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EFFECT OF N LEVEL ON GROWTH AND YIELD OF T. AMAN RICE CV. SURJOMONI

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ABSTRACT

Siddique MA, Islam N, Islam MZ, Islam SMM, Hussain J (2014) Effect of N level on growth and yield of T. aman rice cv. Surjomoni. *Int. J. Sustain. Crop Prod.* 9(2), 33-37.

An experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, during July to December 2007 to observe the effect of nitrogen level on the yield performance of transplant aman rice cv. *Surjomoni*. Four spacing, 25×10, 25×15, 25×20 and 30×20 cm were compared at five nitrogen levels, 0, 45, 90, 135 and 180 kg N ha^{-1} in randomized complete block design. Nitrogen level significantly influenced yield contributing characters and yield except 1000-grain weight. The highest number of panicle $hill^{-1}$ (6.53), panicle length (28.65 cm), grains $panicle^{-1}$ (128.25), grain yield (5.77 t ha^{-1}), straw yield (8.80 t ha^{-1}) and harvest index (39.60%) were obtained with 90 kg N ha^{-1}. The maximum plant height (124.66 cm), tillers $hill^{-1}$ (8.88) and sterile spikelets $panicle^{-1}$ (39.83) were obtained with 180 kg N ha^{-1}. Rice yield responded quadratically to N application. The calculated maximum N dose was 78 kg ha^{-1} and optimum 73 kg ha^{-1}. The response of rice to applied N (agronomic efficiency) varied from 24.67 kg grain/kg N at 45 kg N ha^{-1} to 4.5 kg kg^{-1} at the highest N rate (180 kg N ha^{-1}).

Key words: *N level, growth, yield, surjomoni, transplant aman*

INTRODUCTION

Nitrogen is one of the most yield-limiting nutrients for rice production, and proper nitrogen fertilizer management is critical for high yield. In rice research, more time and energy are devoted to managing nitrogen fertilizer than any other nutrient because of the high potential for a return on the fertilizer investment. Rice yield may be increased by 70-80 percent through proper utilization of nitrogen fertilizer (IFC 1982). Earlier studies reveal that judicious and proper use of fertilizers can markedly increase the yield and improve the quality of rice (Place *et al.* 1970). Given the importance of nitrogen fertilization on the yield in grain from the rice plant, it is necessary to know the best dose is for each variety as well as its influence on components of yield and other agronomic parameters. The height of a rice plant is positively correlated to the length of the maturation cycle. A taller plant is more susceptible to lodging and responds less well to nitrogen (Yoshida 1978). Panicles with a low percentage of sterile flowers permit the application of higher doses of nitrogen and produce better yields (Yoshida 1981). Some factors, like early sowing, meet the twin objectives of producing higher yields and improving the grain quality. Other factors, like increased rates of fertilizer nitrogen, may increase the yield but reduce the quality of the grain (Corny 1995). On the other hand, deficiency of nitrogen hampers the yield of rice. An adequate supply of nitrogen to the crop plants during their early growth period is very important for the initiation of leaves and florets primordia (Tisdale and Nelson, 1984). *Surjomoni* is a locally improved and high yielding T. aman rice variety widely grown in Bangladesh. Therefore, more investigations are needed to determine the optimum dose of nitrogen for *Surjomoni*. The present study was undertaken during *aman* season of 2007 to find out the optimum nitrogen level on the yield performance of *Surjomoni* during transplant *aman* season.

MATERIALS AND METHODS

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during *aman* season, 2007. The treatments were four plant spacing namely, 25×10 cm (S_1), 25×15 cm (S_2), 25×20 cm (S_3) and 30×20 cm (S_4) and five nitrogen levels, 0 (N_0), 45 (N_1), 90 (N_2), 135 (N_3) and 180 kg N ha^{-1}(N_4). The 5×4 factorial experiment was laid out in a randomized complete block (RCB) design, each treatment had three replications. The unit plot size was 5 m^2 (2.5 m×2.0 m) and the space between the blocks and unit plots were 1.0 m and 0.75 m, respectively. At the time of final land preparation 80 kg triple supper phosphate (TSP), 120 kg muriate of potash (MP), 55 kg gypsum and 10 kg zinc sulphate per ha were applied. Nitrogen from urea was top dressed in three equal splits at 15, 30 and 45 days after transplanting (DAT) as per specification of the treatments. Thirty- day- old seedlings were transplanted at the rate of 2-3 seedlings $hill^{-1}$ on the well puddle plots on 6^{th} August 2007 maintaining four different spacing as per experimental specification. Appropriate plant protection measures and cultural management practices were followed throughout the growing period. Five hills in each plot excluding border rows were randomly selected and tagged prior to harvesting for collection of data on plant characters and yield components. The net plots area was harvested and sun-dried for 5 days in the field and the total biomass yield was recorded. After threshing, cleaning and drying the grain and straw yields were recorded and the yield attributes were recorded from plant samples. Straw yield was obtained by subtracting grain yield from total biomass yield. The grain yield was adjusted to 14% moisture content. The maximum (N_{max}) and the economic optimum (N_{opt}) amount of N required to produce rice grain was calculated in the following way (Gomez and Gomez, 1984):

$$N_{max} = -b/2c \quad [1]$$

$$N_{opt} = 1/2c\,(P_f/P_y - b) \quad [2]$$

where, P_f and P_y are prices of applied N kg^{-1} and rice grain t^{-1} ($0.38 and 200, respectively) and b and c are the estimates of the regression co-efficient in $y = a+bN+cN^2$, the form of the observed relationship between grain yield and applied N. Agronomic use efficiency (AUE) was estimated as AUE= (Yn-Yo)/N; Where, Yn= Yield in N applied plot (kg ha^{-1}), Yo= Yield in without N applied plot (kg ha^{-1}) and N= Applied N (kg ha^{-1}). Data for different parameters were compiled and tabulated in appropriate form for statistical analysis.

Data were analyzed using the analysis of variance (ANOVA) technique and the mean differences among the treatments were adjudged with Duncan's Multiple Range test using a computer package program MSTAT-C.

RESULTS AND DISCUSSION

Nitrogen level significantly influenced yield contributing characters and yield except 1000-grain weight ($p<0.01$). Application of N fertilizers had significant effect on plant height at maturity. The maximum plant height (124.66 cm) was observed in 180 kg N ha^{-1} which was statistically similar to those in 135 kg N ha^{-1} (124.40 cm), 90 kg N ha^{-1} (124.40 cm) and 45 kg N ha^{-1} (123.21 cm). The lowest plant height (115.24 cm) was obtained in control treatment (N_0). Plant height increased with the increase in nitrogen level. The increase in plant height in response to application of increased level of nitrogen is probably due to enhanced availability of nitrogen which enhanced more leaf area resulting in higher photo assimilates and thereby resulted in more dry matter accumulation. These results are supported by the findings of Mandal *et al*. (1992).

A significant variation in number of tillers hill^{-1} was recorded due to nitrogen level. Increasing nitrogen level progressively increased the number of tillers hill^{-1}. The maximum number of tillers hill^{-1} (8.88) was obtained in 135 kg N ha^{-1} which was statistically similar to 90 kg N ha^{-1} (8.78) and 180 kg N ha^{-1} (8.82). The minimum number of total tillers hill^{-1} (7.27) was counted from control (0 kg N ha^{-1}). The progressive improvement in the formation of tillers with increased nitrogen level might be due to increased availability of nitrogen that played a vital role in cell division. These results are full compliance with those of Dixit and Singh (1980) and Nossai and Vargas (1982), who recorded increased number of tillers hill^{-1} with increased nitrogen levels.

Table 1. Effect of nitrogen levels on growth characters of *Surjomoni* rice variety

Nitrogen (Kg ha^{-1})	Plant height (cm)	Tillers hill^{-1} (no.)
0 (N_0)	115.24 b	7.27 c
45 (N_1)	123.21 a	7.92 b
90 (N_2)	124.40 a	8.78 a
135 (N_3)	124.40 a	8.82 a
180 (N_4)	124.66 a	8.88 a
CV (%)	3.00	9.21

Means with the same letters in the same column do not differ significantly at $P>0.05$

Application of N fertilizers had significant effect on the production of panicle no. hill^{-1}. The highest number of panicle hill^{-1} (6.53) was produced with 90 kg N ha^{-1} which was statistically similar to produced with 135 kg N ha^{-1} (6.51) and 180 kg N ha^{-1} (6.28). The lowest number of panicle hill^{-1} (5.48) was obtained from control treatment. Adequacy of nitrogen at 90 kg N ha^{-1} probably favored the proper cellular activities during panicle formation and development which led to increase the number of panicle hill^{-1}.

Nitrogen level had significant effect on the panicle length. The plant received no applied nitrogen fertilizer produced the shortest panicle. The longest panicle (28.64 cm) was found from 90 kg N ha^{-1} which was statistically similar to 45 kg N ha^{-1} (28.01 cm), 135 kg N ha^{-1} (28.32 cm) and 180 kg N ha^{-1} (28.48 cm). These results are supported by the results of Sharma and Mishra (1986).

Table 2. Effect of nitrogen levels on panicle characters of *Surjomoni* rice variety

Nitrogen (Kg ha^{-1})	Panicle hill^{-1}(no.)	Panicle length (cm)
0 (N_0)	5.48 b	25.32 b
45 (N_1)	6.07 a	28.01 a
90 (N_2)	6.53 a	28.65 a
135 (N_3)	6.52 a	28.32 a
180 (N_4)	6.28 a	28.48 a
CV (%)	10.36	3.22

Means with the same letters in the same column do not differ significantly at $P>0.05$

Application of N fertilizers significantly increased the number of grains panicle^{-1}. The number of grains panicle^{-1} against various level of N reveal that 90 kg N ha^{-1} produced maximum number of grains panicle^{-1} (128.24) which was statistically similar to 45 kg N ha^{-1} (127.39), 135 kg N ha^{-1} (123.58) and 180 kg N ha^{-1} (122.37) and the lowest number of grains panicle^{-1} (106.38) was obtained from control treatment (0 kg N ha^{-1}). The results are in agreement with the results of Chopra and Chopra (2000).

Nitrogen level had significant effect on the production of number of sterile spikelets panicle^{-1}. The maximum number of sterile spikelets panicle^{-1}(39.82) was produced at 180 kg N ha^{-1} and the minimum (29.16) at 0 kg N ha^{-1}. The results showed that number of sterile spikelets panicle^{-1} gradually increased with level of nitrogen. Higher level of nitrogen was probably a case of over dose in respect of sterile spikelets panicle^{-1} which might lead to yield loss.

Application of nitrogen had no significant effect on 1000-grain weight. 1000-grain weight ranged from 26.74 to 26.92 g among the nitrogen levels. Grain weight is a genetically controlled trait, which is greatly influenced by environment during the process of grain filling (Kausar *et al.* 1993).

Table 3. Effect of nitrogen levels on yield contributing characters of *Surjomoni* rice variety

Nitrogen (Kg ha^{-1})	Grains $panicle^{-1}$ (no.)	Sterile spikelets $panicle^{-1}$ (no.)	1000-grain weight (g)
0 (N_0)	106.38 b	29.16 d	26.85
45 (N_1)	127.39 a	33.29 c	26.92
90 (N_2)	128.25 a	36.98 b	26.78
135 (N_3)	123.59 a	35.55 b	26.88
180 (N_4)	122.37 a	39.83 a	26.74
CV (%)	9.18	7.28	2.39

Means with the same letters in the same column do not differ significantly at P>0.05

Nitrogen levels significantly influenced the grain yield. The highest grain yield (5.77 t ha^{-1}) was obtained when the crop was fertilized with 90 kg N ha^{-1} and the lowest grain yield (4.02 t ha^{-1}) in 0 kg N ha^{-1}. There was an increasing trend in grain yield with an increase in levels of nitrogen up to 90 kg N ha^{-1}. However, with further increase in nitrogen application there was a decrease in grain yield. Development of yield components such as number of tillers $hill^{-1}$, panicle $hill^{-1}$ and grains $panicle^{-1}$ are favored in 90 kg N ha^{-1} which ultimately contributed for highest grain yield in *Surjomoni* rice variety. A regression analysis showed that rice responded quadratically to N application in terms of grain yield (Fig. 1). The quadratic functional relationship between N application and grain yield was significant with a coefficient of determination of 0.9679. The predicted maximum dose and economic dose of N calculated from the response equations (Fig. 1) showed that the predicted maximum dose was 78 kg ha^{-1} and economic optimum dose was 73 kg ha^{-1}.

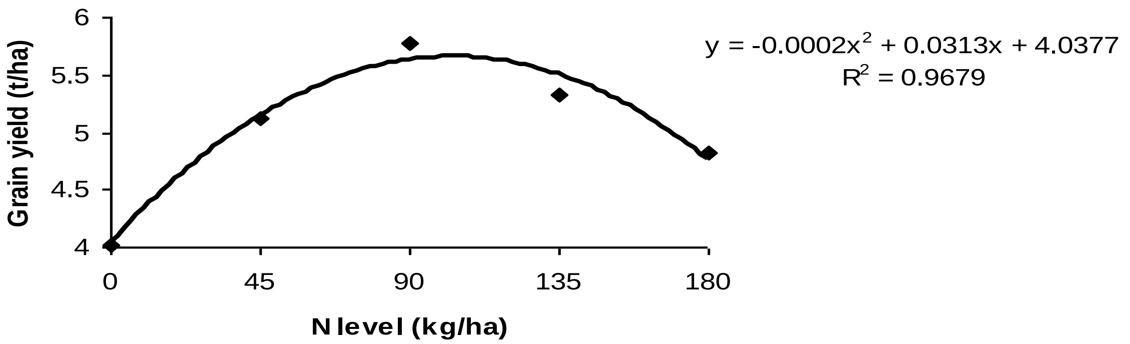

Fig.1 Relationship between N level and grain yield in rice (cv. Surjomoni)

Application of N fertilizer increased straw yield up to 180 kg N ha^{-1} but beyond 90 kg N ha^{-1} application was not significant. The highest straw yield (8.8 t ha^{-1}) was obtained in 90 kg N ha^{-1} while the lowest straw yield (5.62 t ha^{-1}) was produced in control treatment (N_0). Higher straw yield in higher nitrogen might be due to tremendous effect of nitrogen on vegetative growth specially the plant height and number of tillers $hill^{-1}$ which contributed the highest production of straw yield per hectare. Similar results of straw yield was also reported by Chopra and Chopra (2000). The quadratic functional relationship between N application and straw yield was significant with a coefficient of determination of 0.9516 (Fig. 2).

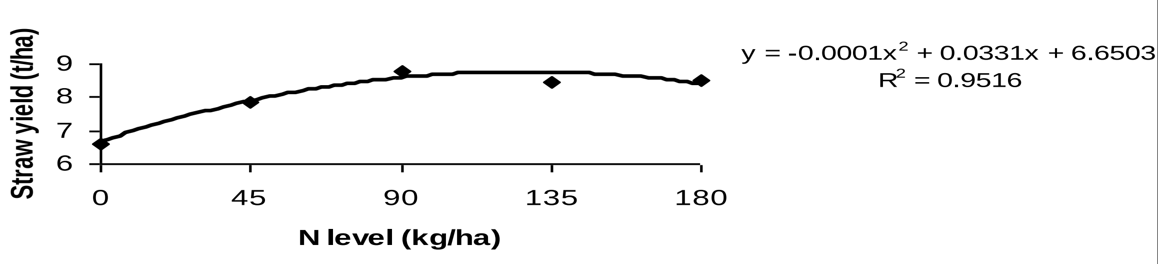

Fig. 2 Relationship between N level and straw yield in rice (cv.Surjomoni)

Harvest index of rice increased consistently with an increase in the N fertilizer. The highest harvest index (39.60%) was recorded with the application of 90 kg N ha^{-1} which was statistically similar to 45 kg N ha^{-1} (39.49%) and the lowest (36.00%) with 180 kg N ha^{-1}. The quadratic functional relationship between N application and harvest index was significant with a coefficient of determination of 0.9976 (Fig. 3).

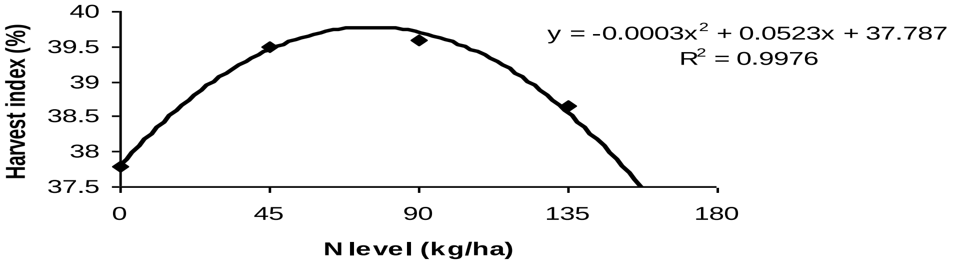

Fig. 3 Relationship between N level and Harvest index in rice (cv. Surjomoni)

Table 4. Effect of nitrogen levels on Agronomic efficiency of *Surjomoni* rice variety

Nitrogen (Kg ha^{-1})	Agronomic efficiency (kg grain/kg N)
0 (N_0)	-
45 (N_1)	24.67
90 (N_2)	19.44
135 (N_3)	9.70
180 (N_4)	4.5

The response of rice to applied N (agronomic efficiency) varied from 24.67 kg grain/kg N at 45 kg N ha^{-1} to 4.5 kg kg^{-1} at the highest N rate (180 kg N ha^{-1}). As the rate of N application was increased, the N use efficiency decreased. Fageria *et al*. (1997) reported that the highest efficiency is achieved with the first increment of fertilizer.

CONCLUSION

The study reveals that the maximum and economic optimum N doses for the maximum grain yield of *Surjomoni* rice variety are 78 and 73 kg ha^{-1}, respectively.

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