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Effects of Different Phosphorus Levels on the Growth and Yield of Two Cultivars of Maize (*Zea mays* L.)

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ABSTRACT

A field experiment was conducted to evaluate the effect of various levels of phosphorus (0, 50, 75, 100, 125 and 150 kg ha^{-1}) on the yield and yield components of two maize cultivars viz "Golden" and "composite -17". Leaf area per plant, number of grains per cob and 1000- grains weight was significantly increased by increasing levels of P. Maximum grain yield, number of grains per cob and 1000 grain weight was observed at 125 kg P ha^{-1}. On overall basis cv. "Composite -17" performed better than cv. "Golden".

Key Words: Phosphorus; Maize; Fertilizer

INTRODUCTION

Maize (*Zea mays* L.) is the third most important cereal crop of the world after wheat and rice. It is grown on an area of 0.970 thousand hectares with annual production of 1758 thousand tones given an average yield of 1810 kg per hectare (Anonymous, 2003). Being a short duration crop, it either permits raising of two maize crops or vacate the land in time for the sowing of another crop in the same field, thus making it possible to produce more food from a given area.

Inspite of favorable soil and climatic conditions and availability of high yielding varieties, the yield recovery in the farmer's field is very low in Pakistan as compared to other maize growing countries, possibly due to injudicious use of inputs and lack of quality seed. Earlier studies reveal that the quality and yield of maize crop is significantly increased with combined effect of NP fertilizer application (Anwar, 1980; Javed, 1982). Similarly, days taken to tesseling, silking and maturity and leaf area are significantly affected by increasing phosphorus levels in case of newly evolved variety "Composite-17" against "Sultan" (Hur, 1993).

The present study was undertaken to find out growth and yield responses of maize varieties "Composite-17" and "Golden" grown in irrigated conditions of Faisalabad.

MATERIALS AND METHODS

Studies pertaining to the effect of varying levels of phosphorus on yield and yield components of two maize cultivars was conducted on a sandy loam soil, (0.057% N, 7.45 ppm P_2O_5 and 236 ppm K_2O). The experiment was comprised of six P levels viz 0, 50, 75, 100, 125 and 150 kg ha^{-1}. The experiment was laid out according to randomized complete block design with split plot arrangement giving more importance to fertilizer. Each treatment was replicated thrice. Crop was sown in the field by single row hand drill. All of phosphorus according to treatments and half of nitrogen was side dressed at sowing in the form of dimonium phosphate and area respectively. The remaining dose of nitrogen was side dressed at 4 leave stage. Thinning was done when crop attained the height of about 15 cm. The crop was harvested at maturity and data regarding plant height, leaf area per plant, number of grains per cob, 1000-grain weight, grain yield and stover yield, were collected. The data thus recorded were analyzed statistically by following standard procedures (Steel & Torrie, 1980) and differences among treatment means were compared by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Plant height at maturity. Phosphorus fertilizer influenced the plant height of maize significantly over control (Table I) but the results were not consistent, maximum plant height (195.9 cm) was recorded where P was applied 125 kg ha^{-1}. P levels below or beyond this exhibited reduced plant height i.e., 166.5 cm, 188.2 cm, a88.35 cm, 188.6 cm and 183.85 cm. As far as cultivars are concerned, "composite-17" produced taller plants (187.2 cm) than cv. Golden. Whereas the interaction between phosphorus levels and maize genotypes was found to be non-significant. Similar results were reported by Javed (1982).

Leaf area per plant at tesseling. Leaf area per plant was increased progressively with increasing level of P from 0 to 150 kg ha^{-1}. Maximum leaf area (3937.18 cm^2) was recorded from the plots fertilized @ 125 kg P ha^{-1} and it was at par to the plots fertilized @ 150 kg P ha^{-1} giving 3935.4 cm^2 leaf area. Significantly least value for leaf area (2850.32 cm^2) was recorded in control. These results are in line to those of Shah (1984) and Ahmad (1989). Among the two maize genotypes maximum leaf area (3628.5 cm^2) was observed in case of cv. "Composite-17". This might be due to the difference in genetic potential and plant characteristics of both varieties. Nagy (1984) also reported similar findings.

Number of grains per cob. Increasing rates of phosphorus fertilizer greatly affected the number of grains per cob. Maximum number of grains per cob (270.6) was recorded against application of 125 kg P ha^{-1} which was followed by treatment F_4 (100 kg P ha^{-1}) producing 242 grains per cob. Whereas, the differences between treatment F_6 (150 kg P ha^{-1}) and F_3 (75 kg P ha^{-1}) were non-significant.

Minimum number of grains per cob (183) was observed in control (Table I). This trend might be due to role of phosphorus in crop maturation, flowering and fruiting including seed formation. These results are in accordance with those of Ahmad (1989).

Regarding comparison of varieties, "Composite-17" produced significantly higher number of grains per cob a compared to "Golden" which might be due to difference in genetic make-up of the two varieties. These results are supported by the findings of Toor (1990).

1000-grain weight (g). It is obvious from the Table I that results pertaining to 1000-grains weight in all the treatments differed significantly from one another and the highest 1000-grain weight (280.35 g) was obtained from the plots fertilized @ 125 kg P ha^{-1}, which was followed by treatment F_6 (150 kg P ha^{-1}) giving 260-3 g. 1000-grain weight.

The increase in 1000-grain weight with increasing P levels might be due to improvement in source-sink relationship. These results are supported by the findings of Ahmad(1989) and Toor (1990).

In case of genotypes significantly highest 1000-rain weight of 250.6 g was recorded for the "Composite-17" than that of cv. Golden exhibiting 235.7 g 1000- grain weight.

The difference might be due to the difference in P uptake by both the genotypes. "Composite-17" gave best results in the plot fertilized @ 125 kg P ha^{-1} as compared to cv. "Golden" showing significant interaction between genotypes and phosphorus levels.

Grain yield (t ha^{-1}). Data regarding grain yield ha^{-1} is presented in Table I. It reveals that application of phosphorus @ 125 kg ha^{-1} resulted in the highest grain yield of 5.32 t ha^{-1} (F_5) which was followed by treatment F_4 (100 kg P ha^{-1}) and F_6 (150 kg P ha^{-1}) yielding 4.42 t ha^{-1} and 4.35 t ha^{-1} grain yield respectively. Control treatment (F_1) yielded significantly to the lowest extent i.e., 2.46 t ha^{-1} grain yield. Increase in grain yield per hectare in response to increasing levels of P is due to increased number of grains per cob and 1000-grain weight.

As far as varieties are concerned, cv, "Composite-17" produce significantly higher yield (4.18 t ha^{-1}) than cv. "Golden" giving 3.77 t ha^{-1} grain yield. These results are in agreement with those of Duggul (1990), Hanif (1990) and

Table I. Growth and yield of two maize genotypes as affected by different phosphorous levels

Fertilizer levels NP kg ha^{-1}	Plant height at maturity (cm)	Leaf area per plant at tesselling (cm^2)	No. of grains per cob	1000-grain weight (g)	Grain Yield (t/ha)	Stover Yield (t/ha)	Harvest Index (%)
Fertilizers							
F_1 (0-0)	166.5 d	2850.32 e	183 e	196.3 E	2.46 d	8.63 e	28.5 d
F_2 (150-50)	188.35 b	3471.4 d	211 d	222.53 d	2.26 e	10.26 d	31.83 c
F_3 (150-75)	188.2 b	3648.9 c	238 c	244.35 c	4.07 c	10.40 cd	39.09 b
F_4 (150-100)	183.85 c	3822.68 b	242 b	260.73 b	4.42 b	10.67 c	41.49 a
F_5 (150-125)	195.9 a	3937.18 a	270 a	280.35 a	5.32 a	12.84 a	41.35 a
F_6 (150-150)	188.6 b	3935.4 a	239 c	260.3 b	4.35 b	12.27 b	35.43 c
Varieties							
V_1 Golden	183.2 b	3593.3 b	227 b	237.5 b	3.77 b	10.65 b	35.08 b
V_2 Composite-17	187.2 a	3628.5 a	235 a	250.6 a	4.189 a	11.04 a	37.86 a

Table II. Comparison of interaction between varieties and fertilizer phosphorus levels

Varieties	Fertilizer levels NP kg/ha					
	F_1 (0-0)	F_2 (150-50)	F_3 (150-75)	F_4 (150-100)	F_5 (150-125)	F_6 (150-150)
1000-grain weight (g)						
V_1-Golden	196.4 f	213.6	232.5 d	255.3 c	268.26 b	254.4 b
V_2-Composite-17	196.2 f	231.5 c	256.2 c	266.2 a	292.4 b	261.2 b
Grain yield (t/ha)						
V_1-Golden	2.42 f	3.03 e	3.78 c	4.26 b	4.87 a	4.28 b
V_2-Composite-17	2.50 f	3.49 d	4.35 c	4.59 b	5.77 a	4.41 b
Straw yield (t/ha)						
V_1-Golden	8.52	10.17 d	10.25 d	10.52 b	12.43 b	12.03 b
V_2-Composite-17	8.74	10.34 d	10.56 c	10.83 c	13.26 a	12.51 b
Harvest index (%)						
V_1-Golden	28.43 d	29.84 d	36.92 c	40.54 b	39.20 b	35.58 c
V_2-Composite-17	28.63 d	33.82 c	41.27 b	42.45 b	43.5 a	35.28 c

Any two means not sharing a single letter in common differ significantly

Toor (1990), who reported that fertilizer application invariably increased 1000-grains weight, grains and stalk yield. Variety "composite-17" with the application of 125 kg P ha^{-1} produced highest grain yield of 5.77 t ha^{-1}.

Stover yield (t ha^{-1}). Stover yield was significantly increased with increasing levels of phosphorus. The highest stover yield (12.84 t ha^{-1}) was observed in response to application of 125 kg P ha^{-1}, followed by P level at 150 kg P ha^{-1} giving 12.27 t ha^{-1} stover yield. The control treatment produced significantly the lowest stove yield of 8.63 t ha^{-1} (Table I). Ahmad (1989) had also reported almost similar findings. In case of genotypes the stover yield was significantly higher in cv. "Composite-17" than in cv, "Golden" yielding 11.04 t ha^{-1} and 10.65 t ha^{-1} stover yield, respectively. These results are inline with those of Hanif (1990). The interaction comparison (v x F) show that "Composite-17" proved to be more responsive to P application than Golden against application of 125 kg P ha^{-1} yielding 13.26 and 12.43 t ha^{-1} stover yield, respectively (Table II).

Harvest Index. Harvest index values in response to phosphorus application @ 100 kg P ha^{-1} and 125 kg P ha^{-1} were significantly higher than rest of all the treatments, giving 41.49 and 41.25 harvest index values, respectively (Table I). Harvest index values recorded @ 75 kg P ha^{-1} and 150 kg P ha^{-1} were statistically similar to each other. These results are in accordance to those of Ahmad (1989).

In case of varieties cv. Composite-17 exhibited significantly higher value of harvest index (37.86) than that of cv. "Golden" showing 35.08 harvest index value. While comparing the interaction between verities and phosphorus levels, cv, "Composite-17" proved to be best (Table II).

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