

Interactive Effects of Nitrogen and Phosphorus on Agronomic Traits of Maize (*Zea mays* L.)

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ABSTRACT

Interactive effects of different sources of N and P on growth and yield of maize were determined at University of Agriculture, Faisalabad. The results showed that the maximum leaf area per plant (4665.5 cm²), plant height (235.30 cm), 1000-grain weight (245.23 g), grain yield (5.41 t ha⁻¹) and stover yield (14.2 t ha⁻¹) were obtained with the application of 185 kg N + 85 kg P₂O₅ ha⁻¹ as ammonium sulfate and single super phosphate respectively. The results further suggested that this treatment combination had an added advantage of ameliorating the alkalinity problem.

Key Words: Nitrogen; Phosphorus; Fertilizer; Agronomic traits; Maize

INTRODUCTION

The intensive cropping has deprived the soil of essential plant nutrients such as nitrogen, phosphorus and potassium. This has resulted in lowering the crop yields especially of the fast growing crop like maize. Nitrogen plays a dominant role in growth processes as it is an integral part of chlorophyll molecule, protein and nucleic acid (Marschner, 1986), while phosphorus stimulates blooming and seed formation. As our soils are mostly alkaline in reaction so the use of fertilizers having alkaline reaction should be avoided and those with acidic reaction may be encouraged. To overcome the gap between realized and potential yield, combined use of appropriate types of fertilizer is of prime importance as proper combination of fertilizer can increase the yield by 50% (Zia *et al.*, 1991). Vaidya (1973) stated that a combination of ammonium sulfate and single super phosphate was the most efficient combination for nitrogen and phosphorus. Zahir-ud-Din and Ismail (1984) concluded that ammonium sulfate + single super phosphate resulted in more yield than other combinations. Hefner and Tracy (1989) found that ammonium sulfate was more effective than ammonium nitrate and urea. Bajwa *et al.* (1991) observed that phosphal was agronomically equally efficient as single super phosphate for rice but less so by 15 and 27% for wheat and maize respectively. Kala (1994) tested the efficiency of single super phosphate, triple super phosphate and phosphal and concluded that single super phosphate and triple super phosphate were at par but significantly better than phosphal.

Keeping all this in view the present study was planned to determine the interactive effects of different nitrogen and phosphorus fertilizers on the agronomic traits of maize under irrigated conditions in Faisalabad soils.

MATERIALS AND METHODS

The experiment was conducted at the agronomic research area, University of Agriculture, Faisalabad. The crop was sown on a well prepared seedbed in the first week of August in a randomized completed block design having three replications and a net plot size of 3m x 6m. The treatments comprised ammonium sulfate + diammonium phosphate (T₁), urea + diammonium phosphate (T₂), ammonium nitrate + diammonium phosphate (T₃), ammonium sulphate + single super phosphate (T₄), urea + single super phosphate (T₅), ammonium nitrate + single super phosphate (T₆), ammonium sulphate + triple super phosphate (T₇), urea + triple super phosphate (T₈) and ammonium nitrate + triple super phosphate (T₉). The recommended dose of fertilizer was 185 kg N and 85 kg P₂O₅ ha⁻¹. The crop was kept free of weeds by hoeing and hand weeding to avoid competition between weeds and maize crop. All other cultural practices were kept normal and uniform for all treatments. Observations on desired parameters were recorded using standard procedures. The data collected were analyzed by using Fisher's analysis of variance technique and differences among treatments means were compared by the LSD test at P = 0.05 (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Plant height. The data on final plant density at harvest revealed non-significant differences among different treatments and the average plant density m⁻² ranged from 8.5 to 8.6.

Leaf area. Leaf area per plant plays a key role in the plant photosynthetic production and it determines the

crop growth rate. The combination of ammonium sulfate + single super phosphate produced the maximum leaf area plant⁻¹ (4665.5 cm²) while the minimum leaf area was recorded in treatment T₂ which was statistically at par with treatments T₆ and T₉. Similar results were reported by Zahir-ud-Din and Ismail (1984).

Plant height. The data regarding plant height revealed that plant height was influenced differently by various combinations of nitrogenous and phosphatic fertilizer sources. Application of ammonium sulfate + single super phosphate produced the maximum plant height (235.3 cm). The minimum plant height was obtained in treatment T₂ i.e. urea + diammonium phosphate (210.4 cm). These results are in accordance with the findings of Zahir-ud-Din and Ismail (1984) but are contradictory to those of Johnson (1993) who reported that ammonium sulfate + diammonium phosphate produced relatively better results in terms of plant height.

for the combination of urea + diammonium phosphate. Vaidya (1973) reported similar results.

Grain yield. Grain yield is the result of interaction between the genetic make up of the variety and the environmental conditions prevailing during the period of the crop growth. The data on grain yield of maize indicated that the maximum grain yield (5.41 t ha⁻¹) was produced by the combination of ammonium sulfate + single super phosphate (T₄). The minimum grain yield was recorded in treatment T₁ comprising ammonium sulfate + diammonium phosphate (3.75 t ha⁻¹) which was statistically at par with the T₂. These results are in line with those of Dhua (1972) but are contradictory to those of Sheikh *et al.* (1987) who reported that different nitrogenous and phosphatic sources of fertilizers did not affect significantly the grain yield of wheat.

Stover yield. The maximum tonnage of stover (14.2 t ha⁻¹) was produced by the application of ammonium sulphate + single super phosphate (T₄) and was

Table I. Yield and yield parameters in maize as influenced by various sources of N and P fertilizers

Treatments	Plant density (m ⁻²)	Leaf area (cm ² plant ⁻¹)	Plant height (cm)	No. of cobs plant ⁻¹	1000-grain (g)	Grain yield (tha ⁻¹)	Stover yield (tha ⁻¹)	Harvest index
T ₁ AS+DAP	8.5 ^{N.S.}	3974.75 def	216.03 cd	1.00 ^{N.S.}	190.40 g	3.75 f	11.7 d	24.28 d
T ₂ Urea+DAP	8.6	3707.01 g	201.40 g	1.03	186.43 h	3.98 ef	10.8 e	26.92 ab
T ₃ AN+DAP	8.5	4141.04 cd	218.47 c	1.07	210.03 d	4.50 cd	12.6 c	26.38 abc
T ₄ AS+SSP	8.5	4665.50 a	235.30 a	1.10	245.23 a	5.41 a	14.2 a	27.60 a
T ₅ Urea+SSP	5.6	4332.92 bc	215.43 cde	1.07	222.87 c	4.79 bc	12.7 c	27.31 a
T ₆ AN+SSP	8.6	3804.41 efg	208.47 f	1.10	189.87 g	4.17 e	10.9 e	27.69 a
T ₇ AS+TSP	8.5	4039.48 de	212.17 cde	1.10	201.93 e	4.21 de	12.5 c	25.15 cd
T ₈ Urea+TSP	8.6	4396.64 b	228.65 b	1.13	227.90 b	4.95 b	13.3 b	27.11 ab
T ₉ AN+TSP	8.5	3918.50 defg	211.57 def	0.97	155.70 f	4.32 de	12.3 c	25.87 ec
LSD	-	250.1	6.53	-	4.38	0.36	0.13	1.34

Any two means within a column not sharing a letter differ significantly at 0.05%.

N.S. = Non-significant.

Number of cobs per plant. Different fertilizer combinations had non-significant effect on the number of cobs per plant and the average number of cobs per plant was in range of 0.97 to 1.13.

1000-grain weight. The weight of 1000-grains represents the magnitude of grain development that reflects to the final yield. The comparison of treatment means showed that maximum 1000-grain weight (245.23 g) was obtained from a combination ammonium sulfate + single super phosphate but the minimum 1000-grain weight (186.43 g) was recorded

followed by urea + TSP treatment (T₈) while application of urea + DAP (T₂) resulted in the minimum stover yield (10.8 t ha⁻¹).

Harvest index. All the sources of nitrogenous and phosphatic fertilizers resulted in significant difference in harvest index values. The maximum harvest index was obtained from the treatment (T₆) ammonium nitrate single super phosphatic which was statistically at par with treatment T₄ (Ammonium sulfate + single super phosphate) and T₅ (urea + SSP). These results are in accordance with the findings of Dhua (1972) and Vaidya (1973).

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