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Effect of Different Nitrogen and Phosphorus Sources on The Growth and Grain Yield of Maize (*Zea mays* L.)

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Abstract: The effect of different NP sources viz., urea + single super phosphate (SSP), Ammonium nitrate (AN) + SSP, ammonium sulphate (AS) + SSP, Urea + Triple super phosphate (TSP), AN + TSP and AS + TSP on the growth and grain yield of maize was studied in the Agronomic Research Area, University of Agriculture, Faisalabad during the year 1997. A quadruplicated experiment was arranged in a randomized complete block design measuring a net plot size of 3m × 8m. The combination of ammonium sulphate and single super phosphate produced significantly higher plant height, leaf area plant^{-1} and grain yield (5.41 t ha^{-1}) than all other combinations. The increased yield was mainly associated with higher 1000-grain weight. Number of cobs plant^{-1} and number of grain rows cob^{-1} were statistically similar in all combinations of NP sources. The combination of AS + SSP seems to be the most suitable one for obtaining higher grain yield of maize in Faisalabad conditions.

Key words: Maize, NP sources, growth and grain yield

Introduction

Maize is the third most important cereal crop in Pakistan after wheat and rice. It plays an important role in the national economy. In spite of all efforts made in the past, the average grain yield of maize (1432 kg ha^{-1}) is still much lower than yields obtained in many other countries of the world like New Zealand, Austria and Korea Republic having average yields of 9778, 9186 and 4168 kg ha^{-1}, respectively (Anonymous, 1998). Judicious use of fertilizers is considered one of the most important factor which could increase maize yield on per unit area basis. Among the nutrients applied, nitrogen and phosphorus are considered most essential elements for plant growth. The use of correct fertilizer can increase yield upto 50% (Zia *et al.*, 1991). Contradictory results have been reported on the use of N and P sources. According to Muirhead *et al*. (1985), dry matter yield was not affected significantly by different sources of nitrogen. Similarly Yibirin *et al.* (1996) reported that urea, ammonium chloride, calcium nitrate and urea mixed with calcium nitrate (1:1) have similar effect on dry matter accumulation at all stages of corn development. But Watson (1987) reported that ammonium nitrate was the most efficient source of nitrogen fertilizer as compared to urea and ammonium sulphate in terms of dry matter production and nitrogen recovery of the crop. Khan (1968) reported that ammonium nitrate produced higher spike length, number of grains spike^{-1} and grain yield as compared to urea and nitrophos, however, plant population, plant height and 1000-grain weight were not affected significantly by different nitrogen sources. Similarly, Zafar (1996) reported a non-significant effect of different NP sources on plant population and number of cobs plant^{-1}. The fertilizer combination of ammonium sulphate and single super phosphate gave significantly higher leaf area, 1000-gram weight, plant height, grain yield, stalk yield and harvest index. Singh (1984) reported that triple super phosphate increased the total leaf area per plant and uptake of phosphorus more than nitrophos. Raghuram *et al.* (1977) observed that single super phosphate was more efficient source of phosphorus than triple super phosphate and diammonium phosphate in terms of grain yield of maize. Whereas, Osiname and Sobulo (1985) reported that basic slag, single super phosphate and triple super phosphate were equally good sources of phosphorus for maize crop. Thiagalingam and Atanasi (1995) applied rock phosphate and triple super phosphate as phosphorus sources to maize crop and reported that triple super phosphate was better utilized by plant growth than rock phosphate. Present study was planned to find the most suitable sources of nitrogen and phosphorus for obtaining the optimum grain yield of maize in Faisalabad conditions.

Materials and Methods

The effect of different nitrogen and phosphorus sources i.e., Urea + single super phosphate (SSP), Ammonium nitrate (AN) + single super phosphate, Ammonium sulphate (AS) + single super phosphate, Urea + Triple super phosphate (TSP), Ammonium nitrate + triple super phosphate and Ammonium sulphate + triple super phosphate on growth and yield of maize was studied at the Agronomic Research Area, University of Agriculture, Faisalabad during the year 1997. Experiment was quadruplicated in randomized complete block design having a net plot size of 3m x 8m. Before sowing the crop, soil samples were taken from different places of the field upto a depth of 30 cm by using a soil sampler. The composite soil sample was analyzed for pH and NPK status of the soil. The soil was having pH 8.2, 0.044 % nitrogen, 10.89 ppm available phosphorus and 265 ppm available potassium. The crop was sown with the help of single row hand drill on a well prepared seedbed in 60 cm apart rows, using seed rate of 30 kg ha^{-1}. The nitrogenous and phosphatic fertilizers were applied at the rate of 185 and 85 kg ha^{-1}, respectively. The full dose of phosphorus and 1/3 nitrogen was side drilled at the time of sowing. The remaining nitrogen was applied in two equal splits i.e., 1/3 with Ist irrigation and 1/3 at grain filling stage. To obtain desired number of plants, thinning was done at four-leaf stage, keeping a distance of about 20 cm between plants. Hand hoeing was done to control weeds. All other cultural practices were kept uniform and normal for all the treatments. Crop was harvested manually on November 25, 1997. The data thus collected were analyzed statistically using the Fisher's analysis of variance technique and treatment means were compared using the LSD test at 5% level of probability (Steel and Torrie, 1984).

Results and Discussion

Plant height at maturity: The height of a plant is influenced by its genetic make up and as well as the prevailing environmental conditions during the growth period of the crop. The data given in Table 1 showed that the different sources of nitrogen and phosphorus fertilizers have significant effect on plant height. The application of ammonium sulphate + single super phosphate produced significantly taller plants (235.30 cm) than all other treatments and was followed by treatment combination of urea + triple super phosphate which produced plant height of 228.63 cm. Minimum plant height (208.47 cm) was obtained from treatment combination of ammonium nitrate + single super phosphate which was statistically at par with treatments of ammonium nitrate + triple super phosphate and ammonium sulphate + triple super phosphate giving plant heights of 211.57 and 212.17 cm, respectively. Zafar (1996) have also reported significant effect of NP sources on plant height.

Leaf area plant^{-1}: Leaf area plant^{-1} was influenced significantly by NP sources. The application of ammonium sulphate alongwith single super phosphate gave significantly higher leaf area plant^{-1} (4665.50 cm^2) than all other treatments and was followed by treatment combinations of urea + triple super phosphate and urea + single super phosphate having average leaf area plant^{-1} of 4397.14 cm^2 and 4339.92 cm^2, respectively. The minimum leaf area (3804.41 cm^2) was recorded from plots receiving the application of ammonium nitrate + single super phosphate. The results are in conformity with those of Zafar (1996), but are contradictory to those of Singh (1984). These contradictory results might have been due to differences in fertility status of the soil.

Number of cobs plant^{-1}: The number of cobs plant^{-1} was not influenced significantly by NP sources under study. The number of cobs plant^{-1} ranged from 1.00 to 1.08. It is obvious from the results that the number of cobs plant^{-1} may not be influenced by management practices and this seems to be a genetic character. These results are quite in line with those of Zafar (1996).

Number of grain rows cob^{-1}: The data showed that number of grain rows per cob was not influenced significantly by various NP fertilizer sources under study. The number of grain rows per cob varied from 13.50 to 14.50 for ammonium nitrate + triple super phosphate and ammonium nitrate + single super phosphate, respectively.

Cob length: The cob length was influenced significantly by NP sources. The application of ammonium nitrate + single super phosphate and ammonium sulphate + single triple phosphate remained at par with each other but produced significantly longer cobs than other treatments. The difference between ammonium sulphate + single super phosphate and ammonium nitrate + triple super phosphate was not significant. Khan (1968) has also reported significant effect of fertilizer sources on cob length.

1000-grain weight: Among the various parameters contributing to economic yield of a crop, 1000-seed weight is of prime importance. All fertilizer combinations varied significantly from one another regarding 1000-grain weight. The combination of ammonium sulphate + single super phosphate produced significantly higher 1000-seed weight (245.23 g) than all other NP combinations and it was followed by combination of urea + triple super phosphate having 1000-grain weight of 227.90 g. The lowest 1000-grain weight (189.87g) was recorded from plots receiving ammonium nitrate + single super phosphate. Significant effect of NP sources on 1000-grain weight has also been reported by Zafar (1996).

Grain yield: Grain yield was influenced significantly by different sources of nitrogen and phosphorus. The application of ammonium sulphate + single super phosphate produced significantly higher grain yield (5.41 t ha^{-1}) than all other treatments and it was followed by urea + triple super phosphate and urea + single super phosphate having average grain yields of 4.93 and 4.79 t ha^{-1}, respectively. The application of ammonium sulphate and ammonium nitrate along with triple super phosphate and ammonium nitrate + single super phosphate produced statistically similar grain yields. The difference between urea + single super phosphate and urea + triple super phosphate was also non-significant. Zafar (1996) has also reported significant effect of NP sources on grain yield of maize.

Harvest index: Significant effect of NP sources was recorded on harvest index. The application of urea + single super phosphate, ammonium nitrate + single super phosphate, ammonium sulphate + single super phosphate and urea + triple super phosphate have statistically similar

Table 1: Growth and yield of maize as influenced by different nitrogen and phosphorus sources

Treatments	Plant height (cm)	Leag area plant^{-1} (cm)	No. of cobs plant^{-1}	No. of grain rows cob^{-1}	Cob length (cm)	1000-grain weight (g)	Grain yield (t ha^{-1})	Harvest index (%)
Uear + Single super phosphate	215.43C	4339.92b	1.00^{NS}	14.00^{NS}	14.53C	222.02C	4.79	27.31a
Ammonium nitrate + single super phosphate	208.47d	3804.41d	1.05	14.50	20.13	189.87f	4.17	27.70a
Ammonium sulphate + single super phosphate	235.30a	4665.50a	1.03	14.00	19.18ab	245.23a	5.41a	27.67a
Urea + triple super phosphate	228.63b	4397.14b	1.08	14.00	13.78c	227.90b	4.93b	27.11a
Ammonium nitrate + triple super phosphate	211.57cd	3919.52cd	1.03	13.50	18.13b	195.70e	4.32c	25.15b
Ammonium sulphate + triple super phosphate	212.17cd	4042.23c	1.05	14.00	10.93d	201.93d	4.26c	25.15b

Values followed by the same letter in each column are statistically non-signigicant. NS = Non-significant

harvest index values but significantly higher than ammonium nitrate + triple super phosphate and ammonium sulphate + triple super phosphate which in turn were also statistically similar. The maximum (27.70%) and minimum (25.15%) harvest index values were recorded for ammonium nitrate + single super phosphate and ammonium sulphate + triple super phosphate, respectively. These results conform to the findings of Zafar (1996).

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