INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2001/03–1–61–63
http://www.ijab.org

Effect of Various Levels and Methods of Nitrogen Application on Nitrogen Use Efficiency in Rice Supper Basmati

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ABSTRACT

A field experiment was carried out to determine the effect of various methods of nitrogen application for increasing nitrogen use efficiency in fine rice (*Oryza sativa* L.) using cv. Supper Basmati. The application of 100 kg N ha^{-1} showed maximum number of tillers per hill and 75 kg N ha^{-1} showed minimum tillers per hill. Similarly, application of nitrogen by incorporating in between hill in wrapped tissue paper produced more tillers $hill^{-1}$ than other treatments and the differences were significant. The nitrogen level of 125 kg N ha^{-1} when incorporated in between hills in wrapped tissue paper (T_4) produced maximum number of grains/panicle (96.97). Both nitrogen levels and method of application significantly affected the 1000-grain weight and harvest index as well. Maximum straw yield was obtained from 125 kg N ha^{-1} (N_3) and T_4 treatment (incorporated in between hills in wrapped tissue paper). The application of 125 kg N ha^{-1} when incorporated in between hills in wrapped tissue paper (T_4) gave maximum paddy yield.

Key Words: Nitrogen application; Rice; Basmati

INTRODUCTION

Rice (*Oryza sativa* L.) is an important food crop of the world. Average yield of fine rice is much below from its production potential. There are a number of factors contributing to this yield gap and proper application of an optimum dose of fertilizers is one of the important factors. Since fertilizer is an expensive and precious input, so determination of an appropriate dose and method of application would reduce the cost of production and enhance the productivity, and consequently increase the profits of the grower under given situations. Among macro-nutrients, nitrogen plays a vital role in the growth and consequently the yield of crops. Apart from being a part of proteins, N is essential component of chlorophyll, a chemical crucial for life sustaining process, photosynthesis.

Submergence/flooding is necessary for rice, which has an edge over conditions for upland crops in having relatively uniform root environment and in controlling weed infestation but special nutrient management practices (especially for N) are required for promising yields. Method, dose and time of application of fertilizers are vital for securing higher yields (Oh *et al*., 1990; Sahoo *et al*., 1990; Irshad, 1996). The present study was, therefore, designed to investigate the effect of different nitrogen levels and application methods to increase nitrogen-use efficiency in fine rice (cv. Supper Basmati) under Faisalabad conditions.

MATERIALS AND METHODS

A field experiment was carried out to determine the effect of various methods of nitrogen application for increasing nitrogen use efficiency in fine rice (*Oryza sativa* L.) using cv. Supper Basmati. The experiment was laid out in a RCBD with split plot arrangement at the Post Graduate Agricultural Research Station, University of Agriculture, Faisalabad. The main plot treatments comprised three levels of nitrogen, i.e. 75, 100 and 125 kg ha^{-1} while the sub plot treatments were; five different methods of nitrogen application, i.e broadcast - mixed in dry soil, broadcast - incorporated in puddled soils, incorporated in between hills in mud balls, incorporated in between hills in wrapped tissue paper and band placement with hand drill at 8 cm depth. The soil was analysed for NPK at the time of seed bed preparation on 20th July, 1998. The crop was planted by transplanting nursery at plant to plant and row to row distance of 25 cm. Phosphorus and potassium fertilizers were applied @ 67 kg ha^{-1} and 62 kg ha^{-1}, respectively. In first two treatments (T_1 and T_2) nitrogen was applied before transplanting while in other three treatments (T_3, T_4 and T_5) full dose of nitrogen was applied after seven days of transplanting. All other agronomic practices/operations except those under study were kept normal and uniform for all the treatments. The crop was harvested on 10th November, 1998. The following observations were recorded during the course of experimentation.

Standard procedures were adopted for recording the data on various growth and yield parameters. Fisher's Analysis of Variance technique and L.S.D. method were applied for testing the significance of differences among treatment means (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Number of tillers hill^{-1}. Various levels of nitrogen gave significant differences in producing number of tillers hill^{-1}. Maximum tillers per hill (16.31) were produced by N_2 treatment (100 kg N ha^{-1}) which was statistically similar to N_3 treatment (125 kg N ha^{-1}) producing 15.89 tillers per hill. The N_1 treatment (75 kg N ha^{-1}) produced the minimum number of tillers hill^{-1} (14.17). Similarly, different methods of nitrogen application influenced number of tillers per hill. The treatment T_4 (N incorporated in between hills in wrapped tissue paper) produced maximum (19.19) tillers, followed by T_3 (incorporated in between hills in mud balls) producing 17.00 tillers per hill. The treatment T_1 (broadcast - mixed in dry soil) and T_2 (broadcast - incorporated in puddled soils) produced statistically similar number of tillers per hill, i.e. 14.21 and 14.17 tiller hill^{-1}. The minimum number of tillers per hill were produced with T_5 (band placement with hand drill at 8 cm depth) producing 12.72 tillers per hill. The lesser number of tillers recorded in rest of the treatments may be due to insufficient nitrogen supply which depressed the plant growth and per hill tillers (Khan & Vergara, 1981; Oh *et al*., 1990)

Number of grains per panicle. Nitrogen @ 125 kg ha^{-1} (N_3) produced maximum number of grains per panicle (87.55) followed by the treatments N_2 (100 kg N ha^{-1}) and N_1 (75 kg N ha^{-1}) producing 83.45 and 75.70 grains per panicle, respectively. Application methods also affected number of grains per panicle significantly. The treatment T_4 produced the maximum number of grains per panicle followed by T_5, producing 90.68 and 84.28 grains/panicle respectively. The minimum number of grains per panicle were achieved from T_1 i.e. 76.11 grains per panicle. Interaction between nitrogen levels and application methods was also found significant. The maximum number of grains per panicle (96.96) was recorded in N_3 x T_4 treatment.

1000-grain weight. The nitrogen level of 125 kg N ha^{-1} (N_3) gave the highest 1000-grain weight (17.65g), N_1 (75 kg ha^{-1}) plots gave the lowest 1000-grain weight of 16.07 g and plots fertilized @ 100 kg N ha^{-1} had a weight of 16.87 g. The application of nitrogen as incorporated in between hills in wrapped tissue paper (T_4) produced the highest grain weight followed by T_3, T_1 and T_2 which gave a weight of 17.40 g, 16.60 g and 16.23 g, respectively. The interaction between nitrogen levels and application methods was found to be non-significant, suggesting the independence of treatment factors affecting 1000-grain weight.

Grain yield. The minimum yield of 4.29 t ha^{-1} was obtained at the minimum nitrogen level 75 kg N ha^{-1} (N_1). The maximum yield of 4.72 t ha^{-1} was obtained at 125 kg N ha^{-1} (N_3) followed by N_2 (100 kg N ha^{-1}) giving yield of 4.58 t ha^{-1}. Grain yield is a complex character and each of the yield components contributes towards the character. In the present case an increase in tillers hill^{-1}, number of grains per panicle and 1000-grain weight at increasing levels of nitrogen contributed positively towards final grain yield and consequently similar pattern of increase was observed for the character in response to nitrogen treatments. The treatment T_4 (incorporated in

Table I. Effect of various levels and methods of nitrogen application on yield and yield components of rice

	Number of tillers hill^{-1}	Number of grains panicle^{-1}	1000-grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
Nitrogen level						
75 kg N ha^{-1} (N_1)	14.16b	75.70c	16.07c	4.29c	11.91b	26.61a
100 kg N ha^{-1} (N_2)	16.31a	83.45b	16.87b	4.57b	14.93a	23.66b
125 kg N ha^{-1} (N_3)	15.89a	87.55a	17.65a	4.71a	14.80a	24.33b
Significance	**	**	**	**	**	**
Application methods						
T_1 (Broadcast – mixed in dry soil)	14.21c	76.11d	16.60c	4.39b	13.00c	25.40a
T_2 (broadcast - incorporated in puddled soils)	14.17c	79.57c	16.23cd	4.29bc	12.95c	25.24a
T_3 (incorporated in between hills in mud balls)	17.00b	80.51c	17.40b	4.79a	14.38b	25.11a
T_4 (incorporated in between hills in wrapped tissue paper)	19.19a	90.68a	18.01a	4.92a	16.10a	23.51a
T_5 (band placement with hand drill at 8 cm depth)	12.72d	84.28b	16.07d	4.23c	12.95c	24.07a
Significance	**	**	**	**	**	*
Interaction	NS	**	NS	**	**	NS

*Significant; **Highly significant; NS: Non significant

Two means not sharing a single letter in common, differ significantly

between hills in wrapped tissue paper) resulted in high grain yield (4.92 t ha^{-1}) which was statistically at par with T_3 (incorporated in between hills in mud balls) producing 4.79 t ha^{-1} grain yield. While the treatment T_5 (band placement with hand drill at 8 cm depth) produced minimum grain yield of 4.24 t ha^{-1}. Interaction between nitrogen level and application methods was found significant. The maximum grain yield was obtained at a combination of N_2 (100 kg N ha^{-1}) x T_4 (incorporated in between hills in wrapped tissue paper) which gave 4.16 t ha^{-1} of grain yield. Application of nitrogen at later stages i.e. panicle emergence does not play a significant role in improving the grain yield. Similar results were reported by Sahoo *et al*. (1990).

Straw yield. The minimum straw yield of 11.92 t ha^{-1} was produced by the treatment N_1 (75 kg N ha^{-1}). The maximum straw yield was obtained in N_2 (100 kg N ha^{-1}) producing 14.93 t ha^{-1} which was statistically similar to the treatment N_3 (125 kg N ha^{-1}) which produced 14.80 t ha^{-1} straw yield. This may be attributed to increase in vegetative growth, number of tillers $hill^{-1}$, and plant height. Among application methods T_4 (incorporated in between hills in wrapped tissue paper) gave higher straw yield (16.11 t ha^{-1}) than rest of the treatments. The interaction between nitrogen levels and application methods was significant, suggesting varying effect of nitrogen levels with different application methods. These results are quite in agreement with those reported by Patel and Mishra (1994) and Irshad (1996).

Harvest index (%). The treatment N_1 (75 kg N ha^{-1}) have the maximum harvest index (26.61%) followed by N_3 (125 kg N ha^{-1}) and N_2 (100 kg N ha^{-1}) having statistically similar harvest index value of 24.33% and 23.66% respectively. Significant differences were observed between the application methods for their effect on harvest index. The interaction between the two factors was found to be non-significant.

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(Received 10 September 2000; Accepted 20 November 2000)