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EFFECT OF NURSERY TRANSPLANTING TECHNIQUES AND NITROGEN LEVELS ON GROWTH AND YIELD OF FINE RICE (BASMATI-2000)

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An experiment was conducted with two factors (A) Planting methods viz. P_1 – Manual transplanting, P_2 – Parachute technology (B) Nitrogen levels viz. N_0 (control), N_1 (25 kg ha^{-1}), N_2 (50 kg ha^{-1}), N_3 (75 kg ha^{-1}), N_4 (100 kg ha^{-1}), N_5 (125 kg ha^{-1}) and N_6 (150 kg ha^{-1}). Plant height was significantly affected by different N levels. The N_6 treatment (150 kg N ha^{-1}) resulted in maximum plant height (116.55 cm) that is statistically similar with that of N_5 treatment (125 kg N ha^{-1}) but differs significantly from N_4 (100 kg N ha^{-1}), N_3 (75 kg N ha^{-1}) and N_2 (50 kg N ha^{-1}) showing the plant heights of 111.8 cm, 106.9 cm and 100.3 cm respectively. N_5 treatment produced maximum number of productive tillers m^{-2} (184.27). Maximum leaf area index (5.17) was obtained in N_5. Maximum number of spikelets $panicle^{-1}$ (118.85) was obtained in N_6 treatment. Maximum percentage of normal kernels (84.45%) was obtained in N_5 Maximum 1000-kernel weight (21.87 g) was obtained in N_5. Maximum paddy yield (5.15 t ha^{-1}) was obtained in N_5. Minimum. paddy yield (2.75 t ha^{-1}) was obtained by N_0. Straw yield was maximum (11.00 t ha^{-1}) in case of N_6. Maximum harvest index (31.97%) was recorded by N_5. Both nursery-transplanting techniques behaved similarly.

Key words: Manual transplanting; nitrogen levels; parachute technology; rice

INTRODUCTION

Rice (*Oryza sativa* L.) is an important cereal crop and is the staple food of majority of the peoples of the world. It is especially important in Asia, where more than 90% of the world's rice is grown and consumed, and where more than half of the world's people live. Conventionally nursery is transplanted manually and the shortage of labour at transplanting delays the sowing. Moreover, plant population is not maintained by the hired labour. Hence manual transplanting results in yield reductions due to low plant population. In many parts of the world alternative methods of seedling transplanting are being practiced. One of these is parachute technology. Because of rising labour cost and shorter turn around time in rice-wheat cropping system, the so-called "light rice cultivation" such as parachute technology for rice plant establishment, has been adopted in some rice growing regions in China. Parachute technology has developed rapidly in recent years because of its significant advantages, as well as the use of low-cost soft polyvinyl chloride (PVC) trays for growing seedlings (MOA, 1997; Cheng, 2000).

Nitrogen is most important nutrient for rice plant as it is required at much higher rates than other macronutrients such as phosphorus and potash. Increasing rate of nitrogen application significantly increases both paddy yield and total dry matter (TDM) yield over control or lower rate of nitrogen application (Maqsood 1998). Application of 130-67-67 kg NPK ha^{-1} and N in three splits to Basmati-385 results in higher kernel yield with a higher percentage of kernel filling and normal kernels due to considerable reduction in sterility, abortiveness and chalkiness (Asif *et al.* 1999). The present study was, therefore, designed to evaluate the advantages of parachute technology (if any) in comparison with the manual transplanting and to find out the optimum level of nitrogen application in order to have high quality rice production under Faisalabad conditions.

MATERIALS AND METHODS

The experiment to examine the effect of different nursery transplanting techniques and nitrogen levels on growth and yield of fine rice (Basmati-2000), was conducted at Agronomic Research Area, University of Agriculture, Faisalabad, during "Kharif" season 2002. The experiment was laid out in a randomized complete block design (RCBD) with split plot arrangement with three replications. Net plot size was 2m x 3m. The experiment comprised of following treatments:- A). Planting methods (main plot) viz. P_1 = Manual transplanting and P_2 = Parachute technology, B). Nitrogen levels kg ha^{-1} (sub-plots) viz. $N_0 = 0$, $N_1 = 25$, $N_2 = 50$, $N_3 = 75$, $N_4 = 100$, $N_5 = 125$ and $N_6 = 150$ kg N ha^{-1} For manual transplanting nursery was sown by wet bed method on 25th May, 2002. For parachute technology, nursery was sown in polyvinyl chloride (PVC) trays on 30th May, 2002. Seed rate was 12.5 kg ha^{-1} for both of the nurseries.

Seed bed was prepared thoroughly and puddling was done manually to transplant the crop. The crop was transplanted in first week of July, 2002. For manual transplanting, row to row distance was 25 cm and plant to plant distance was 20 cm. For parachute technology, plants were thrown freely into the field @ 500 trays ha^{-1} (each tray having 400 plants). Phosphate fertilizer was applied @ 60 kg ha^{-1}. The whole of phosphorus along with half of nitrogen in the form of di-ammonium phosphate (130 kg ha^{-1}) and urea, respectively, were applied at transplanting. The remaining half of nitrogen was applied 35 days after transplanting in the form of urea. Weeding was done manually during the vegetative growth period of the crop. All the other agronomic practices were kept normal and uniform. The crop was harvested in first week of November.

The data were analyzed using Fisher's Analysis of Variance Technique (Steel and Torrie, 1984). Duncan's New Multiple Range (DNMR) test at 5% probability was used to compare the differences among treatments' means (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Plant height (cm)

Data pertaining to the final plant height of the crop are presented in table 1. It is revealed from the data that nursery transplanting techniques did not affect plant height significantly. However, more plant height (106.20 cm) was obtained from P_1 (manual transplanting) than P_2 (parachute technology) showing plant height of 105.49 cm. It is also revealed from the data that final plant height was significantly affected by different N levels. The N_6 treatment (150 kg N ha^{-1}) resulted in maximum plant height (116.55 cm) that is statistically similar with that of N_5 treatment (125 kg N ha^{-1}) but differs significantly from N_4 (100 kg N ha^{-1}), N_3 (75 kg N ha^{-1}) and N_2 (50 kg N ha^{-1}) showing the plant heights of 111.8 cm, 106.9 cm and 100.3 cm respectively. N_0 treatment (control) produced minimum plant height (93.75 cm) which is statistically similar with plant height (95.50 cm) produced by N_1 (25 kg N ha^{-1}). Maximum plant height in case of N_6 might be due to adequate availability of N which is essential for maximum growth of the plant. Minimum plant height in case of N_0 was due to unavailability of N which is required for optimum metabolism and growth of plant. However, this level will differ in different situations according to fertility level of particular soil and genetic characteristics of a variety. These findings are in conformity with those obtained by Awan *et al.* (1984), Singh and Sharma (1987).

Number of productive tillers m^{-2}

Data indicate that nursery transplanting techniques did not affect number of productive tillers m^{-2} significantly. It is also revealed from the data that the effect of N levels on the number of productive tillers m^{-2} is highly significant. The maximum number of productive tillers m^{-2} (184.3) were produced by N_5 (125 kg N ha^{-1}) which are statistically similar (183.8) with those of N_6 (150 kg N ha^{-1}). N_6 and N_5 are followed by N_4 (100 kg N ha^{-1}), N_3 (75 kg N ha^{-1}), N_2 (50 kg N ha^{-1}) and N_1 (25 kg N ha^{-1}) producing 176.38, 172.05, 163.5 and 156.66 productive tillers m^{-2} respectively. N_1 (25 kg N ha^{-1}) is followed by N_0 (control) producing minimum number of productive tillers m^{-2} (138.8). The increase in number of productive tillers m^{-2} with increase in N level is due to increased vegetative growth and translocation of

Table 1. Yield and yield components of rice as affected by different nursery transplanting techniques and nitrogen levels.

Planting methods	Final plant height (cm)	No. of productive tillers m^{-2}	LAI	No. of spikelets/ panicle	Normal kernels (%)	1000-kernel weight (g)	Paddy yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
P_1	106.20	168.09	3.66	104.57	81.76	19.80	4.00	8.82	31.01
P_2	105.49	167.76	3.52	104.72	81.74	19.91	3.99	8.83	30.90
N_0 Nitrogen levels	93.75 e	138.83 f	1.71 f	90.14 e	79.38 f	18.17 e	2.75 e	6.87 e	28.55 b
N_1	95.50 e	156.66 e	2.81 e	95.30 d	80.08 e	18.54 de	3.17 d	7.30 d	30.27 ab
N_2	100.35 d	163.50 d	3.05 e	99.65 c	80.65 d	19.08 cd	3.60 c	8.13 c	30.64 a
N_3	106.95 c	172.05 c	3.44 d	102.65 c	81.54 c	19.78 bc	3.90 c	8.29 c	31.91 a
N_4	111.75 b	176.38 b	4.08 c	107.10 b	83.09 b	19.91 b	4.35 b	9.26 b	31.94 a
N_5	116.05 a	184.27 a	5.17 a	118.80 a	84.45 a	21.87 a	5.15 a	10.93 a	31.97 a
N_6	116.55 a	183.77 a	4.85 b	118.85 a	83.07 b	21.63 a	5.05 a	11.00 a	31.43 a
LSD values	1.90	1.99	0.29	3.26	0.44	0.73	0.38	0.16	1.82

photosynthates into the panicles during reproductive growth stage and also due to maintenance of soil fertility. These results are in accordance with Maqsood *et al.* (1997).

The data given in table 1 reveal that the effect of nursery transplanting techniques on leaf area index was non-significant. However, more LAI (3.66) was obtained from P_1 (manual transplanting) than (3.52) P_2 (parachute technology). It is also clear from the data that the effect of different N levels on leaf area index is highly significant. The maximum leaf area index (5.170) was observed from N_5 (125 kg N ha^{-1}), which is followed by N_6 (150 kg N ha^{-1}), N_4 (100 kg N ha^{-1}), N_3 (75 kg N ha^{-1}), N_2 (50 kg N ha^{-1}) and N_1 (25 kg N ha^{-1}) showing LAI values 4.85, 4.08, 3.44, 3.05 and 2.81 respectively. The minimum LAI (1.70) was produced from N_0 (control). The increase in LAI with increasing levels of N might be due to more leaf canopy development with increasing vegetative growth. These results are in agreement with those reported by Maqsood (1998).

Number of spikelets panicle^{-1}

Data regarding the number of spikelets panicle^{-1} are given in table 1. Data reveal that nursery transplanting techniques did not significantly affect the number of spikelets panicle^{-1}. It is also clear from the data that the effect of N levels on number of spikelets panicle^{-1} is highly significant. Maximum and same number of spikelets panicle^{-1} (118.8) was obtained from N_5 (125 kg N ha^{-1}) and N_6 (150 kg N ha^{-1}). These treatments were followed by N_4 (100 kg N ha^{-1}), N_3 (75 kg N ha^{-1}), N_2 (50 kg N ha^{-1}) and N_1 (25 kg N ha^{-1}) producing 107.10, 102.65, 99.65 and 95.30 spikelets panicle^{-1}, respectively. Minimum number of spikelets panicle^{-1} (90.14) was obtained from N_0 (control). The increase in number of spikelets panicle^{-1} with increasing levels of N might be the result of better reproductive growth at optimum supply of N and translocation of photosynthates into the spikelets. These results are in conformity with those reported by Mathew *et al.* (1990).

Normal kernels

Data regarding the percentage of normal kernels is given in table 1.It is revealed from the data that nursery transplanting techniques did not significantly affect the percentage of normal kernels. It is also clear from the data that the effect of N levels on percentage of normal kernels was highly significant. Maximum normal kernels (84.45%) were obtained in N_5 (125 kg N ha^{-1}) followed by N_4 (100 kg N ha^{-1}), N_6 (150 kg N ha^{-1}), N_3 (75 kg N ha^{-1}), N_2 (50 kg N ha^{-1}) and N_1 (25 kg N ha^{-1}) giving 83.09, 83.07, 81.54, 80.65 and 80.08 percent of normal kernels, respectively. Minimum normal kernels (79.38%) were obtained in N0 (control). The percentage of normal kernels was increased with increasing N levels because more photoassimilates were translocated in to the kernels at their development stage. These results are in agreement with those reported by Asif *et al.* (1999).

1000-kernel weight (g)

Data regarding the 1000-kernel weight (g) is given in table 1. It is revealed from the data that nursery transplanting techniques did not affect 1000-kernel weight significantly. However, the effect of N levels on 1000-kernel weight was highly significant. Maximum 1000-kernel weight (21.87 g) was obtained from N_5 (125 kg N ha^{-1}), which is statistically similar (21.63 g) with that of N_6 (150 kg N ha^{-1}). N_5 and N_6 are followed by N_4 (100 kg N ha^{-1}) which is statistically at par with N_3 (75 kg N ha^{-1}) showing 1000-kernel weight of 19.91 g and 19.78 g respectively. Minimum 1000-kernel weight (18.17 g) was obtained from N_0 (control) which is statistically at par with N_1 (25 kg N ha^{-1}). This increase in 1000-kernel weight might be due to the optimum kernel development and optimum filling of starch in kernel at optimum level of N application. These results are in accordance with those reported by Kasturi and Purushothaman (1992).

Paddy yield

It is clear from the table 1 that nursery transplanting techniques did not affect paddy yield significantly. It might be the result of same number of productive tillers m^{-2} in both the nursery transplanting techniques. Paddy yield was significantly affected by application of different levels of N. Maximum paddy yield (5.15 t ha^{-1}) was obtained from N_5 (125 kg N ha^{-1}) followed by N_6 (150 kg N ha^{-1}) showing the paddy yield of 5.05 t ha^{-1}. These treatments were followed by N_4 (100 kg N ha^{-1}) and N_3 (75 kg N ha^{-1}) showing the paddy yield of 4.35 t ha^{-1} and 3.90 t ha^{-1} respectively. Minimum paddy yield (2.75 t ha^{-1}) was obtained from N_0 treatment (control). The significant increase in paddy yield is a consequence of increase in number of productive tillers m^{-2} with an increase of N levels. These results are in conformity with those of Counce *et al.* (1992), Dixit and Patro (1994).

Straw yield

The data regarding straw yield (t ha^{-1}) is given in table 1. It is revealed from the data that nursery transplanting techniques did not affect straw yield significantly. It is also clear from the data that straw yield was significantly affected by N levels. The maximum straw yield (11.00 t ha^{-1}) was obtained in case of N_6 (150 kg N ha^{-1}) which is statistically non significant (10.93 t ha^{-1}) with N_5 (125 kg N ha^{-1}) but differs significantly from N_4 (100 kg N ha^{-1}) followed by N_3 (75 kg N ha^{-1}) and N_2 (50 kg N ha^{-1}) showing the straw yields of 9.26 t ha^{-1}, 8.29 t ha^{-1} and 8.13 t ha^{-1}, respectively. The minimum straw yield (6.87 t ha^{-1}) was produced in case of N_0 (control). The increase in straw yield may be attributed to increase in number of tillers $hill^{-1}$ with increased N level, which resulted in increased vegetative growth. These findings concur with those reported by Maqsood 1998.

The data regarding harvest index are shown in table 1. the data reveal that nursery transplanting techniques did not significantly affect harvest index percentage. It is also clear from the data that harvest index was significantly affected by N levels. The maximum harvest index (31.97%) was obtained in case of N_5 (125 kg N ha^{-1}), which was statistically similar to that of harvest index of N_6, N_4, N_3, N_2 and N_1 respectively. The minimum harvest index (28.55%) was obtained from N_0 (control). These results are in conformity with those reported by Shrivastava and Solanki (1994).

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