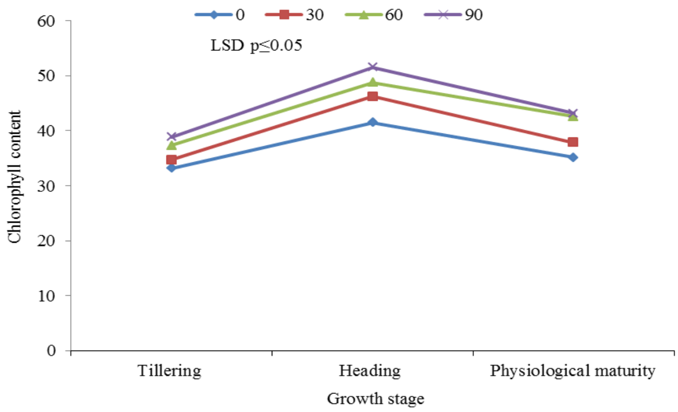


Figure 7. *Effect of level of potassium on leaf chlorophyll content at different growth stages of aromatic Boro rice (cv. BRRI dhan50).*

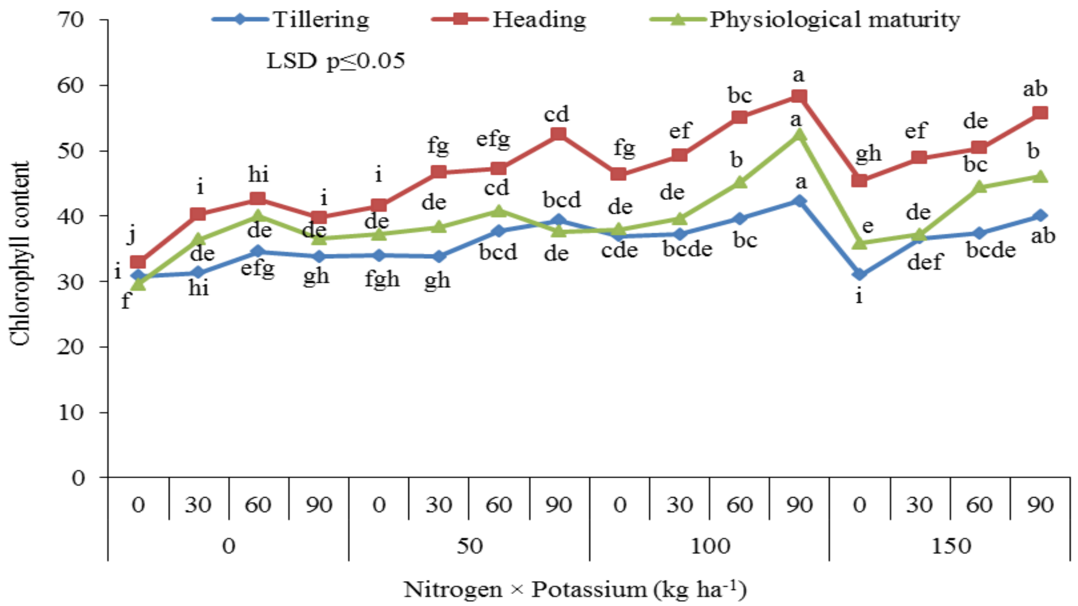


Figure 8. *Interaction effects of level of nitrogen and level of potassium on leaf chlorophyll content at different growth stages of aromatic Boro rice (cv. BRRI dhan50).*

Effect of interaction between nitrogen and potassium

The interaction effect of nitrogen and potassium fertilization on chlorophyll content from tillering to physiological maturity stages was significant (Figure 8). Chlorophyll content increased progressively with the advancement of time from tillering to heading stage and then decreased at physiological maturity stage. At tillering stage, 100 kg N ha^{-1} along with 90 kg K ha^{-1} recorded the highest value of chlorophyll content (42.29) which was at par with 150 kg N ha^{-1} along with 90 kg K ha^{-1}, while the interaction 0 kg N ha^{-1} along with 0 kg K ha^{-1} produced the lowest chlorophyll content (30.86). At heading stage, 100 kg N ha^{-1} along with 90 kg K ha^{-1} recorded the highest value of chlorophyll content (58.28) which was statistically identical to 150 kg N ha^{-1} along with 90 kg K ha^{-1}, while the interaction 0 kg N ha^{-1} along with 0 kg K ha^{-1} produced the lowest chlorophyll content (32.87). At physiological maturity stage, 100 kg N ha^{-1} along with 90 kg K ha^{-1} recorded the highest value of chlorophyll content (52.40) followed by 100 kg N ha^{-1} along with 60 kg K ha^{-1}, 150 kg N ha^{-1} along with 60 kg K ha^{-1} and 150 kg N ha^{-1} along with 90 kg K ha^{-1}, while the interaction 0 kg N ha^{-1} along with 0 kg K ha^{-1} produced the lowest chlorophyll content (29.56).

Conclusion

The growth performance of BRRI dhan50 was different with various concentrations of N and K. The present investigation revealed that the tallest plant, the highest number of tillers hill^{-1} and chlorophyll content were obtained from the application of 100 kg N ha^{-1}, and application of 90 kg K ha^{-1} produced the tallest plant at physiological maturity stage, the highest number of tillers hill^{-1} and chlorophyll content at heading stage. In interaction, application of 100 kg N ha^{-1} along with 90 kg K ha^{-1} produced the tallest plant, the highest number of tillers hill^{-1} and chlorophyll content at heading stage. Therefore, it can be concluded that aromatic *Boro* rice (cv. BRRI dhan50) can be cultivated at 100 kg N ha^{-1} along with 90 kg K ha^{-1} for better growth performance.

ACKNOWLEDGEMENTS

The financial assistance of the Ministry of Science and Technology, Government of the People's Republic of Bangladesh to carry out the research work is thankfully acknowledged.

REFERENCES

Bahmaniar, M. A., & Ranjbar, G. A. (2007). Response of rice cultivars to rates of nitrogen and potassium application in field and pot conditions. *Pakistan Journal of Biological Sciences*, *10*(9), 1430-1437.

BBS (Bangladesh Bureau of Statistics) (2020). The Yearbook of Agricultural Statistics of Bangladesh. Statistics Division, Ministry of Planning, Government of People's Republic of Bangladesh, Dhaka. pp. 02-40.

Bithy, S., Paul, S. K., Kader, M. A., Sarkar, S. K., Mahapatra, C. K., & Islam, A. K. M. R. (2020). Foliar application of boron boosts the performance of tropical sugar beet. *Journal of Bangladesh Agricultural University*, *18*(3), 537–544, https://doi.org/10.5455/JBAU.121026

Chakraborty, S., Rahman, A., & Salam, M. A. (2020). Effect of integrated nutrient management on the growth and yield of *Boro* rice (*Oryza sativa* L.) cultivars. *Archives of Agriculture and Environmental Science*, *5*(4), 476-481, https://dx.doi.org/10.26832/24566632.2020.050407

Djaman, K., Mel, V. C., Ametonou, F. Y., El-Namaky, R., Diallo, M. D., & Koudahe, K. (2018). Effect of nitrogen fertilizer dose and application timing on yield and nitrogen use efficiency of irrigated hybrid rice under semi-arid conditions. *Journal of Agricultural Science and Food Research*, *9*(2), 1000223, https://hdl.handle.net/10568/102040

Fageria, N. K., Santos, A. B. D., & Coelho, A. M. (2011). Growth, yield and yield components of lowland rice as influenced by ammonium sulfate and urea fertilization. *Journal of Plant Nutrition*, *34*, 371-386.

Ferdush, J., Sarkar, M. A. R., Paul, S. K., Rahman, M. S., Talukderb, F. U., & Imran, S. (2020). Interaction influence of row arrangement and nitrogen level on the growth and yield of transplant *Aman* rice (BRRI dhan34). *Sustainability in Food and Agriculture (SFNA)*, *1*(1), 55-63, http://doi.org/10.26480/sfna.01.2020.55.63

Gomez, K. A., & Gomez, A. A. (1984). Statistical Procedures for Agricultural Research. Int. Rice Res. Inst., John Wiley and Sons. New York, Chichester, Brisbane, Toronto, Singapore, p. 680.

Hartati, S., Suryono, & Purnomo, D. (2018). Effectiveness and efficiency of potassium fertilizer application to increase the production and quality of rice in entisols. *IOP Conf. Series: Earth and Environmental Science*, *142*, 012031. http://doi.org/10.1088/1755-1315/142/1/012031

Islam, A., Chandrabiswas, J., Karim, A. J. M. S., Salmapervin, M., & Saleque, M.A. (2015). Effects of potassium fertilization on growth and yield of wetland rice in Grey Terrace Soils of Bangladesh. *Research on Crop Ecophysiology*, *10/2*(2), 64-82.

Jahan, A., Islam, A., Sarkar, M. I. U., Iqbal, M., Ahmed, M. N., & Islam, M. R. (2020). Nitrogen response of two high yielding rice varieties as influenced by nitrogen levels and growing seasons. *Geology, Ecology, and Landscapes*. 1-8, http://doi.org/10.1080/24749508.2020.1742509

Jisan, M. T., Paul, S. K., & Salim, M. (2014). Yield performance of some transplant *Aman* rice varieties as influenced by different levels of nitrogen. *Journal of the Bangladesh Agricultural University*, *12*(2), 321–324.

Kabir, M. E., Kabir, M. R., Jahan, M. S., & Das, G. G. (2004). Yield performance of three aromatic fine rices in a coastal medium high land. *Asian Journal of Plant Sciences*, *3*, 561-563.

Khan, A. G., Shabbir, G., Sadiq, M., & Hussan, G. (2003). Grain quality traits of a candidate rice variety PB-95. *Asian Journal of Plant Sciences*, *2*(6), 483-484.

Kumar, V., Chopra, A.K., Srivastava, S., Singh, J. and Thakur, R.K. (2017). Irrigating okra with secondary treated municipal wastewater: Observations regarding plant growth and soil characteristics. *International Journal of Phytoremediation*, *19*(5): 490-499, https://doi.org/10.1080/15226514.2016.1244169

Kundu, A., Raha, P., Dubey, A. N., Rani, M., Paul, A., & Patel, R. (2021). Differential responses of rice (*Oryza sativa* L.) to foliar fertilization of organic potassium salts. *Journal of Plant Nutrition*, *44*(9), 1330–1348, https://doi.org/10.1080/01904167.2020.1862193

Liu, L. J., Chang, E. H., Fan, M. M., Wang, Z. Q., & Yang, J. C. (2011). Effect of potassium and calcium on root exudates and rain quality during grain filling. *Acta Agronomica Sinica*, *37*, 661-669.

Mahfuza, S. N., Islam, M. N., Aktar, S., Amin, M. R., & Islam, M. A. (2008). Influence of split application of potassium on yield and yield contributing characters of rice cultivars- BR11 and Nizersail. *The Agriculturists*, *6*(1&2), 84-89.

Meena, S. L., Singh, S., & Shivay, Y. S. (2002). Response of hybrid rice (*Oryza sativa*) to nitrogen and potassium application. *Indian Journal of Agronomy*, *47*, 207-211.

Paul, N. C., Paul, S. K., Salam, M. A., & Paul, S. C. (2021). Dry matter partitioning, yield and grain protein content of fine aromatic *Boro* rice (cv. BRRI dhan50) in response to nitrogen and potassium fertilization. *Bangladesh Journal of Botany*, *50*(1), 103-111.

Paul, S. K., Nila, N. Y., & Sarkar, M. A. R. (2020). Grain yield and quality of aromatic *Boro* rice (cv. BRRI dhan50) subject to date of transplanting and nutrient management. *Thai Journal of Agricultural Science*, *53*(2), 85-96.

Paul, S. K., Paul, U., Sarkar, M. A. R., & Hossain, M. S. (2018). Yield and quality of tropical sugarbeet as influenced by variety, spacing and fertilizer application. *Sugar Tech*, 20(2), 175-181.

Paul, S. K., Roy, B., Hasan, A. K., & Sarkar, M. A. R. (2017). Yield and yield components of short duration transplant *Aus* rice (cv. Parija) as influenced by plant spacing and nitrogen level. *Fundamental and Applied Agriculture*, *2*(2), 233-236.

Power, P. (1985). User's to MSTAT (version 4.0): A Software Program for the Design, Management, and Analysis of Agronomic Research Experiment. Michigan State University, USA.

Rathiya, P. S., Singh, V. K., & Kumar, R. (2017). Growth and yield performance of aromatic rice (*Oryza sativa* L.) varieties as affected by various nutrient management practices. *Journal of Pharmacognosy and Phytochemistry*, SP1, 866-868.

Rea, R. S., Islam, M. R., Rahman, M. M., & Mix, K. (2019). Study of nitrogen use efficiency and yield of rice influenced by deep placement of nitrogen fertilizers. *SAARC Journal of Agriculture*, *17*(1), 93-103, https://doi.org/10.3329/sja.v17i1.42764

Rengel, Z., & Damon, P. M. (2008). Crops and genotypes differ in efficiency of potassium uptake and use. *Physiologial Plantarum*, *133*, 624-636.

Roy, A., Sarkar, M. A. R., & Paul, S. K. (2018). Effect of age of seedlings at staggered transplanting and nutrient management on yield performance of aromatic fine rice (cv. BRRI dhan38). *SAARC Journal of Agriculture*, *16*(1), 49-59.

Roy, B., & Paul, S. K. (2018). Growth analysis of short duration transplant *Aus* rice (*Oryza sativa* L. cv. Parija) under irrigated ecosystem. *Archives of Agriculture and Environmental Science*, *3*(1), 68-72, https://doi.org/10.26832/24566632.2018.0301010

Senthilvalavan, P., & Ravichandran, M. (2019). Growth and physiological characters of rice (*Oryza sativa*) as influenced by integrated nutrient management under SRI in Cauvery Deltaic Zone of Tamil Nadu. *Annals of Plant and Soil Research*, *21*(3), 210-216.

Singh, A. K., Singh, P. K., Nandan, R., & Rao, M. (2012). Grain quality and cooking properties of rice germplasm. *Annals of Plant and Soil Research*, *14*(1), 52-57.

Sinha, T., Paul, S. K., & Sarkar, M. A. R. (2018). Effect of age of seedlings at staggered transplanting and weed management on growth and yield of aromatic *Boro* rice (cv. BRRI dhan50). *Journal of Bangladesh Agricultural University*, *16*(1), 5-11, https://doi.org/10.3329/jbau.v16i1.36472

Sumon, M. J. I., Roy, T. S., Haque, M. N., Ahmed, S., & Mondal, K. (2018). Growth, yield and proximate composition of aromatic rice as influenced by inorganic and organic fertilizer management. *Notulae Scientia Biologicae*, *10*(2), 211-219, https://doi.org/10.25835/nsb10210260

Tayefe, M., Gerayzade, A., Amiri, E., & Zade, A. N. (2014). Effect of nitrogen on rice yield, yield components and quality parameters. *African Journal of Biotechnology*, *13*(1), 91-105, https://doi.org/10.5897/AJB

UNDP and FAO. (1988). Land Resources Appraisal of Bangladesh for Agricultural Development. Report 2. Agroecological Regions of Bangladesh. Bangladesh Agril. Res. COUN., Dhaka-1207. pp. 212-221.

Wang, Y., Lu, J., Ren, T., Hussain, S., Guo, C., Wang, S., Cong, R., & Li, X. (2017). Effects of nitrogen and tiller type on grain yield and physiological responses in rice. *AoB PLANTS*, *9*, plx012. https://doi.org/10.1093/aobpla/plx012

Yadanar, S. M., Mar, S. S., Than, A. A., & Ngwe, K. (2018). Effect of nitrogen and potassium on yield and yield components of rice. Conference: Proceedings of the eleventh Agricultural Research Conference, At: Yezin Agricultural University, Myanmar, October 2018.

Yoshida, H., Horie, T., & Shiraiwa, T. (2006). A model explaining genotypic and environmental variation of rice spikelet number per unit area measured by cross-locational experiments in Asia. *Field Crops Research*, *97*(2-3), 337–343. https://doi.org/10.1016/j.fcr.2005.11.004