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Interactive Effect of Phosphorus and Potassium Nutrition on the Growth and Yield of Hybrid Maize (*Zea mays* L.)

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Abstract

The interactive effect of varying levels of phosphorus viz. 75, 100 and 125 kg/ha with that of potassium viz. 50, 75 and 100 kg/ha on the growth and yield of hybrid maize "Shahensha" was studied at the agronomic research area, University of Agriculture, Faisalabad during the year 1997. The results revealed that the highest grain yield of 6.02 t/ha and thousand grain weight 405.2 g respectively were obtained from the plot fertilized at the rate of 125-75 PK kg/ha against the lowest grain yield (4.20 t/ha) and 1000 grain weight (372.4 g) were obtained from the control plots. This increase in grain yield was attributed to increased leaf area per plant, greater cob length, increased number of grains per cob and the heavier grain weight.

Introduction

Maize (*Zea mays* L.) is the third most important cereal crop grown in Pakistan after wheat and rice. The intensive cropping pattern presently followed has deprived the soil of essential plant nutrients such as N, P and K. This has resulted in lowering the yield especially the fast growing crop like maize. Phosphorus is an essential nutrient for plant growth, which stimulates blooming and seed formation. Similarly potassium is well documented in photosynthesis, increasing efficiency of enzymes improving metabolism of protein carbohydrates, starch formation and for opening and closing of stomata.

Ali *et al.* (1986) reported that grain yield of maize increased with N, P and K with the highest yield when applied with 150 kg N + 150 kg P and 75 kg K/ha. Rizvi *et al.* (1988) reported that in maize crop maximum grain yield of 3133 kg/ha was obtained with the application of 100-100-50 NPK kg/ha. Sikra (1991) obtained fertilizer-use efficiency in maize at 11.07 kg grains/kg NPK applied on alluvial soil. Wu *et al.* (1993) observed that NPK at 150-65-65 produced the higher grain yield of 11.32 t/ha as compared to control yield of 7.30 t/ha. Kumpawat and Rathore (1995) obtained the highest grain yield in maize with 120 kg N + 60 kg P₂O₅ per hectare but K application did not show significant effect. Sharif *et al.* (1993) in a field trial on maize cv. Azam obtained the highest grain yield and 1000-grain weight with the application of 120 kg N + 90 kg P₂O₅ + 120 kg K₂O/ha. Alias (1997) reported that application of phosphorus at the rate of 125 kg/ha to maize Cv. "Composite-17" significantly increased total leaf area, plant height, cob length, number of grain rows per cob, number of grains per row, 1000-grain weight, harvest index and grain yield of 5.71 t/ha.

Keeping in view the above mentioned importance of phosphorus and potassium present study was designed to select the best suited combinations of phosphorus and potassium levels for maize productivity.

Materials and Methods

The effect of phosphorus and potassium nutrition on the growth and yield of hybrid maize "Shahensha" was carried out at the Agronomic Research Area, University of Agriculture, Faisalabad during the year 1997. The experiment was laid out in randomized complete block design (RCBD), with three replications using a net plot size of 3 m x 10.5 m. The experiment comprised of varying combinations of Pk viz. 75-50 (F₁), 75-75 (F₂), 75-100 (F₃), 100-50 (F₄), 100-75 (F₅), 100-100 (F₆), 125-50 (F₇), 125-75 (F₈) and 125-100 (F₉) kg/ha in addition to control. A standard basal dose of nitrogen at 150 kg/ha was applied in all plots.

The maize hybrid "Shahensha" was sown on 8th of August, 1997 using a seed rate of 30 kg/ha in 60 cm apart rows with the help of single row hand drill. Nitrogen, phosphorus and potassium were applied in the form of urea, TSP and K₂SO₄ respectively. The plants were thinned at 23 cm apart when the crop was 15 cm high. Furadon was applied at the rate of 20 kg/ha to check the attack of stem borers. The crop was given 9 irrigations in addition to 209.2 mm rainfall received during the growing period and field was kept weed free throughout the season. All other agronomic practices were kept normal and uniform for the all treatments. The crop was harvested on 12th of November 1997.

The data were collected by following the standard procedures on plant height at maturity, leaf area per plant at tasseling, number of grain rows per cob, number of grains per row, 1000-grain weight, grain yield and harvest index.

Data collected were analyzed statistically using Fisheries Analysis of Variance Technique and least significant difference (LSD) test at 5% probability level was applied to compare the differences among treatment means (Steel and Torrie, 1984).

Table 1: Interactive effect of phosphorus and potassium nutrition on the yield and parameters in maize

Treatments	Fertilizer rates (kg/ha)		Plant height at maturity	Leaf area per plant at tasseling	No. of grain rdws/	No. of grain /row	1000-grain weight (g)	Grain yield (t/ha)	Harvest index (%)
	P	K							
F0		Control	184.5g	3424.09h	13.30g	24.60h	372.4h	4.20h	31.73
F1	75	50	187.6f	4045.61g	13.60f	27.00g	384.19	4.50g	31.58
F2	75	75	189.4ef	4210.61f	13.70ef	27.70f	386.5f	4.67f	31.55
F3	75	100	191.4e	4458.64e	13.83de	28.03rf	388.6e	4.741	31.36
F4	100	50	183.5d	4582.25de	14.00d	28.47de	390.8d	4.78f	31.55
F5	100	75	196.7c	4608.27d	14.20c	28.70d	392.6d	4.99e	31.67
F6	100	100	198.4c	4795.94c	14.30bc	29.30c	395.8c	5.20d	31.85
F7	125	50	202.4b	4816.36c	14.40b	30.23b	400.4b	5.51c	31.14
F8	125	75	208.4a	5272.54a	15.10a	30.83a	405.2a	6.02a	31.35
F9	125	100	207.4a	5015.33b	15.00a	30.40ab	404.4a	5.83b	31.29
S. E.			0.70	44.58	0.058	0.16	0.66	0.05	0.75

Results and Discussion

The data on the grain yield and different yield parameters are presented in Table 1. It is evident from the data that the plant height at maturity in all the fertilized plots was significantly greater than that of control plot (F₀). The crop raised with PK doses of 125-100 and 125-75 PK kg ha⁻¹ produced the tallest plants as compared to rest of the treatments. On contrary, crop grown without P and K application (F₀) produced plants with the lowest plant height (184.5 cm).

Maximum leaf area of 5272.54 cm² per plant at tasseling was obtained from the plot fertilized at the rate of 125-75 PK kg ha⁻¹ (F₈) which was followed by treatment F₉ (125100 PK kg/ha) among the treatments F₆, F₇, and F₄, F₅. The lowest leaf area of 3429.09 cm² was recorded for control plot (F₀). Similar results have been reported by Alias (1997). Application of all PK doses to maize crop resulted in higher number of grain rows per cob as compared to control (13.50). Within the fertilizer treatments the highest number of grain rows per cob was found in case of plots treated with PK doses of 125-75 kg/ha (F₈) & 125-100 kg ha⁻¹ (F₉).

The difference in the number of grains per row were found highly significant and the maximum number of grains per row of 30.83 was recorded from treatment F₈ (125-75 PK kg/ha) which was statistically at par with F₉ (125-100 PK kg/ha). On the contrary, the lowest number of grains per rows was recorded for control (F₀).

Application of PK at the rate of 125-75 kg ha⁻¹ (F8) gave maximum 1000-grain weight of 405.2 g which was at par with treatment F₉ (125-100 PK kg/ha). The crop raised without P and K application (F₀) produced grains with the lowest 1000-grain weight (372.4 g). These results are in line with the findings of Sharif *et al.* (1993).

Differences in grain yield were highly significant and maximum grain yield of 6.02 t/ha was recorded in case of treatment F₈ (125-75 PK kg ha⁻¹) followed by 5.83 t/ha in treatment F₉ (125-100 PK kg ha⁻¹). Difference between treatments F₂, F₃ and F₄ were non-significant but yield increased significantly with the increasing levels of P and K

from treatment F₅ to F₇. The lowest grain yield of 4.20 t ha⁻¹ was observed in case of control plot (F₀). Similar promotive effects of phosphorus and potassium and grain yield of maize have been reported by Ali *et al.* (1986), Rizvi *et al.* (1988) and Alias (1997).

The data shows that harvest index was not affected significantly by various PK doses. However, harvest index values ranged between 31.14 and 31.85 for different treatments.

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