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Effect of nitrobenzene on growth and yield of *boro* rice

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Abstract

The present experiment was conducted at the research field of Patuakhali Science and Technology University (PSTU), Patuakhali during the period from December 2013 to March 2014 to evaluate the effect of Nitrobenzene as plant growth regulators on growth and yield parameters of *Boro* Rice. It also observed the comparative growth and yield performance of foliar application Nitrobenzene (0, 1.0, 3.0 and 5.0 ml L^{-1}). Data were collected on Plant height; number of leaves $plant^{-1}$; number of total, effective and non–effective tillers $hill^{-1}$; leaf area (LA); leaf area index (LAI); total dry matter (TDM); Crop and relative growth rate (CGR and RGR); and Yield and yield contributing characters such as length of root; length of panicle; number of total, sterile and non–sterile spikelets $panicle^{-1}$; 1000–grain weight; grain, straw and biological yield and harvest index (HI). The experiment was laid out in a completely randomized block design (RCBD) with three replications. The collected data were analyzed statistically and means were adjudged by DMRT at 5% level of probability. The treatments Nitrobenzene @ 3.0 ml L^{-1} as foliar application gave the highest performance in respect of plant height (90.39 cm), LAI (3.514), TDM (19.17 g $plant^{-1}$), effective tiller (20.33 $hill^{-1}$), total tillers (22.73 $hill^{-1}$), panicle length (26.01 cm),non sterile spikelets (134.70 $panicle^{-1}$), total spikelets (155.80 $panicle^{-1}$), 1000–grain weight (28.21 g), grain yield (5.86 t ha^{-1}), straw yield (8.44 t ha^{-1}), biological yield (14.29 t ha^{-1}) and HI (41.00%) of boro rice.

Key words: Nitrobenzene, growth , yield, *boro* rice

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Introduction

Rice (Oryza sativa L.) is the dominant food crop in Bangladesh. Bangladesh ranks 3rd position in rice growing area and 4th position in production among rice growing countries of the world (FAO 2008). In Bangladesh among cereals, the primary position is occupied by rice with about 80 percent of the total arable land is dedicated to rice cultivation (BBS 2014). Integrated use of organic manure and chemical fertilizers would be quite promising not only in providing greater stability in production, but also in maintaining better soil fertility (Tilahun *et al.*, 2013). In Bangladesh, about 80% of the total lands are used for rice cultivation. Rice contributes 91.1% of the total grain production and covers 74% of the total calorie intake for the people of Bangladesh. (MOA, 2001), although rainfall pattern is an important factor for rice production (Rokonuzzaman et al., 2018). Area under Bangladesh is the 5th largest country of the world with respect to rice cultivation. Rice is cultivated in about 28489 thousand acres land and total annual production is 33542TM. tons, with an average of 1177 kg $acre^{-1}$ (BBS, 2011).

As reported in Aziz et al. (2009) spraying of plant growth substances containing Nitrobenzene

significantly increase the panicle production in wetland rice. Moreover, early flowering was achieved by 1% Nitrobenzene in Paprika cv.KtPl-19 Kannan et al. (2009). Nitrobenzene is a combination of nitrogen and plant growth regulators extracted from sea weeds. Nitrobenzene, also known as Nitrobenzol or oil of mirbane, is an organic compound with the chemical formula $C_6H_5NO_2$. 'Elite' is a commercially available plant growth substance containing 20% (v/v) Nitrobenzene. Pathan (2014) also reported that Nitrobenzene 20% used to repair the hormonal function of a plant thus promotes the flowering activity and growth of roots. Nitrobenzene 20% is also known to increase the number of fruits by sustaining the flower bloomed.

Nitrobenzene (nitrobenzene 20% w/w) is a new generation plant energizer and yield booster of low cost PGRs compared to others. Nitrobenzene is quickly absorbed into the plants. Its influences the bio-chemical pathway of the plants to uptake more nutrients from the soil. it also increases the nutrient use efficiency thus improves the vegetative growth. Induces profuse flowering and helps in the retention of the flowers and fruits. Therefore, the present research work was undertaken to investigate the effect of nitrobenzene as plant growth regulators on growth and yield parameters of boro Rice. However, from the above discussion, the present study was carried out on the aspect of growth and yield of boro rice regarding to various levels of foliar spraying of nitrobenzene.

Materials and Methods

An experiment was conducted at the research farm of patuakhali Science and Technology University, Patuakhali during the period from December, 2013 to May, 2014. The research farm is located at $22^0 37'$ N latitude and $89^0 10'$ E longitudes. The maximum area is covered by Gangetic Tidal Floodplains and falls under Agroecological Zone "AEZ– 13". The area lies at 0.9 to 2.1 meter above mean sea level (Iftekhar and Islam, 2004). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Four different concentrations of Nitrobenzene" (nitrobenzene 20%w/w) as a plant growth regulator as foliar application was used for the present study as level T_1: Control (without Nitrobenzene), T_2: 1.0 ml Nitrobenzene L^{-1}, T_3: 3.0 ml Nitrobenzene L^{-1} and T_4: 5.0 ml Nitrobenzene L^{-1}. Preparation of one liter liquid nitrobenzene as par treatments, 0, 1, 3 and 5 ml nitrobenzene were dissolved in 1 litre distilled water and making 0, 1, 3 and 5 ml L^{-1} nitrobenzene solution. Prepared nitrobenzene treatments were sprayed at 3 times from 20 days after transplanting (DAT) while recommended dose of NPK fertilizers were used as basal soil application according to Fertilizer Recommendation Guide (FRG, 2012). All fertilizers were applied to the respective plots during land preparation. The applied fertilizers were mixed properly with the soil in the plot using a spade. The seedling of boro rice was transplanted in the research field on January 09, 2014. The distances between row to row and plant to plant were 20 and 15 cm, respectively. Gap filling was made up to 7 days after transplanting to maintain proper treatment and similar plant population density for every plot. Morphological characters such as Plant height, total tiller, effective and non–effective tillers $hill^{-1}$, leaf area index (LAI), total dry matter (TDM), Crop and relative growth rate (CGR and RGR), Yield and yield contributing characters such as length of panicle, number of total, sterile and non–sterile spikelets $panicle^{-1}$; 1000–grain weight, grain yield, straw yield, biological yield and harvest index (HI) were recorded.
The crop growth rate values at different growth stages were calculated using the following formula:-

$$\text{Leaf area index (LAI)} = \frac{LA}{P}$$

$$\text{Crop Growth Rate (CGR)} = \frac{1}{GA} \times \frac{W_2 - W_1}{T_2 - T_1} \text{ g m}^{-2}\text{day}^{-1}$$

$$\text{Relative growth rate (RGR)} = \frac{\text{Log}_e W_2 - \text{Log}_e W_1}{T_2 - T_1} \text{ g cm}^{-2}\text{day}^{-1}$$

Leaf area = Length of leaf (cm) × Width of leaf (cm)

Biological yield = Grain yield + Straw yield

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

Where, LA = leaf area (cm^2), P = ground area, W_1= Total dry matter production at previous sampling date, W_2= Total dry matter production at current sampling date, T_1= Date of previous sampling, T_2= Date of current sampling, GA= Ground area (m^2), Log_e= Natural logarithm.

The data obtained from experiment on various parameters were statistically analyzed in MSTAT–C computer program (Russel, 1986). The mean values for all the parameters were calculate and the analysis of variance for the characters was accomplished by Duncan's Multiple Range Test (DMRT) and the significance of difference between pair of means was tested by the Least Significant Differences (LSD) test at 5 % levels of probability (Gomez and Gomez, 1984).

Results and Discussion

Responses of Nitrobenzene on the morphological characters of boro rice

***Plant height*:** The data on plant height of the present study had statistically significant due to various treatments of Nitrobenzene as foliar application to the plant (Table 1). Among the various rate of nitrobenzene, foliar nitrobenzene @ 3.0 ml L^{-1} produces the tallest plant (39.55, 50.08, 57.69 and 90.39 cm) at 30, 60, 90 and 120 DAT respectively while statistically similar height of plant was recorded in 5.0 ml L^{-1} nitrobenzene (88.79 cm) at 120 DAT and statistically differed from other rates of nitrobenzene at 30, 60 and 90 DAT. In contrast, the shortest plant (20.75, 34.63, 39.24 and 76.96 cm) was produced from the control. Similar results were also obtained by Patil *et al*. (2011) and reported that plant height is increased maximum by treatment nitrobenzene (20%). Deotale *et al.* (1998) studied the effect of GA_3 and NAA on growth parameter of soybean and obtained highest values for plant height with 100 mgL^{-1} NAA.

Table1. Effect of foliar application of nitrobenzene on plant height and number of leaf plant $^{-1}$ of boro rice

Treatment	Plant height (cm) at different DAT			
	30	60	90	120
T_1: Control	20.0d	34.0d	36.8d	75.6c
T_2:1.0 ml L^{-1} Nitrobenzene	26.1c	41.6c	44.7c	82.3b
T_3:3.0 ml L^{-1} Nitrobenzene	39.6a	50.1a	57.7a	90.4a
T_4:5.0 ml L^{-1} Nitrobenzene	34.4b	45.4b	49.9b	86.6ab
CV%	2.26	4.23	1.03	2.43
Sig. level	**	**	**	**

**=significant at 1% level of probability and *= significant at 5% level of probability. Figures followed by same letter(s) are statistically similar as per DMRT at 5%

***Leaf area index*:** Different rates of nitrobenzene as foliar application on LAI had statistically significant at all the data recording stages where the highest LAI (0.4392, 1.158 and 3.514) was found in foliar application of nitrobenzene @ 3.0 ml L^{-1} followed by nitrobenzene @ 5.0 ml L^{-1} (0.354, 1.030 and 3.209) at 30, 60 and 90 DAT, respectively (Table 2). The lowest LAI (0.171, 0.732 and 2.230) was recorded in without nitrobenzene or control treatment. Foliar application of nitrobenzene @ 3.0 ml L^{-1} produced longest and more leaves, higher LA in this study which ultimately resulted the higher LAI. Pal *et al*. (2009) reported that highest LAI value was recorded in (T_4) triacontanol 95% @ 0.33 ml L^{-1} of water and second highest LAI was found in w nitrobenzene 20% (T_7) @ 2.5 ml L^{-1} of water.

***Total dry matter (g plant^{-1})*:** Foliar application of nitrobenzene also showed significant variation in relation to total dry matter (TDM) at all the data recording stages (Table 2). Nitrobenzene @ 3.0 ml L^{-1} had the higher TDM was recorded (3.69, 5.66 and 19.17 g $plant^{-1}$) among all treatments of the study where without or control treatment had the least producer (1.99, 3.29 and 12.00 g $plant^{-1}$) at 30, 60 and 90 DAT, respectively. The growth of shoot, root,

leaves and other parts of the both varieties were more develop by the foliar application of 3.0 ml L^{-1} which ultimately confirm the higher TDM. Similar effect was also found by Deb *et al*. (2012) studied on the effect of nitrobenzene (a plant growth regulator) on the growth of tomato plants (*Solanum lycopersicum*).

Table 2. Effect of foliar application of Nitrobenzene on leaf area index and total dry matter (g $plant^{-1}$) at different days after transplanting (DAT)

Treatment	LAI $plant^{-1}$ at different DAT			Total dry matter (g $plant^{-1}$) at different DAT		
	30	60	90	30	60	90
T_1: control	0.171d	0.732d	2.230d	1.99d	3.29d	12.00d
T_2: 1.0 ml L^{-1} Nitrobenzene	0.226c	0.889c	2.758c	2.23c	4.26c	15.26c
T_3: 3.0 ml L^{-1} Nitrobenzene	0.439a	1.158a	3.514a	3.69a	5.66a	19.17a
T_4: 5.0 ml L^{-1} Nitrobenzene	0.354b	1.030b	3.209b	2.73b	4.57b	18.24b
CV%	1.63	1.18	2.35	2.17	1.54	1.41
Sig. level	**	**	**	**	**	**

**=significant at 1% level of probability and *=significant at 5% level of probability, Figures followed by same letter(s) are statistically similar as per DMRT at 5%.

Crop growth rate (CGR): Crop growth rate (CGR) of boro rice varied significantly due to the different level of foliar application of nitrobenzene at 30-60 and 60-90 DAT (Table 3). The results revealed that the CGR was higher in between 30-60 DAT and lower at 60-90 DAT stages. Foliar application of nitrobenzene 3.0 ml L^{-1} received higher CGR (0.0230 g cm^{-2} day^{-1} and 0.0151 g cm^{-2} day^{-1}) at 30-60 and 60-90 DAT stage and lowest result (0.015 g cm^{-2} day^{-1} and 0.093 g cm^{-2} day^{-1}) found in control.

Relative growth rate (RGR): There was no significant variation due to foliar application of nitrobenzene was observed in respect of relative growth rate (RGR) at 30–60 DAT but significant variation due to foliar application of nitrobenzene was observed at 30–60 DAT (Table 3). At the growth stages of 30–60 DAT, the highest relative growth rate was found in treatment T_3 (3.0 ml L^{-1} Nitrobenzene) and it was statistically similar with all treatments. At 60 to 90 DAT, treatment T_3 (3.0 ml L^{-1} Nitrobenzene) observed the highest relative growth rate (0.199 g m^{-2} day^{-1}) and it was statistically similar T_4 (5.0 ml L^{-1} Nitrobenzene) treatment and control treatment observed the lowest RGR (0.123 g m^{-2} day^{-1}). A significant variation due to PGRs were also obtained by Jahan and Adam (2011) who found that various concentrations of NAA (0, 25, 50, 75, 100 mg L^{-1}) showed significant variation in respect of RGR where RGR had maximum in T_2 (100 ppm NAA) treatment in comparison to control.

Responses of Nitrobenzene on yield and yield contributing characters of boro rice

***Effective tillers hill^{-1}*:** The number of effective tillers $hill^{-1}$ of boro rice (BRRI dhan 28) differed significantly due to different treatments (Table 4). The maximum number of effective tillers $hill^{-1}$ (20.33) was found in 3.0 ml L^{-1} nitrobenzene followed 5.0 ml L^{-1} nitrobenzene (18.15) while without nitrobenzene or control treatment obtained the minimum effective tillers $hill^{-1}$ (10.08).

***Non effective tillers hill^{-1}*:** A significant variation was found in the effect of different rates of nitrobenzene as foliar application (Table 4). As evident from the Table 4, maximum number of non effective tillers $hill^{-1}$ (6.701) was produced from the untreated (without nitrobenzene or control) plant, while the number of non

effective tillers hill^{-1} had minimum (2.402) in foliar application of 3.0 ml L^{-1} nitrobenzene. These results revealed that the foliar application of 3.0 ml L^{-1} nitrobenzene was the most effective to produced highest grain and straw yield.

***Total tillers per hill^{-1}*:** Total tillers hill–1 showed significant different due to the effect of foliar nitrobenzene at harvest (Table 4). Among the various rate of nitrobenzene as foliar application, 3.0 ml L–1 recorded the maximum number of total tillers hill–1 (22.73) followed by 5.0 ml L–1 nitrobenzene (21.80) while without nitrobenzene exhibited the minimum total tillers hill–1 (16.78). Aziz and Miah (2009) reported that the application of flora (nitrobenzene) or chemical fertilizer either alone or in combination increased the tiller production. Among the treatments, the highest tillers hill–1 was observed in treatment T4 (STB + Flora @ 3ml/lit. of water) followed by treatment T3 (STB).

***Sterile spikelets panicle^{-1}*:** The effect of nitrobenzene as foliar application showed significant variation in respect of sterile spikelets panicle^{-1} (Table 4). From the Table 4.8, it was found that significantly the maximum number of sterile spikelets panicle^{-1} (25.50) was found in control or without nitrobenzene which was statistically differed among other foliar application treatments while nitrobenzene @ 3.0 ml L^{-1} obtained the minimum sterile spikelets panicle^{-1} (11.70) which was also statistically differed among other varieties. Among the various rates of nitrobenzene, 3.0 ml L^{-1} as foliar application observed the better results than that of other all treatments of the study in case of the minimum sterile spikelets panicle^{-1} were recorded. So, the variation in sterile spikelets panicle^{-1} was found due to the variation in foliar nitrobenzene (Table 4). In 3.0 ml L^{-1} nitrobenzene confirmed the maximum number of effective and total tillers, panicle and also grains production in case of the less production of sterile spikelets panicle^{-1}.

Table 3. Effect of foliar application of nitrobenzene on the crop growth rate (CGR) and relative growth rate (RGR) at different days after transplanting (DAT)

Treatment	Crop growth rate (cm^{-2} day^{-1}) at different DAT		RGR (g cm^{-2} day^{-1}) at different DAT	
	30-60	60-90	30-60	60-90
T_1: control	0.015c	0.093d	0.02	0.123d
T_2: 1.0 ml L^{-1} Nitrobenzene	0.020b	0.113b	0.0287	0.149c
T_3: 3.0 ml L^{-1} Nitrobenzene	0.023a	0.151a	0.0296	0.199a
T_4: 5.0 ml L^{-1} Nitrobenzene	0.019b	0.146a	0.0267	0.196a
CV%	3.9	2.42	9.52	2.87
Sig. level	**	**	NS	**

**=significant at 1% level of probability and *=significant at 5% level of probability, Figures followed by same letter(s) are statistically similar as per DMRT at 5%

***Non sterile spikelets panicle^{-1}*:** A significant variation was found due to the effect of foliar application of nitrobenzene in respect of non sterile spikelets panicle^{-1} (Table 4). Among the treatment of foliar nitrobenzene, the maximum non sterile spikelets panicle^{-1} (134.70) was found in 3.0 ml L^{-1} nitrobenzene followed by 5.0 ml L^{-1} nitrobenzene (115.10) while it was minimum (64.88) in control treatment.

***Total spikelets panicle^{-1}*:** Total spikelets production panicle^{-1} was significantly influenced amongst the foliar treatments of nitrobenzene (Table 4). Among the nitrobenzene treatments, foliar application of 3.0 ml L^{-1} recorded the maximum total spikelets panicle^{-1} (155.80) compare other foliar application treatments of

nitrobenzene. On the other hand, the minimum total spikelets panicle^{-1} (90.22) was found in without nitrobenzene or control treatment. Foliar application of nitrobenzene elongated the plant cell and enlarges the panicle which ultimately confirms the greater yield. Similar result was also obtained by Kumar and Son's (2011) who found that the application of nitrobenzene ("Flora") increase the number of fruits plant^{-1} is about 20–30%. Jahan and Adam (2013) observed that grains per spike increased following all the rates of NAA applications. Niknejhad and Pirdashti (2012) found that application of GA_3 markedly increased rice grain number panicle^{-1} (up to 40%) as compared to untreated plants.

Table 4. Effect of foliar application of Nitrobenzene on yield contributing characteristics and yield of boro rice

Treatment	Effect tiller hill^{-1} (No.)	Non effective tiller hill^{-1} (No.)	Total tiller hill^{-1}	Sterile spikelets panicle^{-1} (No.)	Non sterile spikelets panicle^{-1} (No.)	Total spikelets panicle^{-1} (No.)
T_1: control Nitrobenzene	10.08 d	6.70 a	16.78 d	25.50 a	64.88 d	90.22 d
T_2: 1.0 ml L^{-1} Nitrobenzene	15.42 c	5.52 b	20.93 c	19.32 b	82.53 c	101.8 c
T_3: 3.0 ml L^{-1} Nitrobenzene	20.33 a	2.40 d	22.73 a	11.70 d	134.7 a	155.8 a
T_4: 5.0 ml L^{-1} Nitrobenzene	18.15 b	3.65 c	21.80 b	15.08 c	115.1 b	137.4 b
CV%	**2.41**	**1.33**	**2.55**	**1.95**	**3.38**	**2.64**
Sig. level	**	**	**	**	**	**

**=significant at 1% level of probability and *=significant at 5% level of probability, Figures followed by same letter(s) are statistically similar as per DMRT at 5%.

***Panicle length*:** Panicle length of boro rice was also significantly influenced by the different treatments (Tables 5). The mean panicle length varied from 20.05 cm to 26.01 cm. Longest panicle (26.01 cm) was recorded with T_3 (3.0 ml L^{-1} Nitrobenzene) treatment which was statistically better than all other treatments and the shortest panicle (20.05) was recorded in T_1 (control). Pal *et al*. (2009) reported that highest panicle length was recorded in triacontanol 95% @ 0.33 ml L^{-1} of water and second highest panicle length was found in nitrobenzene 20% @ 2.5 ml L^{-1} of water.

***Thousand-grain weight (g)*:** Thousand-grain weight (g) of boro rice was found statistically significant due to the foliar application of different level of Nitrobenzene (Table 5). Thousand-grain weight ranged from 21.70 g to 28.21 g. Nitrobenzene application @ 3.0 ml L^{-1} produced the highest weight of 1000–grain (35.25 g) and control treatment recorded the lowest weight of 1000–grain weight (21.70 g). Aziz and Miah (2009) reported that the application of flora (nitrobenzene) or chemical fertilizer either alone or in combination increased the 1000–grain weight.

***Grain yield (t ha^{-1})*:** There was a significant variation due to the effect of foliar application of nitrobenzene (Table 5). Among the treatments the maximum grain yield (5.864 t ha^{-1}) was recorded in 3.0 ml L^{-1} nitrobenzene which was statistically superior to all other treatments. The second highest yield was found in T_4 (Nitrobenzene @ 5.0 ml L^{-1}) and the lowest grain yield (4.7 t ha^{-1}) was observed in control. The variation in grain yield may be attributes due to the variation in rates of nitrobenzene as foliar application and also the variation in productive tillers, filled and total grains as well as variation in sizes of productive grains. The highest fruit weight was observed from 25% Nitrobenzene applied treatment and the lowest was recorded from control treatment. Nuruzzaman et al., (1991) also found that the maximum fruit weight was provided by the foliar application of Nitrobenzene on strawberry. Nitrobenzene is quickly absorbed into the plants, which has capacity to increase flowering in

plants and maximum number of fruits per plant Mithila *et al (2012)*.

***Straw yield*:** Various treatments of the present study showed significant variation in respect of straw yield (Table 5). The highest straw yield (8.44 t ha^{-1}) was found in the foliar application of Nitrobenzene @ 3.0 ml L^{-1} (T_3) while it was the lowest (6.87 t ha^{-1}) in control treatment. Pal *et al*. (2009) reported that highest straw yield was recorded in triacontanol 95% @ 0.33 ml L^{-1} of water and second highest straw yield was found in nitrobenzene 20% @ 2.5 ml L^{-1} of water.

***Biological yield (t ha^{-1})*:** A significant variation was found due to varieties in respect of biological yield (Table 5).The highest biological yield (14.29 t ha^{-1}) was found in 3.0 ml L^{-1} nitrobenzene followed by 5.0 ml L^{-1} nitrobenzene (13.57 t ha^{-1}) while it was lowest (12.34 t ha^{-1}) in control. The variation in biological yield was found due to the variation in foliar nitrobenzene application rates and also the variation in production of grain and straw. Adam and Jahan (2011) reported that the highest biological yield was observed application of naphthalene acetic acid (NAA).

Table 5. Effect of Nitrobenzene on yield contributing characteristics and yield of boro rice

Treatments	Length of panicle (cm)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw Yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest Index (%)
T_1: control Nitrobenzene	20.05 d	21.70 c	4.87 d	6.87 d	12.34 d	39.43 b
T_2: 1.0 ml L^{-1} Nitrobenzene	21.97 c	24.03 b	5.16 c	7.88 c	13.03 c	39.53 b
T_3: 3.0 ml L^{-1} Nitrobenzene	26.01 a	28.21 a	5.86 a	8.44 a	14.29 a	41.00 a
T_4: 5.0 ml L^{-1} Nitrobenzene	23.68 b	25.00 b	5.43 b	8.15 b	13.57 b	39.94 b
CV%	**19.5**	3.43	2.53	1.67	1.38	2.04
Sig. level	**	**	**	**	*	**

**=significant at 1% level of probability and *=significant at 5% level of probability, Figures followed by same letter(s) are statistically similar as per DMRT at 5%.

***Harvest index (%)*:** Harvest index was significantly influenced due to foliar application of nitrobenzene where 3.0 ml L^{-1} nitrobenzene obtained the highest HI (41.00%) than that of other treatments of the study where control treatment showed the lowest HI (39.43) and it was statistically identical to 1.0 and 5.0 ml L^{-1} nitrobenzene (39.53 and 39.94%, respectively). From the findings of Bakhsh *et al*. (2011) found that the levels of plant growth regulator (NAA) significantly affected the harvest index (HI).

Conclusion

The result indicated that the increasing nitrobenzene rates had advantageous effect on plant growth and yield parameters. Different spraying rates of nitrobenzene enhance the morpho-plogical and also significantly increased growth, yield components and grain and straw yields of boro rice. So, considering the above observation, 3.0 ml L^{-1} nitrobenzene (T_3) spraying rates of nitrobenzene was significantly affected on morpho-physiological and yield attributes characters, which produced the superior result compare with other rates of nitrobenzene. Among the treatment, three milliliter of nitrobenzene per liter of water showed optimum levels to ensure the growth and yield performance of boro rice.

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