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EFFECT OF PLANT SPACINGS AND NITROGEN LEVELS ON THE RIPENING AND YIELD OF RICE

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ABSTRACT

The effect of plant spacings and nitrogen levels was determined on the yield of a high yielding rice variety, IR - 6. Three plant spacings 22 × 22 cm, 22 × 15 cmand 15 × 15 cm, and four nitrogen levels, i. e. 0,27, 33 and 40 kg/ha were employed in the trial. These nitrogen levels were applied at the time of panicle initiation. In addition, a basal dose of 90 kg N and 60 kg P_2O_5/ha was applied at transplanting to all the treatments except the control. It was found that a combination of 22 × 22 cm plant spacing and 33kgN/ha applied at panicle initiation stage proved to be the most favourable for increasing panicle bearing tillers. The sterility, however, was reduced with 22 × 22 cm plant spacing and 40 kgN/ha applied at flowering. The maximun 1000-grain weight was obtained with 22 × 22 cm plant spacing and 33 kgN/ha applied at panicle emergence.

INTRODUCTION

Rice (*Oryza sativa L.*) is an important staple food of more than half of the world's population today. In addition to meeting the dietary requirements, it is an important foreign exchange earning commodity of the country. At present Pakistan is producing rice to the tune of four million tons and earning 500 million dollars per year (Pakistan Statistics, 1981). There exists a great potential for increasing rice production both for local consumption and export with a possibility for the country to become a leading rice exporting nation of the world.

Till now its production has not been increased according to its genetic production potential realized at various research institutes as well as on the farms of progressive farmers. Among many problems encountered in rice pro-

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duction, low plant population and inadequate fertilizer use with its application technique are of major importance. Akbar and Saleemi (1981) expected substantial increase in the rice yield by maintaining a plant population of 200 thousand/ha as against the common average population of 100 thousand in farmer's fields. Moreover, a judicious amount of nitrogen fertilizer, if applied through an appropriate method may also go a long way in boosting up the grain yield/unit area. In the present study an attempt was made to evaluate the effect of plant spacings and nitrogen rates in IR-6, a coarse rice variety commonly grown in the country.

MATERIALS AND METHODS

The investigation was carried out at the Agronomic Research Area, University of Agriculture, Faisalabad, during the year 1981. The experiment was laid out in split plot design with three replications. The spacings were randomized in the main plots, whereas nitrogen doses in the sub-plots. The net plot size was kept as 3.50 m x 2.25 m.

The experimental treatments included were as given below :

(a) *Plant population*

The following plant to plant and row to row distances were maintained:

S_1	=	22 x 22 cm	(206611 plants/ha)
S_2	=	22 x 15 cm	(303030 plants/ha)
S_3	=	15 x 15 cm	(444444 plants/ha)

(b) *Fertilizer rates*

F_0	=	0 kgN/ha	(as urea)
F_1	=	27 kgN/ha	(as urea)
F_2	=	33 kgN/ha	(as urea)
F_3	=	40 kgN/ha	(as urea)

These doses were used at the time of flowering in addition to a basal dose of 90 kgN and 60 kg P_2O_5/ha in urea and superphosphate in all the treatments except control, at the time of puddling, and incorporated in the soil.

Nursery was sown in the first week of June and the seedlings were transplanted in the first week of July. All the Agronomic operations except, those under study were kept normal and uniform for all the treatments. Irrigation water was kept standing in the plots from the time of transplanting till one week before harvesting when the supply of irrigation water was stopped.

Duncan's Multiple Range Test was used to see the significance of variance in treatment means at 5 per cent probability.

The soil used in this study was analysed for nitrogen, available phosphorus and potassium before transplanting. The quantitative picture has been shown in Table 1.

Table 1. *Nitrogen, available phosphorus and potassium contents of the experimental soil*

Sample depth	Total N (%)	Available phosphorus (ppm)	Exchangeable potassium me/100gm of soil
15 cm	0.053	8.00	0.40
30 cm	0.042	6.80	0.45

RESULTS AND DISCUSSION

Number of tillers/hill

The data presented in Table 2 (A) reveal that plant spacings affected the per hill tillers substantially. The spacings 22 x 22 cm and 22 x 15 cm produced more per hill tillers than the 15 x 15 cm plant spacing but did not differ from each other. It suggests that decrease in spacing beyond 22 x 15 cm would not help increase the tillers. The nitrogen levels also showed significant effect on the tillers (Table 2 B). Application of 33 kgN/ha resulted in the maximum per hill tillers. Similar findings have been reported by Chaudhry and Naimat (1982).

Number of panicle bearing tillers

The data further indicate that the spacings did not influence the number of panicle bearing tillers while different levels of nitrogen did influence the number of panicle bearing tillers remarkably. The application of 33 kgN/ha produced the maximum number of panicle bearing tillers. This rate of nitrogen seems to be the most favourable in creating the suitable balance between the supply and the sink, i.e. the nutrients and the spikelets. It further indicates that increase in level of nitrogen beyond 33 kgN/ha will not be helpful in increasing the number of panicle bearing tillers. Similar results were also reported by Chang and Su (1977).

Sterility percentage

The data regarding sterility percentage reveal that the plant spacings had no effect on the occurrence of sterility, although narrow spacings encouraged the sterile kernels, which increased with the decrease in spacing. The nitrogen levels had a substantial effect on the occurrence of sterility. Higher sterility was observed in F_0 (control) which was followed by 27 and 33 kgN/ha. The sterility, in general, was decreased with the increase in nitrogen rate and the lowest rate of sterility occurred where 40 kgN/ha were applied. Nitrogen helps decrease the sterility in rice varieties that show moderately good response to it (Chaudhry *et al.*, 1971).

Table 2. *Response of yield and yield components of rice, IR-6 to varying N levels and plant spacings*

(A) Spacings (cm)	No. of tillers/ hill	No. of panicle bearing tillers	Sterility percentage	Abortive percentage	Opaque percentage	1000-grain weight (gm)
	*	NS	NS	*	*	*
22x22 (S1)	24.0 a	20.7 a	7.3 a	5.1 c	5.8 c	12.4 a
22x15 (S2)	24.2 a	19.2 a	8.0 a	6.6 b	8.3 b	11.8 b
15x15 (S3)	23.2 b	16.7 a	8.1 a	8.2 a	2.9 a	10.3 c
(B) N levels (kg/ha)						
	*	*	*	*	*	*
0 (F_0)	21.3 c	14.0 d	10.1 a	9.0 a	10.6 a	31.0 d
27 (F_1)	22.6 b	17.6 c	7.8 b	7.6 b	8.7 b	33.5 c
33 (F_2)	29.0 a	26.0 a	7.4 b	5.8 c	8.3 c	38.6 a
40 (F_3)	23.3 b	20.0 b	5.9 c	4.1 d	4.3 d	35.5 b

* Any two means in the same column not sharing a letter differ significantly.

N.S = Non-significant at 5 per cent level.

Abortive and opaque kernels

The results show that the percentage of abortive kernels was significantly affected by plant spacings as well as the N levels. The maximum abortive kernels were produced in S_3 spacing (15x15 cm). This could be due to the fact that with the increase in plant population/unit area, the photosynthetic activities of the plant decreased which resulted in reduced photosynthesis and increase in abnormal kernels like the abortive ones. Maximum abortive kernels were produced where no nitrogen was applied. In general, increase in the rate of nitrogen decreased the abortiveness of the grain. The more abortive kernels observed in F_0 might be due to lack of nitrogen supplies resulting in bad ripening. Similarly, opaque grains were also affected by different plant spacings and N levels. More plant population per unit area (15x15 cm) resulted in the maximum occurrence of opaque kernels. As regards nitrogen, the maximum opaque kernels occurred in control. The opaqueness, in general, decreased with the increase in N level, Nitrogen applied at the rate of 40 kgN/ha highly reduced the occurrence of opaqueness.

1000-grain weight (gm)

Different plant spacings significantly influenced the 1000-grain weight. The wider spacing (22x22 cm) gave the highest 1000-grain weight followed by 22x15 cm and 15x15 cm spacing, respectively. This may be attributed to more penetration of light, more photosynthetic activities and lesser competition among the plants. The effect of different levels of nitrogen, too, affected the 1000-grain weight significantly. The 33 kgN/ha resulted in the maximum grain weight. This was followed by Nitrogen level of 40 kg/ha. Rice variety IR-6 seems to be moderately responsive to nitrogen application. Similar findings have been reported by Rajale and Prasad (1974). Hoshino (1974) also found that 1000-grain weight was greatly affected by plant density. It is interesting to note that the increase in nitrogen levels beyond 33 kg/ha would decrease the grain weight. This may be attributed to the poor response of the rice variety, IR-6 to the nitrogen fertilizer. In such cases, with high concentration of nitrogen in less adaptable varieties, the nitrogen and carbohydrate metabolisms are disturbed. The carbohydrate contents in leaf-sheath and culm tend to decrease, resulting in reduced grain weight.

There is a strong evidence to show that under the conditions, the maximum grain weight can be obtained with 22x22 cm plant spacing and 33kgN/ha when applied at panicle emergence stage of the plant. In addition to a basal dose of 90kgN and 60 kg P_2O_5, the application of more nitrogen than 33kg/ha would be wasteful and uneconomical. However, further studies of this nature are warranted.

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