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Yield and Quality Response of Wheat to Different Nitrogen Doses in Rice-Wheat Cropping System

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ABSTRACT

Studies pertaining to the effect of different nitrogen rates at constant level of phosphorus on the yield and quality of a wheat cultivar Inqulab-91, was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad. The treatments comprised 0, 75, 100, 125 and 150 kg N ha^{-1} with a constant dose of 100 kg P_2O_5 ha^{-1}. The 1000-grain weight and grain yield ha^{-1} were significantly affected by various nitrogen levels. Nitrogen application beyond the level of 100 kg N ha^{-1} did not increase the grain yield ha^{-1} to a significant extent. Grain protein contents were also increased with increasing rate of nitrogen up to 100 kg ha^{-1}.

Key Words: Yield; Quality; Nitrogen; Wheat; Cropping system

INTRODUCTION

In Pakistan, wheat is grown on an area of 8354.6 thousand hectares with the total production of 18684 thousand tones giving an average of 2238 kg ha^{-1} (Anonymous, 1999). This yield level is below the potential of our existing wheat varieties. The production of wheat can be increased either by bringing more area under cultivation or by increasing its per hectare yield. Currently, it is nearly impossible to increase area under wheat crop due to other competing crops, restricted supply of irrigation water etc. Therefore, the only alternative left is to increase it's per hectare yield by better crop management. Appropriate time, amount and method of fertilizer application are of prime importance in crop management. The judicious use of fertilizer can increase yield by 30-40%.

There is a common trend among the cultivators to grow wheat after rice in our country. In Punjab, the average wheat yield varies from 1.2-1.6 t ha^{-1} in a rice-wheat cropping system. Wheat yield is relatively lower in the rice-wheat cropping system than the normal irrigated wheat crop. Wheat sowing is delayed due to late vacation of rice field that adversely affects wheat grain yield. Therefore, in order to get better harvest of late sown wheat, appropriate fertilizer management is essential accordingly. The present study was conducted to evaluate the comparative yield potential and grain protein contents of a wheat variety Inqlab-91 at different levels of nitrogen with constant level of phosphorus in a rice-wheat cropping system.

MATERIALS AND METHODS

An experiment to determine the effect of different nitrogen rates at constant level of phosphorus on the yield and quality of a wheat cultivar Inqlab-91 was conducted at Agronomic Research Area, University of Agriculture, Faisalabad during 1998-99. Experiment was laid out in a RCBD with four replications. The net plot size measured 2m x 5m. The treatments comprised 0, 50, 75, 100 and 150 kg N ha^{-1} with a constant dose of 100 kg P_2O_5 ha^{-1}.

The crop was sown on Ist December, 1998 using a seed rate of 100 kg ha^{-1} with single row hand drill at 25 cm apart rows. Urea and single super phosphate were used as a source of nitrogen and phosphorus, respectively. Half of nitrogen and full dose of phosphorus were applied at sowing. The remaining half of the nitrogen was applied at first irrigation. All other cultural practices were kept normal and uniform. Observations were recorded on, final plant height, number of productive tillers per unit area, number of spikelets per spike, number of grains per spike, 1000-grain weight, grain yield and grain protein content.

The data collected were analysed statistically using Fisher's analysis of variance technique, and LSD Test (0.05%) was employed to compare the differences among the treatment means (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Final Plant Height. Different rates of nitrogen significantly affected the final plant height (Table I). Although nitrogen at the rate of 125 kg ha^{-1} produced significantly taller plants (97.65 cm) than 100 and 75 kg N ha^{-1}, yet it did not differ significantly from treatment 150 kg N ha^{-1} (97.05cm).

Productive Tillers (m^{-2}). The maximum number of fertile tillers was recorded in the treatment of 150 kg N

ha^{-1} (290.5) followed by 125 kg N ha^{-1} (255.3). The minimum number of fertile tillers m^{-2} was recorded in control treatment (191.8). These results are similar to those of Hussain (1984) and Behera and Sharma (1991) who reported that increasing nitrogen rate increased number of fertile tillers m^{-2}.

Spikelets per Spike. Nitrogen had significant effect on number of spikelets per spike. The maximum number of spikelets per spike was obtained with 150 kg N ha^{-1} (18.45) which was *at par* with 125 kg N ha^{-1} (18.08). Treatments, 100 kg N ha^{-1} and 75 kg N ha^{-1}, were also statistically *at par* with each other, producing 17.17 and 16.65 spikelets per spike, respectively. While the control treatment produced 14.77 spikelets per spike. Similar results were reported by Hussain *et al.* (1984) who reported an increase in the number of spikelets per spike with increasing nitrogen rate.

Grains per Spike. Data pertaining to number of grains per spike given in Table I revealed that various nitrogen rates significantly affected the number of grains per spike. The maximum number of grains per spike was recorded in case of 125 kg N ha^{-1} (55.05) which was statistically *at par* with 150 kg N ha^{-1} (54.95) followed by 100 kg N ha^{-1} (50.38). The minimum number of grains per spike (33.72) was produced by the control treatment.

1000-Grain Weight. Data on 1000-grain weight reflected significant effect of different nitrogen rates. The maximum 1000-grain weight was noted in case of 125 kg N ha^{-1} (46.45 g) which was statistically similar *at par* with 150 kg N ha^{-1} (44.40 g) followed by 100 kg N ha^{-1} (42.42 g). That was attributed to better nutrition of the plants which resulted in good grain filling and development. The minimum 1000-grain weight was achieved in control treatment (40.79 g) which was statistically similar to 75 kg N ha^{-1} (40.50 g). These results are similar to those of Kirrilov and Pavlov (1989) who reported that application of nitrogen markedly increased 1000-grain weight.

Grain Yield (t/ha). Increasing nitrogen rates had a significant effect on the grain yield. The maximum grain yield was obtained in the case of 150 kg N ha^{-1} (3.91 t ha^{-1}). The grain yield obtained from 125 kg N ha^{-1} did not differ significantly from 100 kg N ha^{-1}. The control treatment gave the minimum grain yield of 2.2 t ha^{-1}.

The maximum grain yield, in case of 150 kg N ha^{-1} (3.91 t ha^{-1}) was due to more number of grains per spike. Grain weight showed that there is a direct relationship between grain yield and nitrogen levels. Similar results were reported by Singh and Uttam (1992) who reported that grain yield increased significantly up to 120 kg N ha^{-1}. Ayub (1994) also reported that grain yield increased significantly with the application of nitrogen fertilizer.

Table I. Effect of different nitrogen rates on agronomic traits and grain protein content of wheat

Treatments	Plant height (cm)	Fertile tillers m^{-2}	Spikeletsspike^{-1}	Grain per spike	1000-grain weight	Grain yield (t ha^{-1})	Protein content (%)
NP (kg ha^{-1})							
F_0 = 0 - 100	76.5d	191.8d	14.7c	33.7d	40.5c	2.2c	9.0c
F_1 = 75 - 100	90.3c	223.5c	16.6b	46.5c	40.5c	3.5d	9.8b
F_2 = 100 - 100	94.2b	231.0c	17.2b	50.4b	42.4bc	3.6ab	9.8b
F_3 = 125 - 100	97.6a	255.3b	18.1a	55.1a	46.5a	3.7ab	11.2a
F_4 = 150 - 100	97.1a	290.5a	18.5a	54.9a	44.4ab	3.9a	11.7a

Any two means in a column not sharing a letter differ significantly at 0.05 P

Grain Protein Content. The various nitrogen rates had significant effect on grain protein content. Crop fertilized with 150 kg N ha^{-1} gave the maximum grain protein content (11.72%) which was statistically *at par* with 125 kg N ha^{-1} (11.23). The minimum protein content was found in control (9.02%). Ayub *et.al.* (1995), and Kirrilov and Pavlov (1989) also reported that applied nitrogen increased wheat grain protein content by 20.29%.

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