



DETERMINATION OF AROMA IN BUDHAN2 AROMATIC RICE AS INFLUENCED BY DIFFERENT APPLIED FERTILIZER AND PLANT SPACING

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[Citation: A.K.M. Alauddin Chowdhury and Md. Matiur Rahman (2019). Determination of aroma in BUDHAN2 aromatic rice as influenced by different applied fertilizer and plant spacing. *Int. J. Bus. Soc. Sci. Res.* 7(2): 76-79. Retrieve from <http://www.ijbssr.com/currentissueview/ijbssr070211>]

Received Date: 18/05/2019

Acceptance Date: 27/06/2019

Published Date: 28/06/2019

Abstract

Field and laboratory experiments were conducted at Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, during boro season of 2015-2016 to assess the aroma (%) and economic performance of newly released aromatic rice variety BUDHAN 2. The variety was grown with three fertilizer levels, viz., recommended (57-10-8-7-0.9 kg N P K S Zn ha⁻¹), 50% higher and 50% lower than recommended level and three plant spacing (20 cm x 25 cm, 20 cm x 20 cm and 20 cm x 15 cm) representing wider, standard and closer plant densities. The highest amylase (24.7%) was found in growing seed under recommended doses fertilizer application at standard plant spacing (20 cm x 20 cm) but it contained no aroma. In contrast, strong aroma was found in rice produced by lower fertilizer dose at standard plant spacing though it contained the lowest amylase (23.5%).

Key words: New aromatic rice, Plant spacing, Fertilizer level.

Introduction

Rice production in the country is increasing but emphasis was given mostly on yield improvement. Currently, people are becoming more conscious about the quality of rice they consumed. There are two types of rice grown in Bangladesh as per grain size, such as coarse rice and another is fine rice with or without aroma, which is a good quality rice and exportable. Department of Agricultural Extension (DAE) identified 54 aromatic and fine rice varieties grown in Bangladesh. (Helal Uddin, 2011). Among those 25 major rice varieties are of fine grain with aroma, such as Kataribhog, Badshahbog, Kaligira, Chinigura, Chinishagar, BR5 (Dulhabhog), Bashful, BRRI dhan 37 (Kataribhog type), BRRI dhan 38 (Bashmati type) etc. Aromatic rice is cultivated in all across Bangladesh but there are certain regions, which have the highest potential. A Major portion of the production was concentrated in four regions, namely Mymensingh, Chottagram, Rajshahi and Rangpur. Aromatic rice is very popular in our country because of its delicious taste. This rice is one of the major types of rice constitutes a small but special group of rice, which is considered best in quality. It is medium to long-grained rice with natural chemical compounds 2-acetyl-1-pyrroline, which gives it a distinctive scent and taste. Basmati of Pakistan and India is very popular in worldwide due to its pleasant aroma, superfine grain and extreme grain elongation after cooking. Demand for aromatic rice in our country in recent years has increased largely for internal consumption as well as export. Thus, the price of the aromatic rice is 2-3 times higher than that of the coarse rice. Aromatic rice of Bangladesh also has the potential to enter the export trade. Bangladesh is gifted with many native fine and aromatic rice varieties that should have major market potentials in other countries. Currently, the private sector produces and exports a fraction of this rice. The quality and productivity of the aromatic rice depend on the environmental conditions of the growing area and crop management practices followed to grow the crop (Singh *et al.*, 2000). T. Aman season is more suitable than other season to retain aroma in polished rice. Indigenous aromatic rice varieties are photoperiod sensitive and its are suitable for cultivation in T. Aman season. Therefore, it is desirable to increase the

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yield as well as quality of rice. Bangabandhu Sheikh Mujibur Rahman Agricultural University developed an aromatic rice variety (BUDhan 2), which released in 2015 for aman and boro season. As there is little information about the aroma and amylase contain of this variety, cultivated in boro season, this study was undertaken for this purpose.

Materials and Methods

Aroma determination

The experiment was conducted at the experimental field of Department of Agronomy, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, during the Boro season of 2014-15 (December, 2014 to June 2015). The climate of the experimental location is subtropical in nature. There was little or no rain during the growing season of the crop. Important meteorological parameters viz., relative humidity, maximum and minimum and temperature are shown in Fig. 1.

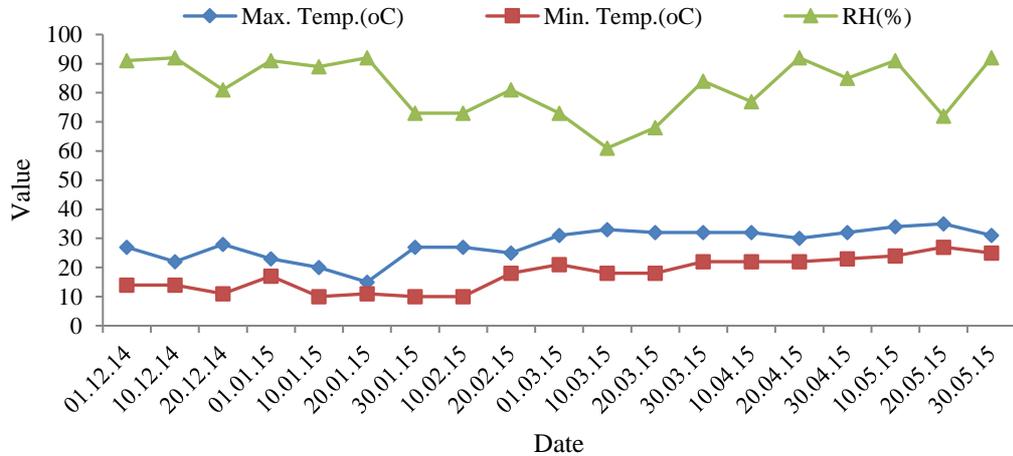


Fig.1. Maximum and minimum temperature ($^{\circ}\text{C}$) and relative humidity (%) in every ten days interval during whole boro 2014-15 season

The Aromatic rice variety BUDhan2 was released in 2015 for aman and boro season. It was used as the test crop of the experiment. The experiment having two factors (plant spacing and fertilizer levels) was set up in a randomized complete block design with four replications. Each plot size was 4 m long and 3 m wide. Distance between plot to plot and block to block was 1m and 1.5 m respectively, for weeding and other intercultural operations, irrigation and drainage. The variety was grown with three fertilizer levels viz. recommended ($57-10-8-7-0.9$ kg NPKSZn ha^{-1}), 50% higher ($114-20-16-14-1.8$ kg NPKSZn ha^{-1}) and 50% lower ($28.5-5-4-3.5-0.45$ kg NPKSZn ha^{-1}) than recommended level and three plant spacing (20 cm x 25 cm, 20 cm x 20 cm and 20 cm x 15 cm) representing wider, standard and closer plant densities. Recommended fertilizer dose was calculated based on Fertilizer Recommended Guide, 2012 of BARC (BARC, 2012). Different technique was developed to detect the aroma by several scientists around the world. The aroma was tested as per the method developed by IRRI (1996). According to this method, a rough grain was crushed and placed on a separate petri-dish of 5cm diameter. Five ml of 1.7% (0.3035 N) solution of KOH was added to each petri-dish immediately after crushing and the petri-dish were covered. The aroma was determined by smelling one hour after crushing. After every 10 samples, one blank test was repeated to ensure the scent sensitivity.

Economic analysis

Simple economic analysis was computed. Cost of land preparation, bed preparation, labour, seed, pesticide and irrigation were considered as fixed cost because it was same in all the treatments. The price of fertilizer urea, triple super phosphate (TSP), murate of potash (MoP), Gypsum and zinc sulfate was considered as a variable cost, because it varied in different treatments. The farm gate price of the products were collected from farmers and local markets to compute gross return, net return and benefit cost ratio (BCR). The remaining was considered as same for all the managements. Total cost was considered as the sum of fixed cost and variable cost (Total cost = Fixed cost + Variable cost). Gross return was calculated from the farm gate selling price of main product and byproduct {Gross return = (main product x farm gate price

+byproductx farm gate price). Net return was calculated by deducting the total cost from the gross return (Net return= Gross return- Total cost). BCR were computed dividing Gross return by Total cost (BCR=Gross return/Total cost) using this formula given below.

$$\text{Benefit cost ratio} = \frac{\text{Gross return (Tk.ha}^{-1}\text{)}}{\text{Cost of production (Tk.ha}^{-1}\text{)}}$$

Saiful et al. (2015) found Tk.73272 as the total cost of production excluding the fertilizer cost, as it differs treatment to treatment in boro rice in 2015. This price (Tk. 73272) were taken for the calculation of total fixed cost of production.

Results and discussion

Aroma in new rice variety

Environment, fertilization and cultural practices affected the amylase and protein contents of rice cultivars, which in turn may influence the aroma and flavor of the cooked rice. In the qualitative analysis, low aroma in the variety was found in the seed grown with higher doses of fertilizer application (Table1). Dutta, *et al.*, (1999) investigated the aromatic intensity of Basmati rice at different level of fertilizer. In their study 'Aroma synthesis in Basmati rice in relation to nitrogen found higher aroma intensity with the application of nitrogen @ 25kgN/ha than 50kg N/ha or control one.

The highest amylase (24.7%) but no aroma was found in the rice, which was grown under recommended dose fertilizer application (57-10-8-7-0.9 kg NPKSZn ha⁻¹) in standard plant spacing (Table 1). In the study, it was also observed that rice produced under lower dose (28.5-5-4-3.5-0.45 kg NPKSZn ha⁻¹) of fertilizer in standard population density obtained strong aroma though it contained lowest amylase (23.5%). Low protein, rice samples of the same cultivar are reported to be more flavorful than those with high protein (Juliano et al., 1965). This observation was corroborated by two descriptive sensory panels Park, 2001; Chamagne et al., 2004), who found rice with lower protein content to have higher levels of desirable sweet aroma/taste and lower levels of undesirable flavor attributes.

Table1: Amylase content of new aromatic rice as influenced by applied fertilizer rate and plant spacing

Fertilizer rate (kg ha ⁻¹)	Plant spacing	Amylase (%)	Aroma (%)	Remarks
Higher dose (50% higher dose than recommended)	20x25	24.4	++	Medium aroma
	20x20	24.5	+	Low aroma
	20x15	24.4	+	Low aroma
Recommended dose	20x25	24.4	++	Medium aroma
	20x20	24.7	-	No aroma
	20x15	24.6	+	Low aroma
Lower dose (50% lower dose than recommended)	20x25	24.2	+	Low aroma
	20x20	23.5	++	Strong aroma
	20x15	23.8	+	Medium aroma

Fertilizer rate: High dose- 50% higher than recommended dose recommended dose-As per recommendation of BARC Fertilizer Guide, 2012 based on soil test, Low dose-50% lower than recommended dose.

Economic analysis

In table 2 below shows the total cost of production including all costs of different treatments. It was highest (Tk.79680) for higher dose of fertilizer treatments and lowest (Tk.75410) for lower dose of fertilizer treatments. This difference is due to the variation of applied fertilizer. The price of no aroma paddy (Tk. 18 per kg), low aroma paddy (Tk. 22 per kg), medium aroma paddy (Tk.26 per kg), strong aroma paddy (Tk. 30 per kg) and straw ((Tk. 2 per kg) were calculated based on the market price. Then gross return, net return and BCRwer calculated. The highest Gross return (Tk. 133800),net return (Tk.94850) and BCR (1.77) was found in the rice which strong aroma contained. It was produced by lower dose (50% lower than recommended dose) of applied fertilizer in standard plant spacing spacing (20x25cm).

Table 2: Effect of fertilizer dose and plant density on gross return and net return of new aromatic rice

Fertilizer rate (kg ha ⁻¹)	Plant spacing	Total production cost (tk/ha)	Grain yield (t/ha) after drying	Straw yield (t/ha)	Grain yield (tk/ha)	Straw yield (tk/ha)	Gross return (tk/ha)	Net return (tk/ha)	Benefit cost ratio (BCR)
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Higher dose (50% higher dose than recommended	Wider (20x25cm)	79680	4.69 (M.A)	5.1	140700	10200	121940	71220	1.53
	Standard (20x20 cm)	79680	4.58 (L.A)	4.9	109920	9160	100760	39400	1.26
	Closer (20x15cm)	79680	5.18 (L.A)	5.7	124320	11400	113960	56040	1.43
Recommended dose	Wider (20x25cm)	77545	4.6 (M.A)	4.95	138000	9900	119600	70355	1.54
	Standard (20x20 cm)	77545	4.5 (N.A)	4.9	81000	9800	81000	13255	1.04
	Closer (20x15cm)	77545	5.04 (L.A)	5.6	120960	11200	110880	24375	1.42
Lower dose (50% lower dose than recommended	Wider (20x25cm)	75410	4.44(L.A)	4.8	106560	9600	97680	56750	1.29
	Standard (20x20 cm)	75410	4.46 (S.A)	4.85	160560	9700	133800	94850	1.77
	Closer (20x15cm)	75410	4.82 (M.A)	5.4	144600	10800	125320	22150	1.66

S.A= Strong aroma (Market price Tk.30 per kg), M.A= Medium aroma (Market price Tk.26 per kg), L.A= Low aroma (Market price Tk.22 per kg), N.A= No aroma (Market price Tk.18 per kg), Straw (Market price Tk.02 per kg)

Conclusion

The application of fertilizer in either excess or less than optimum rate affects both yield aroma and quality of rice to a remarkable extent. Therefore, efficient use of fertilizer is a prime concern during yield enhancement of rice. It has been proved that the fertilizer application can be increasingly affected to accumulate of large amount of nutrient during the growing season. From this study, it may be concluded that, for the production of fine and aromatic rice of this new aromatic rice, standard plant spacing (20x20cm) and application of lower dose (50% lower than recommended dose) fertilizer is more profitable than others levels of fertilizer application and plant spacing.

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