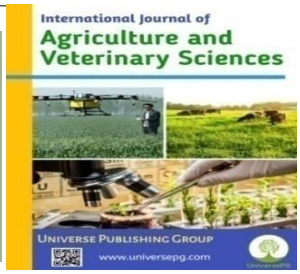
Publisher homepage: www.universepg.com, ISSN: 2663-7529 (Online) & 2663-7510 (Print)

https://doi.org/10.34104/ijavs.022.068074

International Journal of Agriculture and Veterinary Sciences

Journal homepage: www.universepg.com/journal/ijavs



Performance of Aromatic Rice Varieties as Influenced by Nitrogen Doses

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ABSTRACT

An experiment was carried out at the Soil Science Field Laboratory of Bangladesh Agricultural University (BAU), Mymensingh during Aman season to determine the nitrogen requirement of two aromatic rice varieties (Kalizira, and Chinisagar). There were five N levels, viz. N_0 (0 kg ha^{-1}), N_{20} (20 kg ha^{-1}), N_{40} (40 kg ha^{-1}), N_{60} (60 kg ha^{-1}) and N_{80} (80 kg ha^{-1}). Application of N significantly increased the harvest components, grain harvest and straw harvest of both rice varieties. Both grain harvest and straw harvest of Chinisagar variety were higher than that of Kalizira. There was no significant difference between the two rice varieties for N concentration in grain and straw. The variety Chinisagar showed statistically higher total N uptake compared to Kalizira variety. The grain harvest of both varieties without any N application was 1.8 t ha^{-1} and the application of 60 kg N ha^{-1} recorded the highest harvests of 3.1 and 3.2 t ha^{-1} in Kalizira and Chinisagar, respectively. For both varieties, the grain harvest increased progressively with an increase in N application up to 60 kg N ha^{-1} and thereafter decreased at higher dose of N i.e. 80 kg N ha^{-1}. The grain harvests due to 40 kg N ha^{-1} may be optimum for both the varieties.

Keywords: Aromatic rice, Nitrogen doses, Varieties, Effectiveness, and Bangladesh's soils.

INTRODUCTION:

Rice plays a unique role in combating global hunger (IRRI, 2004) and highest priority has been given to produce more rice (Bhuiyan *et al*., 2004). Farmers cultivate modern coarse grained rice to meet up their daily food requirement and aromatic fine grained rice to use during festivals and on special occasions. In fact aromatic rice is very popular in the national and in the international Markets (Yoshihashi, 2005). However, the choice of grain quality depends on the consumers' income. Most of the well-off people preferred long slender scanned fine grain rice but their price is 2-3 times higher than that of coarse grained rice (Biswas *et al*., 1992; Sharmin *et al*., 2021).

The demand for scanted fine grain rice has been increased (BRRI, 2004). In Bangladesh, rice dominates over all other crops and covers 75% of the total cropped area (Rekabdar, 2004) of which around 27% is occupied by fine rice varieties (BBS, 2007). Consumer demand for fine rice varieties is due to better

nutritional quality, palatability and special flavor and fragrant rice trials are highly preferred. Bangladesh produces several fine aromatic rice varieties that have excellent eating qualities for steamed rice as well as for preparations such as polao, biryani, jorda and phirni that are served on special occasions. As a consequence, some Bangladeshi aromatic rice is being exported to Europe, USA and the Middle East where Bangladeshis are living in large numbers. The demand of aromatic rice for internal consumption and also for export is increasing day by day (World Bank, 2005; Ali *et al*., 2022).

However its production requires manipulation for fertilizer rates especially N levels because N is a key element of crop growth and development (Dobermann and Fair hurst, 2000). A good supply of nitrogen also stimulates root growth and development, protein content of seed and foliage as well as the uptake of other nutrients. It is a major part of all amino acids, enzymes, nucleic acids and chlorophyll. The growth and development of T. aman rice are greatly influenced by N application. Optimum N ensures the plants to grow properly with their both aerial and underground parts of plant (Nazimi *et al*., 1995). The crop grows well and produces better harvest when N supply is optimum. Applications of N below and above of the optimum level adversely affect growth and development (De Datta, 1981). But most of the farmers' are habituated to grow fine grain rice without considering an appropriate amount of N application resulting in lower grain harvest (Sing *et al*., 1990). Bangladesh Rice Research Institute (BRRI), (2003) reported that cultivation of fine rice required less amount of N than coarse grain rice for their growth and development. Information on N requirement for growing modern coarse grained rice is available but in case of scanted fine grained rice is lacking. Thus, the present study was undertaken to determine optimum N level for growing fine grained rice for higher grain harvest.

MATERIALS AND METHODS:

The research work was carried out in Aman season from August to December 2008 at the Soil Science Field Laboratory of Bangladesh Agricultural University, Mymensingh. The study was made to evaluate the effect of N fertilizer on fine-grained Kalizira and Chinisagar rice varieties. The soil has pH value 6.9 and 1.92% organic matter. There were five N levels, viz. N^0 (0 kg ha^{-1}), N_{20} (20 kg ha^{-1}), N_{40} (40 kg ha^{-1}), N_{60} (60 kg ha^{-1}) and N_{80} (80 kg ha^{-1}).

Two varieties namely Kalizira and Chinisagar were used as experimental crops. The experiment was laid out in split-plot design with three replications. The varieties of rice were placed in the main plot and the different levels of nitrogen were placed in the sub-plot. The experimental area was divided into 6 blocks representing three replications to reduce soil heterogenetic effects. Each block was divided into 5 unit plots with raised ail. Thus, the total number of unit plots was 30. The unit plot size was 4 m × 2.5 m. Unit blocks were separated from one another by 50 cm drain. Treatments were randomly distributed within the blocks. The different rates of N were supplied from urea in three equal splits at 10, 40 and 60 days after transplanting. A basal dose of 8 kg P, 20 kg K, 8 kg S and 1 kg Zn ha^{-1} was applied to all plots from triple super phosphate, muriate of potash, gypsum and zinc oxide, respectively. Forty day old seedling was carefully uprooted from a seedling nursery and transplanted on newly puddled unit plots on the same day.

The date of transplanting was 20 August, 2008. Plant spacing was 15 cm × 20 cm. Three healthy seedlings were trans-planted in each hill. Gap filling was made 7 days after transplanting to make a uniform plant population for each treatment. Inter-cultural operations were implemented adequately at the right time. A supplementary two irrigation was done in the month of October due to lack of rainwater. Two varieties were harvested at full maturity of rice. Kalizira was harvested on 3 December 2008 and Chinisagar on 10 December 2008. The harvests of the grain and straw per plot were recorded after threshing, winnowing and drying. The representative grain and straw samples were dried in an oven at 65^0C for about 24 hours before they were ground by a grinding machine. Total N content determined by micro Kjeldahl method. After chemical analysis of grain and straw samples, the nitrogen uptake was calculated from the value of N content and harvests of crop. Then biological harvest and harvest index were calculated.

RESULTS AND DISCUSSION:

Effect of variety

Variety showed significant influence on grain and straw harvest, N content and biological harvest of rice (**Table 1**). The harvest of Chinisagar was statistically higher than that of Kalizira. The variety Chinisagar showed highest grain (2.68 t ha^{-1}) and straw harvest, N uptake (30.4 kg ha^{-1}) and biological harvest (**Table 1**). Asaduzzaman *et al.* (1996) observed that grain harvest increased significantly with nitrogen application. These finding are also supported by Salam *et al.* (2004). The two varieties of rice did not vary significantly in N uptake by rice grain (**Table 1**) but differed significantly in N uptake by straw. There was no significant difference in harvest index between the two varieties of rice (**Table 1**).

Table 1: Effects of variety on harvest and qualitative characters of rice.

Variety	Grain harvest (t ha^{-1})	Straw harvest (t ha^{-1})	Grain N content (%)	Straw N content (%)	Grain N uptake (kg ha^{-1})	Straw N uptake (kg ha^{-1})	Biological harvest (t ha^{-1})	Harvest index (%)
zV$_1$: Kalizira	2.52b	6.66b	1.15	0.60	29.5	40.7b	9.2b	27.4
V$_2$: Chinisagar	2.68a	6.84a	1.13	0.63	30.4	43.8a	9.52a	28.2
CV (%)	6.54	9.47	7.42	9.17	8.40	9.6	6.39	7.69
SE (±)	0.93	0.10	NS	NS	NS	0.34	0.82	NS

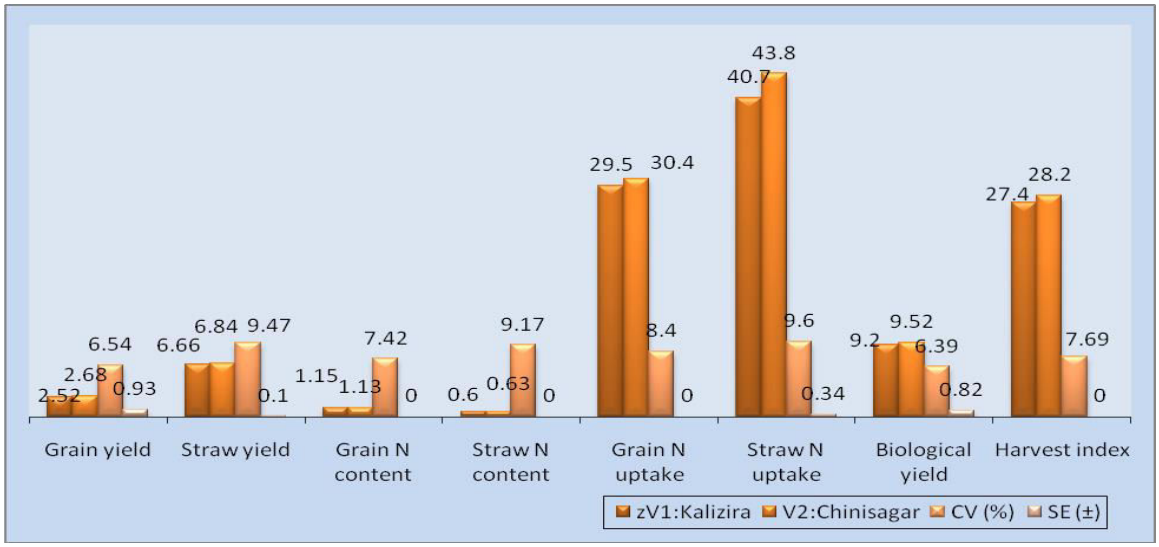

Fig. 1: Effects of variety on harvest and qualitative characters of rice.

Effect of different levels of N rates

The result revealed that all the parameters of study were significantly influenced by N rates except N content and harvest index. The highest mean grain harvest (3.16 t ha^{-1}) was recorded in N_{60} (60 kg ha^{-1}) and the lowest harvest (1.81 t ha^{-1}) was recorded in N^0. The application of different levels of N resulted in significant increase in straw harvest of rice (**Table 2**). The highest straw harvest was observed 7.99 t ha^{-1} when 80 kg N ha^{-1} was applied and lowest was 5.02 t ha^{-1} over control. The effect of the rest of the N application showed statistically identical effects on straw harvest of rice. The mean biological harvest was found due to application of different levels of N fertilizer ranged from 6.8 to 10.9 t ha^{-1}. The different levels of N application had no significant effect on the harvest index of rice. The harvest index in different levels of N application varied from 26.2 % in N_{20} (20 kg N ha^{-1}) treatment to 30.7 g in N_{60} (60 kg N ha^{-1}) treatment. Nasir uddin, (2008) observed that the harvest index significantly influenced by different levels of N. He also stated that the harvest index gradually decreases with increasing N levels. The N uptake by rice straw

was significantly affected by different rates of N application. The highest N uptake by grain (38.6 kg ha^{-1}) was obtained from N_{60} and straw (55.9 kg ha^{-1}) was obtained from N_{80}.

The lowest N uptake (18.0 kg ha^{-1}) by grain and straw (28.1 kg ha^{-1}) was found in N^0. Sengar *et al.* (2000) reported that the N uptake by rice grain and straw increased significantly with the combined application of organic manure and chemical fertilizers.

Table 2: Effects of N rates on harvest and qualitative characters of rice.

N rate	Grain harvest (t ha^{-1})	Straw harvest (t ha^{-1})	Grain N content (%)	Straw N Content (%)	Grain N uptake (kg ha^{-1})	Straw N uptake (kg ha^{-1})	Biological harvest (t ha^{-1})	Harvest index (%)
N_0	1.81 bc	5.02 c	0.99	0.56	18.0 b	28.1 b	6.8 c	26.6
N_{20}	2.28 b	6.46 bc	1.11	0.51	25.2 ab	32.6 ab	8.7 bc	26.2
N_{40}	2.84 ab	7.20 ab	1.17	0.65	33.1 ab	46.3 ab	10.0 b	28.0
N_{60}	3.16 a	7.09 b	1.22	0.68	38.6 a	48.3 ab	10.3 ab	30.7
N_{80}	2.90 ab	7.99 a	1.21	0.70	35.0 a	55.9 a	10.9 a	26.6
CV (%)	6.54	9.47	7.42	9.17	3.76	4.2	5.68	8.91
SE (±)	0.19	0.54	NS	NS	0.19	7.36	1.71	NS

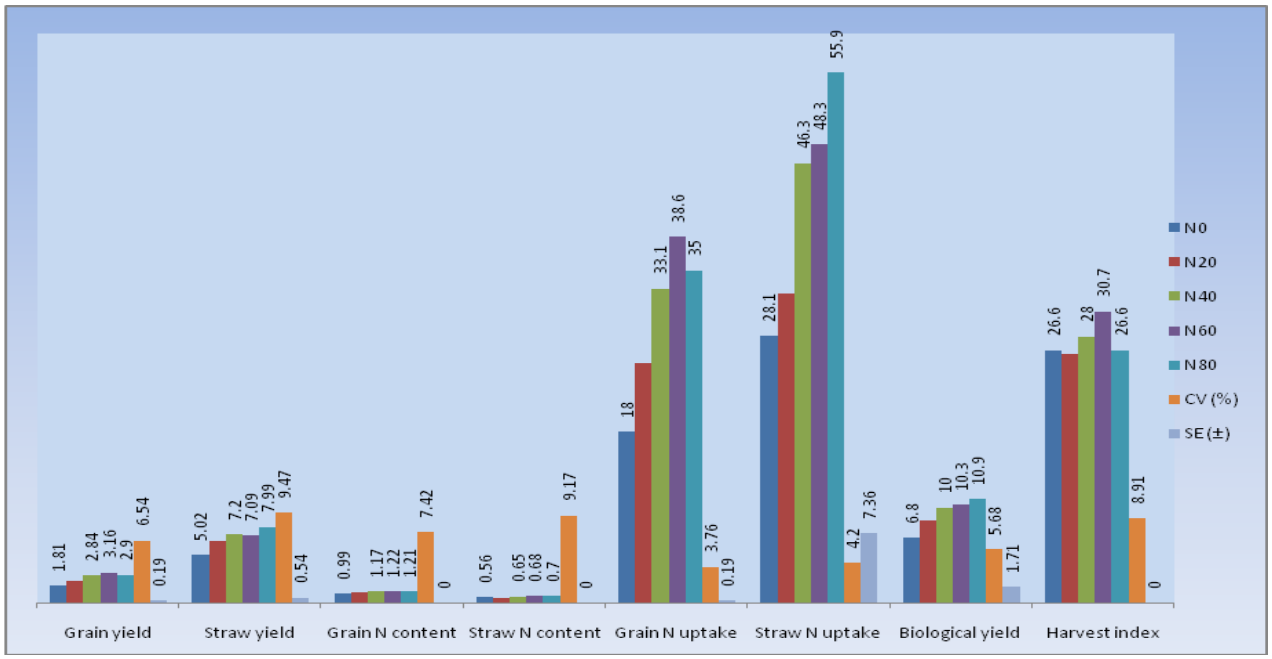

Fig. 2: Effects of N rates on harvest and qualitative characters of rice.

Interaction effect of variety and N rates

The interaction effect of variety and N rates on harvest and qualitative characters studies were highly significant except N content of rice. The interaction effect of variety and N on grain harvest was statistically significant (**Table 3**). The grain harvests of Kalizira rice ranged from 1.8 t ha^{-1} in N^0 treatment to 3.1 t ha^{-1} with 60 kg N ha^{-1} application. In Kalizira rice, the grain harvest increased progressively with increase in N application up to 60 kg N ha^{-1} and then decreased with the application of 80 kg N ha^{-1}. The grain harvest of Chinisagar rice varied from 1.8 t ha^{-1} when no N was applied and 3.2 t ha^{-1} with the application of 60 kg N ha^{-1}. The grain harvests of Chinisagar rice increased progressively with increase in N application up to 60 kg N ha^{-1} and then decreased with 80 kg N ha^{-1} application. The interaction effect of variety and N

(V×N) on straw harvest of rice was statistically significant (**Table 3**). In case of Kalijira rice, the straw harvest ranged from 5.1 t ha^{-1} without any N application to 8.3 t ha^{-1} when 80 kg N ha^{-1} was applied. In Chinisagar rice, the straw harvest varied from 4.9 t ha^{-1} when no N was applied 7.8 t ha^{-1} due to the application of 40 kg N ha^{-1}. The interaction effect of variety and N on biological harvest was significant (**Table 3**). The biological harvests of Kalijira rice ranged from 6.9 t ha^{-1} in N_0 treatment to 11.1 t ha^{-1} with 80 kg N ha^{-1} application. The inter-action effect of variety and N on the harvest index was statistically not significant (**Table 3**). In the case of Kalizira, the harvest index ranged from 24.9% in N_{20} to 31.3% when 60 kg N was applied. On the other hand in the case of Chinisagar rice, the highest harvest index was 30.5% without any N application and lowest was 26.7% when 60 kg N applied. The interaction effect of variety and nitrogen application had no significant effect on grain-N concentration (**Table 3**).

Table 3: Interaction effects of variety and N rates on harvest and qualitative characters of rice.

N rates	Grain harvest (t ha^{-1})	Straw harvest (t ha^{-1})	Grain N content (%)	Straw N content (%)	Grain N uptake (kg ha^{-1})	Straw N uptake (kg ha^{-1})	Biological harvest (t ha^{-1})	Harvest Index (%)
V_1N_0	1.83 c	5.10 bc	0.98	0.53	17.9 c	27.0 d	6.93 c	26.4 bc
V_1N_{20}	2.18 bc	6.54 b	1.12	0.46	24.4 bc	30.1 bcd	8.76 bc	24.9 c
V_1N_{40}	2.69abc	6.55 b	1.18	0.67	31.8 b	43.9 bc	9.27 b	29.1 ab
V_1N_{60}	3.15 a	6.80ab	1.23	0.65	38.7 a	44.2 bc	9.95 ab	31.3 a
V_1 N_{80}	2.81 bc	8.33 a	1.24	0.70	34.8 ab	58.3 a	11.1 a	25.2 bc
V_2N_0	1.879c	4.93 c	1.01	0.59	18.1 c	29.1 cd	6.72 c	26.7 bc
V_2N_{20}	2.38 bc	6.38 bc	1.09	0.55	25.9 bc	35.1 bc	8.76 b	27.3 b
V_2N_{40}	2.98 ab	7.84 a	1.15	0.62	34.3 ab	48.6 abc	10.8 a	27.8 b
V_2N_{60}	3.2 a	7.37 ab	1.21	0.71	38.5 a	52.4 ab	10.5 a	30.5 ab
V_2N_{80}	3.0 ab	7.65 a	1.18	0.70	35.2 ab	53.6 ab	10.6 a	28.3 b
CV (%)	6.54	21.5	7.42	9.17	9.40	8.66	5.68	8.91
SE (±)	0.26	0.92	NS	NS	0.63	0.34	1.70	2.09

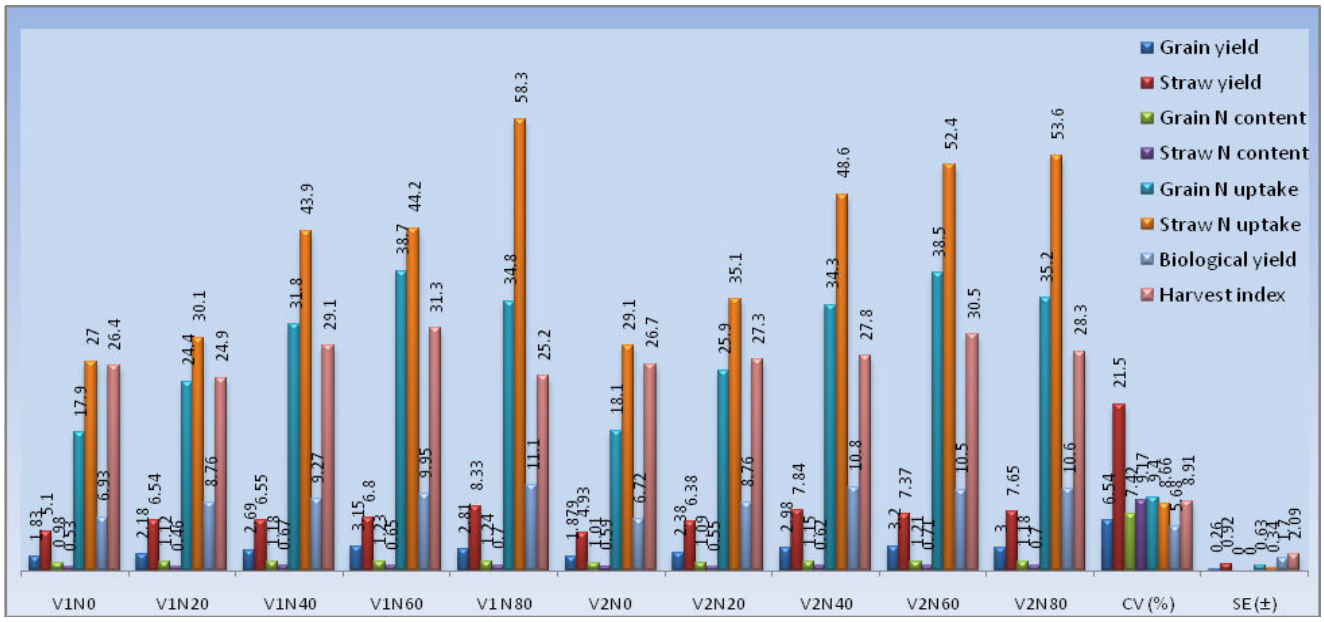

Fig. 3: Interaction effects of variety and N rates on harvest and qualitative characters of rice.

In Kalijira rice, the grain-N concentration ranged from 0.98 % in plot without any N application to 1.24 % with the application of 80 kg N ha^{-1} while in Chinisagar rice it varied from 1.01 % in N control treatment to 1.21 % due to application of 60 kg N ha^{-1}. A significant increase in N content in rice grain and straw due to the application of manures and fertilizers has been reported by many investigators (Verma, 1991; Jeong *et al*., 1996 and Azim, 1999). The inter-action effect of variety and nitrogen application on N uptake by rice grain as well as straw by plant was statistically significant (**Table 3**). In the case of Kalijira rice, the application of 80 kg N ha^{-1} produced significantly higher N uptake compared to that without N application. Similarly, in the case of Chinisagar, the significant grain N uptake was found only with the application of 60 kg N ha^{-1} over control treatment. Akinrinde, (2006) reported that the N application increased the N uptake by grain and straw.

CONCLUSION:

The variety Chinisagar showed higher grain, straw harvest, biological harvest and higher total N uptake com-pared to that of Kalijira variety. The results of the study indicated that N application significantly influenced the harvest and harvest contributing characters of both varieties. In both the varieties, the grain harvests obtained due to 40 and 60 kg N ha^{-1} application were statistically identical indicating that 40 kg N ha^{-1} may be optimum.

ACKNOWLEDGEMENTS:

The authors wishes to express his sincere and deep sense of appreciation to his honorable supervisor Dr. M. Rafiqul Islam and co-supervisor Dr. Md. Jahir uddin, both are Professor, Dept. of Soil Science, BAU for their invaluable guidance, constructive criticism, scholastic super vision and continuous encouragement throughout the period of experiment and preparations of this research work. With hearties gratitude feels proud to convey his sincere appreciation and profound felicitation to Mst. Mimmi Mizan, PhD Student Md. Saidur Islam (Shahin), Technician Ferdous Habib co-operation, analyzing the data, technical support, innovative suggestion and constant encouragement for the preparation of the research work.

CONFLICTS OF INTEREST:

The authors declare there are no potential conflicts of interest to publish it.

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