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Growth and Yield Response of two Wheat (*Triticum aestivum* L.)Varieties to Different Potassium Levels

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Abstract
In field experiment at Faisalabad, Pakistan conducted during Nov. 2005, the effect of control, 30, 60, 90 kg K ha^{-1} on two wheat cultivars Inqlab-91 and Ufaq-2002 was investigated. Fertile tillers m^{-2}, number of grains spike^{-1}, 1000-grain weight and grain yield were significantly increased by increasing K level. The crop fertilized at the rate of 90 kg K ha^{-1} gave significantly higher yield, but on the basis of economic analysis it is recommended that crop fertilized with 60 kg K ha^{-1} gave better results. As for as varieties are concerned, Inqlab-91 respond more to K level than Ufaq-2002.

Key words: *Triticum aestivum* L., wheat, potassium levels, yield

Introduction

Among the various factors responsible for low yield of wheat crop in the country, poor fertility status of the soil and improper crop management practices are of primary importance. Production of wheat can be increased either by bringing more area under cultivation or by increasing its yield per unit area. Under the present situation, it is not possible to increase its area under cultivation due to other competing crops and restricted supply of irrigation water. Therefore, the only alternative left for increasing wheat production in the country is to obtain higher yield per unit area. The judicious use of fertilizer can increase yield from 30-47% (Maseh, 1994). Although our soils are not deficient in K, but to obtain higher yield to fulfill the food requirement of the country and to improve the grain quality of the wheat, the crop must be fertilized with K. Potassium is one of the major elements needed for normal plant growth. It performs several important functions inside the plant body. Its role is well documented in photosynthesis, carbohydrates, starch formation, enabling crop plant to develop tolerance to drought conditions and enhancing plant ability to resist attacks of pest and diseases. It is absorbed by plants in large amount than any other element except nitrogen (Brady, 1990) and plays a key role in increasing crop yield and improving the quality of products (Mengel and Kirby, 1987). The major source of K is the soil potassium that comprises 2.6% of the earth's crust. Over 98% of this K is bounded in soil minerals and only a small portion (<2%) is found in exchangeable and soluble forms (Sekhon, 1982). Weathering of K containing minerals releases K for plant use. Irrigation water contributes 14-34 kg ha^{-1} annually towards the soil K resources (Bajwa, 1987; Ranjha, 1988). Soils of Pakistan are generally made up of such minerals which have large capacity to provide potassium to crops under normal conditions. But increased intensity of cropping and introduction of high yielding cultivars resulted in considerable drain of K fertilization (Ranjha *et al*. 1990). Keeping this in view, the present study was therefore, designed to determine the effect of different K levels on the growth and yield of two wheat varieties.

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Materials and Methods

A field experiment to evaluate the effect of different K levels on the growth and yield of two wheat varieties was carried out at the Agronomic Research Area, University of Agriculture, Faisalabad, Pakistan on November, 2005. The experimental soil had 0.036% N, 6.3 ppm available phosphorus, 139 ppm available potash, 8.1 pH and 0.16 dSm^{-1} EC. The Experiment comprised of four potassium levels (0, 30, 60 and 90 kg ha^{-1}) and two wheat cultivars (Inqlab-91 and Ufaq-2002) and was laid out in randomized complete block design with split plot arrangement having three replication and a net plate size 2 m x 5 m. The nitrogen at the rate of 120 kg ha^{-1} and phosphorous at the rate of 90 kg ha^{-1} was applied in the form of urea and DAP, respectively. All the phosphorous, potash and ½ of the nitrogen were side drilled at the time of sowing and remaining ¼ nitrogen with first irrigation and ¼ with second irrigation. All other agronomic practices were kept normal and uniform for all the treatments. Yield contributing parameters were recorded and the data collected was analysed statistically by using Fisher's analysis of variance techniques and differences among treatment means were compared using least significant difference test at 5% probability level. (Steel *et al*., 1997). Net benefit and benefit cost ratio was also calculated. The purpose of economic analysis was to evaluate the difference in cost and benefit of different treatments.

Results and Discussion

Crop yield mainly depends upon many yield contributing components among them number of fertile tillers are very important because higher the number of fertile tillers m^{-2} higher will be the final yield of the crop. Different potash levels and their interaction with varieties significantly affected the total number of fertile tillers m^{-2}. Inqlab-91 produced more number of fertile tillers (352.55) and differed significantly from Ufaq-2002. The interaction between varieties and potash levels was also highly significant. The number of fertile tillers m^{-2} was the highest (390.4) in Inqlab-91 fertilized with 90 kg K ha^{-1}. The lowest number of fertile tillers m^{-2} (290.6) was obtained in case of ufaq -2002 when it was not fertilized with potassium. These results are in line with Malik *et al*., (1990), Ali and Yasin (1991) and Khaliq *et al*., (1999) who reported that number of tillers was higher when crop is fertilized with potassium.

Plant height is an important component of straw yield and may also affect the grain yield. Potash had significant affect on plant height. The effect of varieties was non significant. The interaction between varieties and potash levels was significant. The maximum plant height (91.55 cm) was recorded when crop was fertilized with 60 kg K ha^{-1} and the minimum (85.90 cm) in control treatment. As for as the interaction between varieties and potash level is concerned, the maximum plant height (92.60 cm) was recorded in Ufaq-2002 fertilized with 60 kg K ha^{-1}. The minimum plant height (85.20 cm) was recorded in Ufaq-2002 where K was not applied. Increase in plant height due to potash levels was also observed by Ayub *et al*., (1994), khaliq *et al*., (1999) and Maqsood *et al*., (1999).

Number of grains per spike is an important yield contributing parameter and has a direct effect on the final grain yield of wheat. All potash levels produced significantly higher number of grains over control and maximum was recorded when crop was fertilized with 90 kg K ha^{-1}. Number of grains per spike in Inqlab-91 were significantly higher than Ufaq-2002. The interaction between varieties and potash levels was also significant. Maximum grains per spike were recorded in Inqlab-91 with potash level on 90 kg ha^{-1}. However, it was statistically at par with Inqlab-91 at potash level of 60 kg ha^{-1}. Increase in number of grains per spike with increased potash levels can be attributed to greater spike length. Similar results were reported by Gwal *et al*., (1999) and Maqsood *et al*., (1999).

The data regarding 1000-grain weight indicated (Table 1) that application of potash in different proportions with recommended doses of N and P increased the 1000-grain weight significantly over control. The maximum 1000-grain weight (41.78 g) was recorded when crop was fertilized with 90 kg K ha^{-1} and minimum 1000-grain weight (37.40 g) was recorded where no potash was applied. Among varieties, Inqlab-91 produced more 1000-grain weight. The interaction between varieties and potash levels was also significant. The maximum 1000-grain weight (43.16 g) was recorded in Inqlab-91 with potash level of 90 kg ha^{-1} while minimum 1000-grain weight (36.33 g) was recorded in Ufaq-2002 without K. Grains produced in control treatment were light in weight due to low K uptake from the soil. Due to low uptake from the soil the translocation of metabolites was also reduced which was important for grain filling and development. Although K is a co-factor for several enzymes yet its effect on starch synthesis is well established. Starch synthesis is one of the major events in grains. Therefore availability of potassium can have a profound effect on grain development. These results are in accordance with Sultan (1995), Dilshad *et al*., (2000) and Ijaz (2004). They reported that the 1000-grain weight of wheat increases by adding potassium fertilizer to crop plants.

Grain yield of wheat crop is the result of combined effect of various yield contributing components. The effect of different potassium levels on grain yield of wheat was highly significant (Table 1). The application of 90 kg K ha^{-1} gave the highest yield (4368 kg ha^{-1}). The minimum grain yield (3947 kg ha^{-1}) was observed in case of no fertilization. The grain yield of Inqlab-91 was greater than ufaq-2002. The interaction between varieties and potash levels was highly significant. The maximum grain yield (4503 kg ha^{-1}) was obtained in case of Inqlab-91 with potash level of 90 kg ha^{-1}. The higher grain yield of Inqlab-91 was due to more number of fertile tillers and number of grains per spike as compared to Ufaq-2002. It is evident from the results that potassium application significantly increased the grain yield of wheat. These results are in consonance with those of Xiong *et al*., (2003), Wilhelm and white (2004).

On the basis of economic analysis benefit-cost ratio was carried out (Table 2). The maximum net income of Rs. 16173.30 ha^{-1} was obtained when crop was fertilized with 60 kg K ha^{-1}, while minimum net income of Rs. 13751.42 ha^{-1} was obtained when crop was fertilized with 30 kg K ha^{-1}. The maximum benefit-cost ratio of 0.58 was observed in case of 60 kg K ha^{-1}, while the minimum benefit-cost ratio of 0.47 was obtained when crop was fertilized with 90 kg K ha^{-1}.

Table 1: Growth and Yield Response of two Wheat (*Triticum aestivum* L.)Varieties to Different Potassium Levels

Treatments	No. of fertile tillers (m^{-2})	Plant height (cm)	Number of grains/spike	1000-grain weight (gm)	Grain yield (kg ha^{-1})
Varieties Inqlab-91(V_1)	352.55 a	89.4 NS	45.60 a	40.85 a	4228.75 a
Ufaq-2002 (V_2)	335.42 b	89.12 NS	44.08 b	38.71 b	4132.0 b
LSD	1.722	0.732	0.319	1.854	74.119
K levels (kg ha^{-1}) Control (K_0)	301.1d	85.9 d	43.72 c	37.40 d	3947 d
30 (K_1)	313.0 c	90.35 b	44.67 b	38.98 c	4098 c
60 (K_2)	376.9 b	91.55 a	45.39 a	40.90 b	4311 b
90 (K_3)	385.0 a	89.25 c	45.59 a	41.78 a	4368 a
LSD	1.739	0.3445	0.2353	0.1779	40.031
(V_1K_0)	311.6 f	86.60 e	44.32 cd	38.46 e	3966 f
(V_1K_1)	320.4 e	90.30 c	45.25 b	39.42 d	4132 d
(V_1K_2)	387.8 b	90.50 c	46.28 a	42.20 b	4314 b
(V_1K_3)	390.4 a	90.20 c	46.58 a	43.16 a	4503 a
(V_2K_0)	290.6 h	85.20 f	43.13 e	36.33 f	3928 f
(V_2K_1)	305.6 g	90.40 b	44.11 d	38.50 e	4064 e
(V_2K_2)	366.0 d	92.60 a	44.49 c	39.59 d	4307 b
(V_2K_3)	379.5 c	88.30 d	44.60 c	40.39 c	4233 c
LSD	2.459	0.4872	0.3328	0.2516	56.613

Table 2: Economic Analysis

Treatments K levels (kg ha^{-1})	Total variable cost (Rs. ha^{-1})	Total expenditure (Rs. ha^{-1})	Gross income (Rs. ha^{-1})	Net income (Rs. ha^{-1})	Benefit-cost Ratio
Control	-	25005	38877.95	13872.95	0.55
30 (K_1)	1440	26445	40196.42	13751.42	0.52
60 (K_2)	2880	27885	44058.30	16173.30	0.58
90 (K_3)	4320	29325	43107.75	13782.75	0.47

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