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Effect of Phosphorus Levels on Yield Components, Grain Yield and Harvest Index of Two Maize Varieties

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Abstract: The investigation to see the effect of different phosphorus level Viz., 0,50,75,100 and 125 kg P_2O_5 ha^{-1} with a recommended constant dose of nitrogen @ 150 kg ha^{-1} on two maize varieties was carried out. The experiment was laid out in Randomized Complete Block Design (factorial) with four replications. The maize cultivars included were Composite-17 against a standard variety Akbar. Both the varieties showed almost a similar growth and yield behaviour. Application of phosphorus increased a number of yield parameters over control such as cob bearing plants, weight of grains per cob, 1000-grain weight and grain yield. However, the difference between phosphorus levels was not always significant.

Key words: Maize Phosphorous levels, yield components, harvest index

Introduction

Soil and climatic conditions of Pakistan are ideal for maize production. But in spite of favourable conditions and high yielding varieties, the yield recovery at farmers fields in Pakistan is very low as compared to other maize growing countries. The reason for low yield may be the injudicious use of inputs, lack of quality seed, plant protection measures and unavailability of irrigation water at critical growth stages. However, the use of suitable fertilizers in appropriate doses to fertilizer responsive varieties of maize greatly affects the crop yield. Although considerable work to determine a suitable dose of fertilizer for different maize cultivars has been done in the past. The newly evolved maize genotypes with different growth behaviour for exploring their yield potential, necessitate readjustment of their fertilizer requirements. The present study was, therefore, undertaken to find out growth and yield response of a newly evolved maize variety "Compsite-17", to varying phosphorus levels against a standard variety "Akbar" grown in irrigated conditions at Faisalabad.

Materials and Methods

The investigation to see the effect of different phosphorus level Viz., 0,50,75,100 and 125 kg P_2O_5 ha^{-1} with a recommended constant dose of nitrogen @ 150 kg ha^{-1} on the leaf growth of two maize varieties was carried out at Faisalabad. The experiment was conducted on a sandy clay loam soil, having initial NPK level of 0.05% of nitrogen, 7.51 ppm of phosphorus and 246.6 ppm of potash, respectively. The experiment was laid out in Randomized Complete Block Design (factorial) with four replications and the net plot size measured 3.6 x 7.0 m. The maize cultivars included were Composite-17 against a standard variety Akbar. Urea, SSP and SOP were applied as a source of N, P and K, respectively. The whole quantity of Phosphorus, potassium and one third of nitrogen as a basal dose was applied at the sowing time, except control. The remaining two third of nitrogen was applied in equal splits at two to three leaf and tasseling stages. The crop was sown on a well prepared seed bed with the help of a single row hand drill during the second week of August. The inter row spacing was 60 cm, while intra row spacing was kept at 25 cm by thinning the crop at the height of 15 cm. First irrigation was given 18 days after sowing, while the subsequent irrigations were applied according to the need of crop. Earthing up was done 30 days after sowing. Hoeing was done twice to keep the crop free from weeds. All other agronomic practices were kept normal. The observations on the growth and yield parameters of the crop were recorded following the standard procedures.

The data collected was subjected to Fisher's analysis of Variance Technique at 5% probability. (Steel and Torrie,1984). Pairwise comparisons were made by Tukey's method as given below: Least Significant Difference (LSD) = S.E. of means X Q (K, df). Q (K. df) was obtained from tables of the studentized range, where K = the number of means to be compared and d.f. = errors degree of freedom.

Results and Discussion

Number of plants per plot at harvest: Number of crop in a field and their distribution play an important role in determining the success of a crop. Plant population is pre-

requisite of plant per plot are presented in Table 1. Plant population per plot at harvest is the king pin of yield in different crops. The data regarding plant population showed that there was no difference among the treatments under study. Plant population ranged between 117 to 182.38 plants per plot. The non-significant difference between the treatments means may be due to the reason that plant population was maintained by thinning. These results are according are those of Shah (1984), Toor (1990), Hassan (1991) and Hur (1993).

Number of cob bearing plants per plot: Number of cob bearing plants has a direct effect on the final grain yield of maize. Analyzed data regarding the number of cob bearing plants per plot presented in Table 2 showed highly significantly differences among various levels of phosphorus under study. Maximum numbers of cob bearing plants (149.25) were observed in plot where phosphorus was applied @75 kg P_2O_5 ha^{-1} (F2) with a basal dose of 150 kg N ha^{-1} as against the control treatment where number of cob bearing plants were 123.00 per plot. The differences among the various fertilizer levels were, however, not significant. These results are in agreement with those of Blagovesta (1981), Hussain *et al.* (1980) and Hur (1993).

The difference between cultivars was also highly significant. Out of the two maize cultivars, number of cob being plants in variety "Akbar" was significantly higher (148.25) than the " composite-17" (134.35). These results indicate that varieties different in their number of cob bearing plant due to the differences in their genetic potential. The interaction between two factors (Variety x fertilizer) was found to be non-significant.

Number of cobs per plant: Number of cobs per plant is an other important character in maize which ultimately affects the grain yield per hectare. Data regarding the number of cobs per plant presented in Table 3 reveal that different phosphorus levels and varieties did not significantly affect the number of cobs per plant. It seems that number of cobs per plant is basically an inherent capability of a crop per plant and is influenced by crop nutrition. These results are in accordance to those of Ahmad (1989) and Hur (1993)

Number of grains per cob: Number of grains per cob is another important yield component of maize. The data for numbers of grains per cob are represented in Table 4. It is clear from the data that the number of grains per cob was significantly affected by the different phosphorus levels. Among the various fertilizer treatments, the plot applied with 100 kg $P_2O_5 ha^{-1}$ produced significantly more number of grains per cob (519.46) than control, whereas all other phosphorus levels remained at par. Minimum number of grains per cob were observed in the control treatment. These results are well supported by the findings of Arian *et al.* (1989), Hassan (1991) and Hur (1993) and Ahmed (1989).

The differences between varieties were found to be non-significant. However, composite-17 produced more number of grains per cob (499.50) as compared to variety "Akbar", where the numbers of grains per cob on an average were found to be 468.8. These results are agreement to those of Toor (1990). The interaction between varieties and fertilizer levels were also non-significant.

Weight of grains per cob (g): Weight per cob influences directly the final grain yield per hectare. Data regarding the grain weight per cob presented in Table 5, showed highly significant differences among the various phosphorus levels. Among the various phosphorus levels, the plot applied with 100 kg P_2O_5 ha^{-1} resulted in more grain weight per cob (117.55) and it was significantly the highest than control but at par with other phosphorus levels. These are supported by Ahmed (1989) and Chaudhry *et al.* (1989).

The differences between varieties were found to be non-significant. The results are contradictory with those of Chaudhry *et al.* (1989) and Duggul (1990). The interaction between varieties and phosphorus levels were found to be non-significant.

1000-grain weight (g): 1000-grain weight expresses the magnitude of seed development which is an important factor for deriving the grain yield per hectare. Weight of 1000-grain was recorded in grams and the data collected are represented in Table 5, which shows that all the phosphorus levels except control remained at par with each other. Highly significant differences were found among the control and phosphorus levels @50 and 100 kg $P_2O_5 ha^{-1}$.

These results support the findings of Hussain (1976), Ahmed (1989) and Chaudhry *et al.* (1989). The difference between varieties was found to be non-significant. This may be attributable of genetic make up of a variety. These results are partly in agreement with those of Hur (1993) and contradictory to those of Chaudhry *et al.* (1989). Similarly the interaction between the varieties and fertilizer level was also found non-significant.

Grain yield (t ha^{-1}): The final grain yield per hectare in maize crop is the combined effect of various yield

Table 1: Effect of different phosphorus levels on number of plants per plot at harvest in two maize varieties

	Phosphorus levels (Kg P_2O_5 ha^{-1})					
Varieties	0	50	75	100	125	Mean
V1. Akbar	179.750	182.00	179.500	177.00	177.500	179.15
V2. Composite	179.750	182.750	178.500	178.750	178.500	179.05
Mean	179.750	182.375	179.00	177.875	178.00	----

Table 2: Effect of different phosphorus levels on number of cob bearing plants per plot at harvest in two maize varieties

	Phosphorus levels (Kg P_2O_5 ha^{-1})					
Varieties	0	50	75	100	125	Mean
V1. Akbar	129.750	157.50	149.750	148.250	255.750	148.25a
V2. Composite	116.250	134.250	148.750	132.250	140.250	124.35b
Mean	123.00b	146.00ab	149.25a	140.25ab	148.00a	--
L.S.D. (fertilizer) (0.05)	6.56					
L.S.D. (varieties) (0.05)	47.96					

Table 3: Effect of different phosphorus levels on number of cob per plot at harvest in two maize varieties

	Phosphorus levels (Kg P_2O_5 ha^{-1})					
Varieties	0	50	75	100	125	Mean
V1. Akbar	393.250	481.650	484.650	493.325	496.925	468.8
V2. Composite	407.700	519.600	521.650	545.600	503.400	499.50
Mean	400.475b	500.625a	503.150a	519.462a	500.162a	--
L.S.D. (fertilizer) (0.05)	82.25					

Table 4: Effect of different phosphorus levels on weight of grains per cob(g) in two maize varieties

	Phosphorus levels (Kg P_2O_5 ha^{-1})					
Varieties	0	50	75	100	125	Mean
V1. Akbar	84.737	107.840	108.470	110.095	112.180	104.66
V2. Composite	87.020	118.760	116.284	125.007	113.295	110.07
Mean	85.879b	113.300ab	112.376ab	117.551a	112.738ab	--
L.S.D. (fertilizer) (0.05)	20.92					

Table 5: Effect of different phosphorus levels on 1000-grain weight (g) in two maize varieties

	Phosphorus levels (Kg P_2O_5 ha^{-1})					
Varieties	0	50	75	100	125	Mean
V1. Akbar	215.325	223.625	223.500	223.100	224.875	222.08
V2. Composite	213.250	228.150	222.975	229.050	225.150	223.71
Mean	214.287b	225.887a	223.238ab	226.075a	225.012ab	--
L.S.D. (fertilizer) (0.05)	7.43					

Table 6: Effect of different phosphorus levels on grain yield (t ha^{-1}) in two maize varieties

	Phosphorus levels (Kg P_2O_5 ha^{-1})					
Varieties	0	50	75	100	125	Mean
V1. Akbar	2.794	3.697	3.560	3.348	3.348	3.337
V2. Composite	2.294	3.683	3.578	3.552	3.373	3.276
Mean	2.544b	3.690a	3.569a	3.420a	3.310ab	--
L.S.D. (fertilizer) (0.05)	0.52					

Table 7: Effect of different phosphorus levels on harvest index (%) in two maize varieties

	Phosphorus levels (Kg P_2O_5 ha^{-1})					
Varieties	0	50	75	100	125	Mean
V1. Akbar	28.110	29.950	28.795	26.855	26.667	28.07
V2. Composite	26.428	28.115	29.657	27.450	26.765	27.68
Mean	27.269	29.033	29.226	27.152	26.716	--

Any two mean not sharing a letter in common differ significantly at 5% probability level

components, like number of cob bearing plants, number of cobs per plant, number of grains per cob, weight of grains per cob and 1000-grain weight.

Data pertaining to the yield per hectare are represented in Table 6, which reveal that grain yield was significantly increased by the application of phosphorus than control,

except treatment where phosphorus was applied @ 125 kg P_2O_5 ha^{-1}. However, all P_2O_5 levels produced statistically same grain yield. Increase in grain yield per hectare by the application of phosphorus was due to higher number of grains per cob and increased 1000-grain weight. These results are in conformity with the findings of Chuiko and Ivashchenko (1980), Tsankova (1981), Grewal *et al.* (1982), Shah (1984), Ali *et al.* (1986), Ahmad (1989), Arian *et al.* (1989), Duggul (1990), Sun *et al.* (1989) and Hur (1993). The differences between varieties were found to be non-significant. Similarly the interaction between varieties and phosphorus levels were also found non-significant.

Harvest Index (%): The physiological efficiency of maize plants to convert the total dry matter into grain yield (source-sink relations) is measured in the forum of harvest index value. The higher the harvest index value, the more will be the physiological efficiency of different crops for converting the total dry matter into final grain yield. Harvest index was calculated on percentage basis in each plot. Data collected along with their statistical analysis are presented in Table 7. It is clear from analysis of variance table that phosphorus level did not significantly affect the harvest index value. It is clear from analysis of variance table an average harvest index value varied from 26.71 to 29.22%. These results cope with the findings of Ahmad (1989), Toor (1990) and Hassan (1991). The difference between varieties and their interaction with phosphorus levels was found non-significant.

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