EFFECT OF NITROGEN LEVEL ON AROMATIC RICE VARIETIES AND SOIL FERTILITY STATUS

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ABSTRACT

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A field experiment was carried out at Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh to evaluate the effect of nitrogen (N) level on the quality of aromatic rice and fertility status of the post harvest soil. The experiment comprised of three varieties viz., Kalizira, Badshabhog and Tulshimala and three levels of nitrogen viz., 40, 60 and 80 kg ha^{-1}. Kalizira was found significantly superior to Tulshimala and Badshabhog with respect to quality of grain and soil fertility of the post harvest soil. Among three N levels, 80 kg ha^{-1} performs the best to quality of aromatic rice and fertility status of the post harvest soil. The effect of interaction of varieties and N levels were not significant on the quality of aromatic rice and fertility status of the post harvest soil.

Key words: Varieties, nitrogen, soil fertility, Aromatic rice

INTRODUCTION

Different rice varieties are grown in Bangladesh and each of them possesses some special different characteristics. The grain of some varieties are very small, some are fine, some of them are of different colors and some of them have special appeal for their aroma. Fine rice is mainly used by the people for the preparation of palatable dishes and sold at a higher price in the market due to its special appeal for aroma and acceptability. Aromatic rice is the most highly valued rice commodity in Bangladesh agricultural trade markets having small grain pleasant aroma with soft texture upon cooking (Dutta *et al*., 1998). Aromatic rice is used in many ways by the people like polau, khir, finny, jarda etc. According to Raju and Reddy (2000) the production of aromatic fine rice in Bangladesh is profitable due to its high price (35-40 Tk kg^{-1}) over low price coarse milled rice (22 Tk Kg^{-1}). But the yield and quality of fine rice can possibly be increased by the growers through improved agronomic practices. Rice plants depend solely upon soil and applied source of N for maximum yield. N plays a key role supporting plants activity and increasing the rice yield (BRRI, 1997). N is the key element in the production of rice and gives the largest response. It is also fact that improper use of nitrogenous fertilizer, instead of giving yield advantage, may reduce the same. Again different varieties may have varying responses to N fertilizer depending on their agronomic traits. N content is directly proportional to the variation in the organic carbon of the soils. Considering 0.12% as the critical level of total N content (Fertilizer Recommendation Guide, 2005) all the soils were found to be deficient in total N. Portch and Islam (1984) reported that 100% of Bangladesh soils studied contained available N below critical level. Major nutrients N and Ca and a beneficial element Na were lost by volatilization, leaching and run off. After volatilization, the rest of above nutrients were available under post harvest soil. Many workers have reported a significant response of rice to N in different soils in Bangladesh (Bhuiyan *et al*., 1989 and Islam *et al.*, 1990). The present piece of work, there are undertaken to examine the effect of varieties and different N levels on the quality of aromatic rice and fertility status of the post harvest soil.

MATERIALS AND METHODS

The research work was carried out at the agronomy field laboratory, Bangladesh Agricultural University, Mymensingh during the period from July to December 2001 (*Amon* season). The experimental plot was a medium high land with silt loam soil having a pH value of 6.4, 1.29% organic matter, 0.101% total N, available phosphorus 26 ppm and exchangeable potassium 0.13 me/100g soil. The experiment comprised of three varieties namely, Kalizira, Badshabhog and Tulshimala and three levels of nitrogen viz., 40, 60 and 80 kg ha^{-1}.The experiment was laid out in a split-plot design while varieties in the main plot and N in sub plot with three replications. The unit plot was 4.0m x 2.5m. The N was applied in the form of urea as experimental specification. One third of urea was applied 15 days after transplanting (DAT) and the rests were applied in two equal installments at 35 and 55 DAT. At the time of final land preparation, each unit plot was fertilized with triple super phosphate, muriate of potash, gypsum and zinc sulphate to provide P, K, S and Zn at the rate of 50, 60, 33 and 5 kg ha^{-1}, respectively. Thirty-six days old seedlings were transplanted in the experimental plot with three seedlings per hill on 12 August 2001. All intercultural operation was done as when necessary. The crop

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60, 33 and 5 kg ha^{-1}, respectively. Thirty-six days old seedlings were transplanted in the experimental plot with three seedlings per hill on 12 August 2001. All intercultural operation was done as when necessary. The crop was harvested at full maturity. Grain and straw samples from each plot were taken and separately oven dried at 65^0C over night to grind in a grinding machine. Total N content determine by Micro-kjeldahl method. Total N uptake was determined by the following formulae:

$$\text{Nitrogen uptake by grain (kg ha}^{-1}) = \frac{\%\ \text{N in grain} \times \text{Grain yield (kg ha}^{-1})}{100}$$

$$\text{Nitrogen uptake by straw (kg ha}^{-1}) = \frac{\%\ \text{N in grain} \times \text{Straw yield (kg ha}^{-1})}{100}$$

Protein content of the grain was determined by multiplying the N content of grain. Seeds were placed on the Petridish and the emerged normal seedlings were counting everyday on 5 to 14 days after placement of seed. Germination percentage and Vigour index were calculated by the following formulae:

$$\text{Percentage of germination} = \frac{\text{No. of seeds produced normal seeedlings}}{\text{No. of seeds set for germination}} \times 100$$

$$\text{Vigour index} = \frac{\text{No. of seed germinated at first count}}{\text{Duration of first count}} + - - - + \frac{\text{No. of seed germinated at last count}}{\text{Duration of last count.}}$$

Aroma of rice was detected by olfactory test. Cooking time of rice was described by Juliano *et al.,* 1969. Soil samples were analyzed to determine pH, organic matter, N, P and K contents. Soil p^H, total nitrogen, available phosphorus and exchangeable potassium were determined following glass electrode pH meter, Micro-Kjeldahl method, modified Olsen method and flame photometer, respectively. Wet oxidation method was followed to determine percentage of organic carbon and the organic matter content was calculated by multiplying the % organic carbon with the Van-Bemnelen factor 1.73. The collected data were analyzed following the ANOVA-technique and the mean differences were adjudged with Duncan's Multiple Range Test using a statistical computer package MSTAT.

RESULTS AND DISCUSSION

Effect of Variety

Variety showed significant influence on N content, N uptake, protein and aroma of grain. Figure 1 indicated that Kalizira contained the highest N content (1.45%) and protein (8.62%) of grain. The lowest N content (1.43%) and protein (8.50%) were recorded from Badshabhog which was statistical similar to Tulshimala. This result was consistent to Dutta *et al.* (1998) who recorded variable N content and protein percentage among varieties. The results showed that the highest N uptake (41.82%) was recorded from Badshabhog while the lowest value (33.92%) was recorded from Kalizira. Manna (2005) observed that the significant variation of N uptake among the varieties. The highest aroma (3.26) was recorded from Kalizira and the lowest aroma (1.28) was recorded from Badshabhog (Figure 5). Varietals differences regarding aroma might be due to their difference in genetic make-up. Dutta *et al.* (1998) reported that aroma varied among the varieties. Variety had no significant effect on germination, vigour index and cooking time of grain and N content of straw.

The N uptake of straw was significantly affected by variety. Results presented in Figure 7 indicate that maximum N uptake of straw (34.28 kg ha^{-1}) was recorded from Tulshimala and the minimum N uptake of straw (31.21 kg ha^{-1}) was recorded from Kalizira.

Variety had significant effect on organic matter, available phosphorus and exchangeable potassium in the post harvest soil. The highest organic matter (1.22%) was recorded from Tulshimala while the lowest value (1.19%) was recorded from the variety Badshabhog. The highest available phosphorus (21.13 ppm) in the post harvest soil was recorded from Kalizira and the lowest value (19.44 ppm) was recorded from Badshabhog. The highest exchangeable potassium (0.110 me/ 100 g soil) was recorded from Kalizira which was statistically at par with Tulshimala and the lowest value (0.098 me/ 100 g soil) was recorded from Badshabhog (Figure 11).

Effect of N level

N level showed significant effect on the qualitative characters of rice plant studied except aroma and cooking time of grain. The Figure 2 and Figure 4 presented that N content, protein, germination and vigour index of grain increase with the increasing level of nitrogen from 40 kg N ha^{-1} to 80 kg N ha^{-1}. Uppal and Shidul. (1995) reported that N and protein content increased with the increasing level of N up to 120 kg N ha^{-1}. Patel *et al*. (1991) also reported that vigour index was significantly increased with N level. The maximum N uptake (42.04%) was calculated at 60 kg N ha^{-1} and minimum N uptake (33.68%) was calculated at 40 kg N ha^{-1}. N content and uptake of straw was found to be highly responsive to N level and had similar pattern as was found in grain. Mannan (2005) reported that N uptake in grain and straw increase with increasing level of N.

N level showed significant effect on all the parameters studied of the post harvest soil. Figure 10 and Figure 12 showed that the soil pH, organic matter, available phosphorus and exchangeable potassium in post harvest increased with increasing level of N from 40 kg N ha^{-1} to 80 kg N ha^{-1}. The maximum total N (0.095%) was obtained from 80 kg N ha^{-1} applied which was statistically at par with the application of 60 kg N ha^{-1} and the lowest value (0.074%) was obtained from 40 kg N ha^{-1}.

Interaction effect of Variety and N

The interaction effect of N and varieties were not significantly effect on all the parameter studied except nitrogen content of straw (Table 1). The highest N uptake of straw (0.60%) was given by V_2N_3 and the lowest value (0.37%) was recorded from $V_1N_1$and V_3N_1.

CONCLUSION

The variety Kalizira performed best in respect of nitrogen content, protein, aroma of grain and soil fertility status of post harvest soil. The quality of aromatic rice and fertility status of post harvest soil were positively influenced by the application of N. The interaction between varieties and N level were not significant on grain quality and nutrient status of post harvest soil.

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Effect of variety

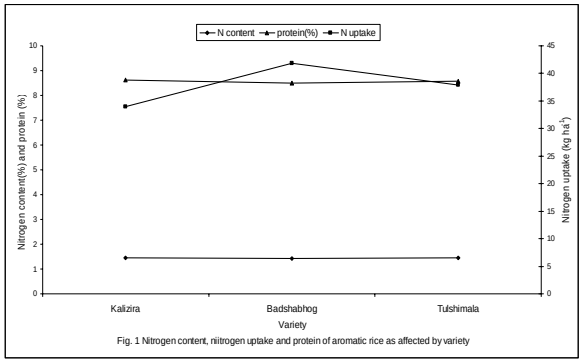

Fig. 1 Nitrogen content, niitrogen uptake and protein of aromatic rice as affected by variety

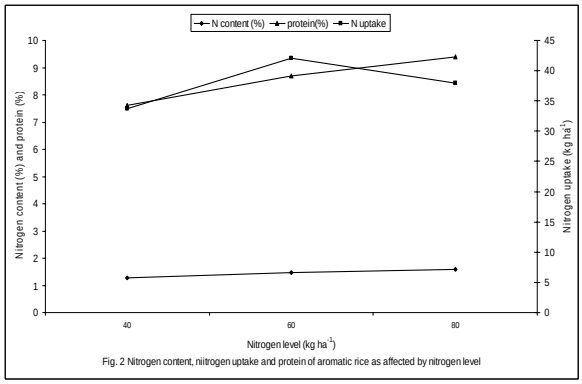

Fig. 2 Nitrogen content, niitrogen uptake and protein of aromatic rice as affected by nitrogen level

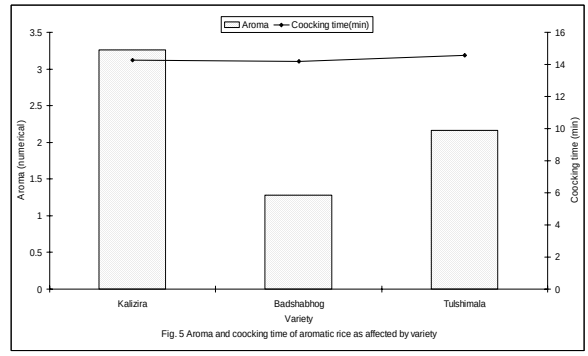

Fig. 5 Aroma and coocking time of aromatic rice as affected by variety

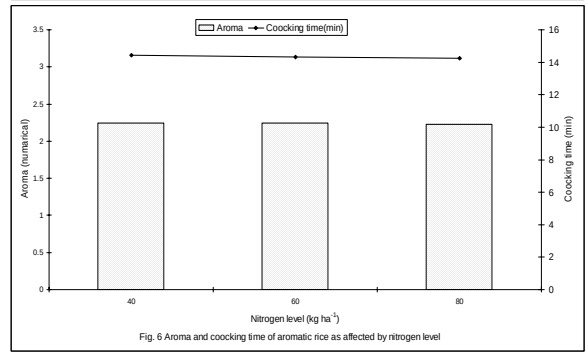

Fig. 6 Aroma and coocking time of aromatic rice as affected by nitrogen level

Effect of nitrogen level

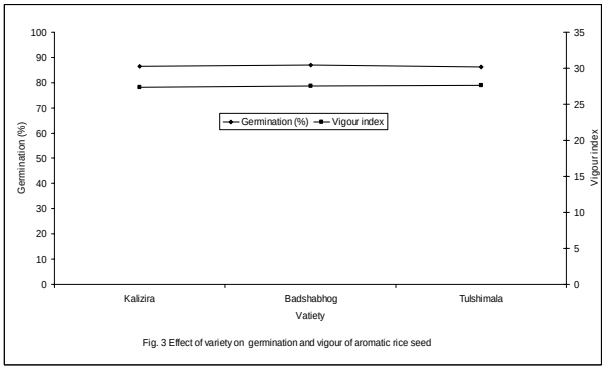

Fig. 3 Effect of variety on germination and vigour of aromatic rice seed

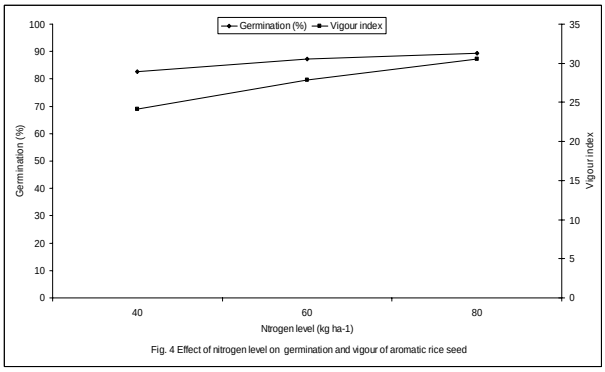

Fig. 4 Effect of nitrogen level on germination and vigour of aromatic rice seed

Effect of variety

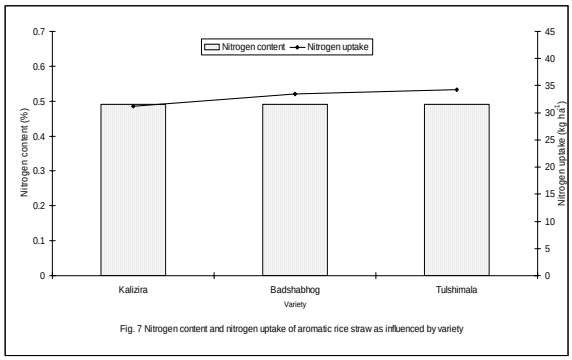

Fig. 7 Nitrogen content and nitrogen uptake of aromatic rice straw as influenced by variety

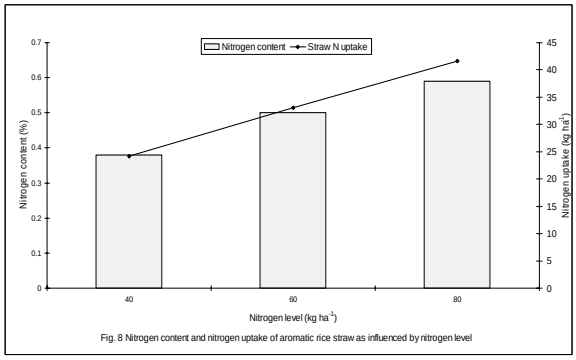

Fig. 8 Nitrogen content and nitrogen uptake of aromatic rice straw as influenced by nitrogen level

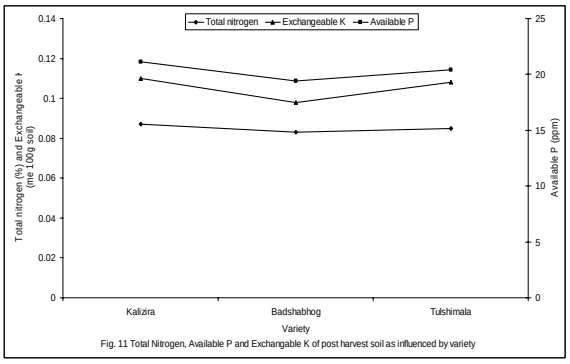

Fig. 11 Total Nitrogen, Available P and Exchangable K of post harvest soil as influenced by variety

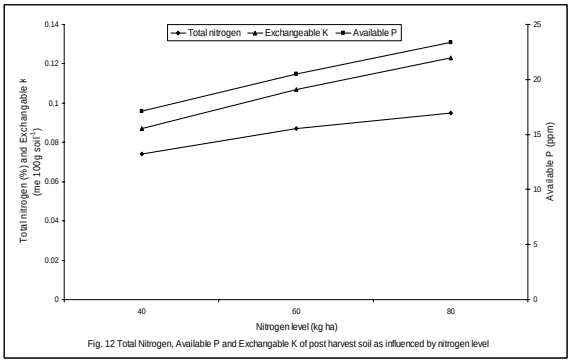

Fig. 12 Total Nitrogen, Available P and Exchangable K of post harvest soil as influenced by nitrogen level

Effect of nitrogen level

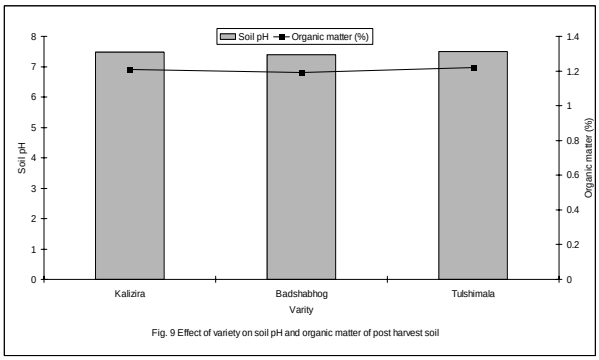

Fig. 9 Effect of variety on soil pH and organic matter of post harvest soil

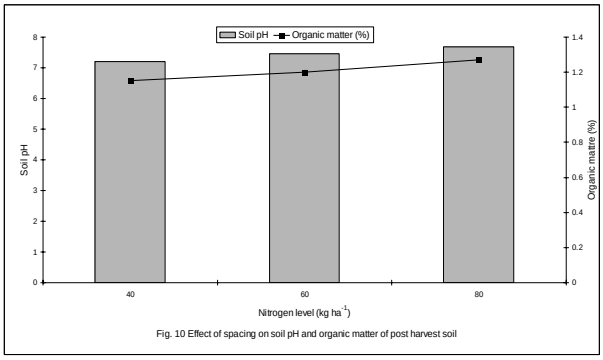

Fig. 10 Effect of spacing on soil pH and organic matter of post harvest soil

Table 1 Effect of interaction of variety and N level on qualitative characters of aromatic rice and nutrient status of the post harvest soil

Interaction (Variety × N level)	Grain							Straw		nutrient status of the post harvest soil				
	N content (%)	N uptake (kg ha^{-1})	Protein (%)	Germination (%)	Vigour index	Aroma (numerical)	Cooking time (min)	N content (%)	N uptake (kg ha^{-1})	Soil pH	Organic matter (%)	Total nitrogen (%)	Available P (ppm)	Exchangeable K (me 100 g soil $^{-1}$)
V_1 N_1	1.30	30.30	7.81	82.80	24.48	3.32	14.4	0.37 g	22.50	7.17	1.15	0.076	12.16	0.090
V_1 N_2	1.47	37.72	8.77	87.37	27.71	3.22	14.24	0.51 c	31.89	7.45	1.21	0.088	22.11	0.113
V_1 N_3	1.58	33.72	9.42	89.46	29.85	3.25	14.12	0.59 b	39.23	7.78	1.28	0.097	24.13	0.128
V_2 N_1	1.28	37.80	7.61	82.91	24.00	1.36	14.27	0.39 f	25.13	7.13	1.14	0.072	16.82	0.080
V_2 N_2	1.44	45.08	8.56	86.96	27.67	1.22	14.20	0.49 e	32.08	7.43	1.19	0.086	19.18	0.100
V_2 N_3	1.59	42.55	9.45	89.53	31.06	1.27	14.15	0.60 a	43.08	7.60	1.24	0.092	22.32	0.115
V_3 N_1	1.27	32.92	7.56	82.40	23.97	2.05	14.67	0.37 g	25.06	7.29	1.16	0.075	17.42	0.090
V_3 N_2	1.47	43.30	8.75	87.20	28.31	2.28	14.55	0.51 d	35.30	7.15	1.21	0.087	20.20	0.108
V_3 N_3	1.58	37.49	9.41	89.34	30.61	2.16	14.45	0.58 b	42.46	7.68	1.28	0.095	23.69	0.125
Level of significance	NS	NS	NS	NS	NS	NS	NS	0.01	NS	NS	NS	NS	NS	NS

In a column, figures bearing same or no letter(s) do not differ significantly at 5% level of significance by Duncan's Multiple Range Test
NS= Not significant
V_1 = Kalizira, V_2 = Badshabhog, and V_3 = Tulshimala
N_1 = 40 kg N ha^{-1}, N_2 = 60 kg N ha^{-1} and N_3 = 80 kg ha^{-1}