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EFFECT OF DIFFERENT NITROGEN LEVELS AND ROW SPACING ON THE PERFORMANCE OF NEWLY EVOLVED MEDIUM GRAIN RICE VARIETY, KSK-133

T. H. Awan, R. I. Ali, Z. Manzoor, M. Ahmad and M. Akhtar

Rice Research Institute, Kala Shah Kaku
Correspondence author e-mail:tahirawanrri@yahoo.com

ABSTRACT

An experiment was carried out to study the effect of different Nitrogen levels (110,133 & 156 kg ha^{-1}) in combination with different row spacing (15 cm, 22.5 cm & 30 cm). The experiment was conducted at Rice Research Institute Kala Shah Kaku during the crop growing season 2006 & 2007.Treatment RS_2N_3,where 156 Kg Nha^{-1} were applied with 22.5 cm row to row and plant to plant spacing had maximum values of plant height (79.07 cm), tillers m^{-2} (594), panicle length(25.40cm), No of grains $panicle^{-1}$ (132.97), grain yield (5461.03 Kg ha^{-1}), straw yield (9662.03 Kg ha^{-1}) and least value of sterility %age (5.7 %). All these parameters were statistically at par with the treatment RS_1N_3 (15cm spacing with 156 Kg N ha^{-1}) except panicle length. Statistically minimum values of all these parameters were recorded under the treatments RS_1N_1 (15cm spacing with 110 Kg N ha^{-1}) and RS_3N_1 (30 cm spacing with 110 Kg N ha^{-1}) except panicle length, 1000 grain weight & sterility %age. Harvesting index had non significant difference among all treatments

Key words: Oryza sativa, row spacing, Nitrogen levels, yield components, paddy yield.

INTRODUCTION

Since fertilizer is an expensive and precious input, determination of an appropriate dosage of application that would be both economical and appropriate to enhance productivity and consequent profit of the grower under given situation needs intensive study. At present the world is facing the problem of shortage of major fertilizer nutrients especially Nitrogen and Phosphorous. The developing countries like Pakistan are more sensitive to this shortage because the fertilizer production in these countries is expensive and less than its demand. Even when the fertilizer supply is satisfactory, the importance of increasing its efficient use cannot be underestimated. The application of nitrogen fertilizer either in excess or less than optimum rate affects both yield and quality of rice to remarkable extent, hence proper management of crop nutrition is of immense importance.

Nitrogen absorbed by rice during the vegetative growth stages contributed in growth during reproduction and grain-filling through translocation (Bufogle *et al*., 1997; Norman *et al*., 1992). Nitrogen is very essential for the growth and development of crops. It enhances biomass and seed yield subject to the efficient water supply. Lack of N results stunted growth, pale yellow color, small grain size and poor vegetative as well as reproductive performance. Nitrogen is an essential component of amino acid and related protein of the plant structure. Growth of plants primarily depends on nitrogen availability in soil solution and its utilization by crop plants during growth and development. Dry matter production and its conversion to economic yield is a cumulative effect of various physiological processes occurring during the plant life cycle. An increase in yield of cereals with increasing rate of nitrogen has been reported earlier (Khan *et al*. 1994). However, it needs to be explored to determine the desired quantity of nitrogen fertilizer for boosting seed yield per unit area avoiding increase in the cost of production through optimizing the N supply of every newly evolved variety.

Light attenuation in row crops, such as rice, is influenced by canopy architecture, which has to be defined in terms of the size, shape orientation of shoot components and row spacing. Cultural practices that improve the efficiency of light interception affect canopy architecture by modifying such components. (Boote and Loomis, 1991). Keeping in view the importance of N supplies in relation to row spacing, the present study was therefore designed to find out the response of N levels in relation to row spacing on dry matter (DM) production, kernel yield and sterility %age of a newly evolved a stiff stemmed, medium grain rice variety KSK-133 for its better-productivity in the region.

MATERIALS AND METHODS

The experiment was carried out to study the effect of different Nitrogen levels in combination with different row spacing on the performance of new rice variety KSK-133. Three Row spacings (15.5 cm, 22.5cm, & 30cm) and three nitrogen levels (110,133 & 156 kg ha^{-1}) were studied. The experiment was conducted at Rice Research Institute Kala Shah Kaku during the crop season 2006 and 2007.

The experiment was laid out in split plot arrangements under the Randomized Complete Block design using three replications. Nursery was sown on 5th June and transplanted on 5th July. The plot size was 6m x 4m. The following treatments were studied during the experiment.

Factor A main plots (Row Spacing): RS_1 = 5.0 cm, RS_2 = 22.5 cm, RS3 = 30.0 cm

Factor B sub plots (N levels) :N_1 = 110 kg ha^{-1}, N_2 = 133 kg ha^{-1}, N_3 =156 kg ha^{-1}

All the agronomical practices were kept standard except the application of nitrogen levels and different row spacing. Nitrogen was applied in three splits i.e. at the time of transplanting; 25 days and 45 days after transplanting. Recommended doses of Phosphorous and potassium were applied as a basal at the time of transplanting.

The following observation were recorded during the course of study, Plant height (cm), Tillers m^{-2}, Panicle length (cm), No of grains $panicl^{-1}$, Thousand (1000) grain weight (g), Harvest Index, Sterility %age, Grain yield (kg ha^{-1}) and Straw yield (kg ha^{-1}). Data on fertile tillers m^{-2} were counted at the time of harvesting using a meter square placed randomly at 3 times in each sub plot in different locations.. Height of 9 plants at random from each plot was recorded at maturity for the calculation of average plant height. Measurements were taken in cm from the soil surface to the tip of the panicle. Nine panicles at random were collected from each sub plot. Filled and unfilled grains were counted and sterility percentage was calculated. The panicles harvested from the selected plants were used for panicle length. The grains counted from selected plants at random were used for number of grains per panicle. One thousand grains were taken randomly from each sub plot and their weight (g) was recorded. For grain and straw yield (kg ha^{-1}) three samples of 10 meter square area harvested at random from each sub plot were selected. Their grain and straw yield was weighed and converted into grain and straw yield (Kg per hectare). Data recorded were statistically analyzed through a computer software M stat C for RCBD with split plot arrangement and LSD test applied to signify the treatment differences (P <_0.05) (Steel *et al*.1997)

RESULTS AND DISSCUSSION

Plant height (cm): It is obvious from the results (Table-1) that there were significant differences among various treatments under test. Maximum plant height (80 cm, 79.07 cm and 78.83 cm) were produced by the treatments RS_1N_3 (15 cm spacing &110 kg ha^{-1}), RS_2N_3 (22.5 cm spacing & 150 kg ha^{-1}) and RS_3N_3 (30 cm-156 kg ha^{-1}), respectively which was statistically at par with each other. The other treatments produced significantly lower plant height. It is evident from the results that plant height increases with the increasing level of N from 110-156 Kg ha^{-1} irrespective of spacing. Singh and Sharma (1987) reported that application of 180 Kg N/ha resulted in higher plant height of rice. Meena *et al.* (2003) also reported similar results. The increase in plant height with increased N application irrespective of spacing might be primarily due to enhanced vegetative growth with more nitrogen supply to plant.

1000-Grain weight: The 1000-grain weight was affected significantly with row spacing and different nitrogen levels. Maximum 1000-grain weight (25.40 g) was obtained in case of treatment RS_2N_3 (22.5 cm spacing with 156 kg N ha^{-1}). The other treatments produced significantly lower 1000-grain weight with increasing level of N upto 156 Kg ha^{-1}. When there are more spacing there will be more air, light and inputs availability. Owing to this reason 1000 grain weight was maximums at 22.5 cm & 30 cm spacing as compared to 15 cm spacing. Similar finding have been reported by Bhowmick and Nayak (2000) and Rafey *et al.* (1989). Increase in grain weight at higher nitrogen rates might be primarily due to increase in chlorophyll content of leaves which led to higher photosynthetic rate and ultimately plenty of photosynthates available during grain development

Table-1. Yield and yield Traits as affected by different row spacing and nitrogen levels

Treatments	Plant Height (cm)	Tillers m^{-2}	Panicle length (cm)	No of grains $panicle^{-1}$	1000 grain Weight(g)
RS_1-N_1	69.43 ^{E}	527.00 ^{D}	23.03 ^{CD}	119.43 F	70.93 ^{AB}
RS_1-N_2	75.60 ^{C}	560.98 ^{B}	22.67 ^{D}	127.87 ^{CD}	67.87 ^{BC}
RS_1-N_3	80.00 ^{A}	601.00 ^{A}	23.10 ^{CD}	131.13 ^{AB}	66.93 ^{C}
RS_2-N_1	71.40 ^{D}	540.10 ^{CD}	22.87 ^{D}	120.30 ^{F}	72.23 ^{A}
RS_2-N_2	77.33 ^{B}	552.90 ^{BC}	23.90 ^{B}	126.73 ^{D}	71.17 ^{AB}
RS_2-N_3	79.07 ^{A}	594.30 ^{A}	25.40 ^{A}	132.97 ^{A}	69.23 ^{ABC}
RS_3-N_1	70.80 ^{DE}	541.47 ^{CD}	23.60 ^{BC}	117.27 ^{G}	68.60 ^{BC}
RS_3-N_2	75.17 ^{C}	555.00 ^{BC}	23.90 ^{B}	123.20 ^{E}	69.13 ^{ABC}
RS_3-N_3	78.83 ^{A}	588.17 ^{A}	23.73 ^{BC}	129.57 ^{BC}	67.73 ^{BC}
LSD Value	1.410	18.23	0.7248	1.928	3.559

* Differences in treatment means with same letter are statistically non-significant. Where as RS1 (15.0 cm), RS2 (22.5 cm) & RS3 (30.0 cm) are three levels of row spacing & N1 (110 kg ha-1), N2 (133 kg ha-1) & N3 (156 kg ha-1) are three levels of nitrogen applied

Fertile tillers m^{-2}: Row spacing and nitrogen levels significantly affected number of tillers m^{-2}. Maximum No. of tillers m^{-2} were produced in case of treatments RS_1N_3 (601) RS_2N_3 (594.30) and RS_3N_3 (588.17) which were statistically at par with each other. The other treatments produced significantly lesser number of tillers m^{-2}. The reason is that when there were more plant m^{-2}, automatically tillers will be more per m^{-2} & this was increases with the increasing level of N as is evident from the results (Table-1). It is evident from the result that maximum level of N (156Kg ha^{-1}) produced maximum tiller irrespective of spacing. These results are in line with those reported by Nawaz (2002) and Meena *et al.* (2003). Enhanced tillering by increased nitrogen application might be attributed to more nitrogen supply to plant at active tillering stage.

No. of grain $panicle^{-1}$: The data (Table-1) indicated that there was significant difference among treatments under test. Maximum number of grains $panicle^{-1}$ was produced in case of treatment RS_2N_3 (132.97) which were statistically at par with RS_1N_3 (131.13). The other treatments produced significantly lesser number of grains $panicle^{-1}$. Minimum No of grain $panicle^{-1}$ (117.27) were produced under the treatment RS_3N_1. As we go from higher level of N to lower level, No. of grain $panicle^{-1}$ were reduced. Similar findings have been reported by Bhowmick and Nayak (2000), Nawaz (2002), Namba (2005). The more number of grains per panicle obtained in treatments receiving higher nitrogen rates were probably due to better nitrogen status of plant during panicle growth period. Number of grain per panicle were more in spacing (15 cm & 22.5 cm) instead of 30cm spacing. Similar results were reported by Awan *et al.* (2006) & (2007).

Table-2 Yield and yield Traits as affected by different row spacing and nitrogen levels

Treatments	Harvesting Index	Sterility % age	Grain Yield (Kg ha^{-1})	Straw Yield (Kg ha^{-1})
RS_1 - N_1	35.27	6.400 ^{C}	4461.27 ^{FG}	8186.63 ^{EF}
RS_1 - N_2	34.80	7.400 ^{B}	4866.37 ^{DE}	9115.82 ^{CD}
RS_1 - N_3	34.96	6.300 ^{CD}	5274.93 ^{AB}	9812.80 ^{AB}
RS_2 - N_1	35.92	5.900 ^{CD}	4688.87 ^{EF}	8366.40 ^{EF}
RS_2 - N_2	34.85	5.767 ^{D}	4976.47 ^{CD}	9303.33 ^{BCD}
RS_2 - N_3	36.11	5.700 ^{D}	5461.03 ^{A}	9662.03 ^{A}
RS_3 - N_1	35.63	8.333 ^{A}	4354.60 ^{G}	7867.27 ^{F}
RS_3 - N_2	35.01	8.333 ^{A}	4727.07 ^{DE}	8773.43 ^{DE}
RS_3 - N_3	35.11	7.300 ^{B}	5163.20 ^{BC}	9541.33 ^{ABC}
LSD Value	NS	0.6290	251.7	652.0

Means with different letters in a column differ significantly ($P < 0.05$). Where as RS_1 (15.0 cm), RS_2 (22.5 cm) & RS_3 (30.0 cm) are three levels of row spacing & N_1 (110 kg ha^{-1}), N_2 (133 kg ha^{-1}) & N_3 (156 kg ha^{-1}) are three levels of nitrogen applied.

Harvesting Index: Data in Table-2 revealed that this trait exhibited non-significant differences among row spacing and nitrogen levels. However, maximum value (36.11) was achieved in the treatments RS_2N_3. The reason was that when we planted rice plant at proper spacing, there were more tillers per plant. When there were more plants m^{-2}, automatically tillers will be more per m^2 and this increases with the increasing level of N as is evident from the results (Table-2).

Sterility percentage: Data (Table-2) indicated significant differences among the treatments. Maximum sterility (8.333%) was recorded in the treatments RS_3N_1 and RS_3N_2. The least sterility (5.7%) was noted in the treatment RS_2N_3. The reason of maximum sterility %age at wider spacing is that there were more tertiary tillers, which bear late flowering. Among them some were fertilized & majority was non fertilized due to lowering temperature and weak tiller. This caused maximum sterility %age. Similar results were reported by Awan *et al*. (2006) & (2007), who reported that sterility %age significantly decreases from primary tillers to tertiary & late tertiary tillers

Grain yield: The results (Table 2) indicated that paddy yield was significantly affected by row spacing and nitrogen levels. Maximum paddy yield (5461.03 kg ha^{-1}) was obtained in case of treatment RS_2N_3 (22.5 cm spacing with 156 kg N ha^{-1}) followed by the treatment RS_1N_3 (15 cm spacing with 156 kg N ha^{-1}) which yielded 5274.93 kg $ha^{-1}$and was at par with each other. All the other treatments produced significantly lower yield. The lowest paddy yield (4354.50 kg ha^{-1}) was observed by the treatment RS_3N_1 (30 cm spacing with 110 kg N ha^{-1}). The reason is that at standard & closer spacing, there were more primary & secondary tillers than tertiary tillers as compared to rice planting at 30 cm spacing. Awan *et al*. (2006) & (2007) reported that yield significantly decreased from primary tillers to tertiary & late tertiary tillers. This was the main reason of more yield in plots of RS_1 and RS_2. Gunri and Chaudhury (2004) reported that closer spacing (15cm x 15 cm) proved better in grain yield of rice, nitrogen use efficiency and N uptake was better than the wider row spacing. Yield increases with the increasing level of N from 110 to 156 Kg/ha. Similar finding had beern reported by Bhowmick and Nayak (2000) and Boling *et al*. (2004).

Straw Yield: It is obvious from the data (Table 2) that maximum straw yield (9662.03 kg ha^{-1}) was achieved in case of treatment RS_2N_3 (22.5 cm -156 kg N/ha) followed by the treatment RS_1 N_3 (15 cm spacing with 156 kg N ha^{-1}) which produced 9612.80 kg ha^{-1} and were at par with each other. The other treatments produced significantly lower straw yield. Similar finding have been reported by Bhowmick and Nayak (2000). Gunri, and Chaudhury (2004) who reported that closer spacing (15cm x 15 cm) proved better in straw yield of rice and nitrogen use efficiency and N uptake was better than the wider row spacing

Conclusion: It ma be concluded that application of nitrogen fertilizer offers a large scope for obtaining higher yield of rice. It appears that good harvest of KSK-133 can be achieved by the application of 156 kg N ha^{-1} with row to row and plant to plant spacing of 22.5 cm.

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