

EFFECT OF NITROGENOUS, PHOSPHATIC AND POTASSIC FERTILIZERS ON THE YIELD AND CHEMICAL COMPOSITION OF MAIZE

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The effect of N, P and K fertilizers on yield and chemical composition of maize was studied in the field. The application of 53.52 kg N/ha alongwith 26.76 kg P/ha gave the maximum and economical yield of maize grain, whereas the further upper levels of these fertilizers reduced the grain yield. Moreover, the application of 58.14 kg K/ha did not show any response towards yield increase. This may be due to the sufficient level of potassium already in the soil. The moisture content of maize grain increased with the application of various N, P and K fertilizers. Crude protein of the grain increased significantly with the application of various N fertilizer treatments. The mineral matter, calcium and phosphorus contents of the maize grain increased significantly by the application of the fertilizers as alone or in various combinations. The combined application of the upper levels of N, P and K fertilizers showed the maximum content of mineral matter, calcium and phosphorus.

INTRODUCTION

Maize is an important food crop of the world which can be selected to combat the problem of food shortages. Maize provides to mankind the maximum per hectare of food and has gained further importance as an industrial raw-material. It is a staple grain and fodder crop and possesses a reasonable nutritive value for human beings, is a valuable feed for livestock and poultry and a cheap source of corn oil. It is quick growing crop. The yield of crops could be increased by 50–100% if fertilized suitably [1]. Nitrogen, phosphorus and potassium are three major nutrients elements. Extensive work has been done on individual fertilizer element requirements of maize. However, very little information is available about the nitrogen requirements of the locally recommended varieties of maize in the presence of other elements like phosphorus and potassium when these are applied at sufficiency levels. Investigations are needed to find the adequate levels of N, P and K fertilizers to get the maximum yield of maize grain without impairing its quality. Therefore, it was considered worthwhile to study the effect of nitrogenous phosphatic and potassic fertilizers on the yield and chemical composition of maize.

Materials and Methods

Field experiment was done with the following fertilizer treatments:

| N kg/ha | P kg/ha | K kg/ha |
|------------|------------|------------|
| Control | — | — |
| 53.52 | 0 | 0 |
| 80.28 | 0 | 0 |
| 107.04 | 0 | 0 |
| 53.52 | 26.76 | 0 |
| 80.28 | 58.14 | 0 |
| 107.04 | 58.14 | 58.14 |

Maize variety Akbar was sown at a distance of 75 cm from row to row and 25 cm from plant to plant in the row. All P, K and half dose of N fertilizer were applied to the field at sowing and rest half dose of N was applied after 40 days of sowing. The nitrogen in the form of ammonium sulphate, phosphorus as single-superphosphate and potassium as potassium sulphate fertilizers were used. The method of fertilizer application at sowing drilled after mixing the requisite fertilizer, and the application of ferti-

lizer at the later stage were also mixed and broadcast just before irrigation. The treatments were arranged in a randomized complete block design with four replicates with 3×14 m plots. The crop was harvested at maturity. Total weight of the maize cobs was recorded and then grain yield of the plots was calculated. Maize grain samples were taken from every plot and they were dried ground for analysis. The representative grain samples were chemically analysed for moisture content by drying overnight at 100° to a constant weight method [2]. Crude protein content were determined by sulphuric acid digestion using microkjeldahl method [2]. Mineral matter content was secured by dry ashing method in a Muffle furnace at $500-550^{\circ}$ [2]. Calcium was determined by titration with versenate (EDTA) solution of A.O.A.C. [3] and for phosphorus content the grain samples were digested first in concd HNO_3 and then with $\text{HNO}_3-\text{H}_2\text{SO}_4-\text{HClO}_4$ ternary acid mixture. Colour intensity was measured by a Beckman spectrophotometer at 660 nm using red filter [3]. The analysis of variance was made and LSD worked out to test the significance of difference between means.

RESULTS AND DISCUSSIONS

The yield of maize grain as affected by the various fertilizer treatments is given in Table 1. The yield data showed that all the fertilizer treatments increased the grain yield significantly over the control. The maximum yield of grain, i.e. 26.22 q/ha was obtained with T_5 where N and P fertilizers were applied at the rate of 53.52 kg and 26.76 kg/ha respectively, it gave about double yield as compared to control. It means that the application of N and P fertilizers increased the grain yield considerably. However, application of K fertilizer gave no response as regards the

Table 1. Effect of N, P and K fertilizers on yield of maize grain.

| Treatments | Average of four replications (q/ha) |
|--|-------------------------------------|
| T_5 53.52 kg N-26.76 kg P | 26.22 |
| T_7 107.04 kg N-58.14 kg P -58.14 kg K | 23.95 |
| T_2 53.52 kg N | 23.84 |
| T_3 80.28 kg N | 23.49 |
| T_6 80.28 kg N-58.14 kg P | 23.16 |
| T_4 107.04 kg N | 22.59 |
| T_1 Control | 13.96 |
| LSD P 0.05 | 1.11 |
| P 0.01 | 1.52 |

yield of maize. The application of N fertilizer over the dose of 53.52 kg N/ha did not increase the yield, rather the yield was decreased significantly at 107.04 kg N/ha as compared to 53.52 kg N/ha. The yield of forage and grain was increased by the application of nitrogen and phosphatic fertilizers [4]. Khan [5] reported that higher yield response from the application of nitrogen whether applied alone or in combination with phosphorus. Bari [6] pointed out that N alone gave increased yield of grain as compared to control. Supplementing N with P and P,K significantly increased grain yield.

Moisture content of maize grain in Table 2 are presented as affected by different N, P and K fertilizer treatments. The data was statistically analysed and found that difference of the means of various treatments are statistically highly significant. All the fertilizer treatments gave a higher moisture content in the grain as compared to control. This may be due to more vigorous and vegetative growth of the grain, which made the grains more succulent.

Affected by the various N, P and K fertilizer treatment
Table 2. Effect of N, P and K fertilizers on moisture content of maize grain.

| Treatments | Average of four replications |
|--|------------------------------|
| T_5 53.52 kg N-26.76 kg P | 11.131 |
| T_3 80.28 kg N | 11.098 |
| T_4 107.04 kg N | 11.011 |
| T_7 107.04 kg N-58.14 kg P -58.14 kg K | 10.996 |
| T_2 53.52 kg N | 10.927 |
| T_6 80.28 kg N-58.14 kg P | 10.866 |
| T_1 Control | 10.116 |
| LSD P 0.05 | 0.16 |
| P 0.01 | 0.23 |

Table 3. Effect of N, P and K fertilizers on crude protein content of maize grain.

| Treatments | Average of four replications |
|--|------------------------------|
| T_4 107.04 kg N | 14.78 |
| T_7 107.04 kg N-58.14 kg P -58.14 kg K | 14.57 |
| T_3 80.28 kg N | 14.31 |
| T_6 80.28 kg N-58.14 kg P | 13.48 |
| T_5 53.52 kg N-26.76 kg P | 11.87 |
| T_2 53.52 kg N | 11.66 |
| T_1 Control | 10.76 |
| LSD P 0.05 | 0.35 |
| P 0.01 | 0.48 |

ments, the crude protein content of maize grain are given in Table 3. The data was subjected to statistical analyses which showed the results highly significant. All the fertilizer treatments gave more protein contents as compared to control. The protein contents were further more at the higher level of N fertilizer. The application of P or P and K fertilizers alongwith N did not increase the crude protein contents as compared to the application of the same dose of N fertilizer alone. Krantz and Chandler [7] found more nitrogen content in corn leaves and grains with nitrogen application. Zuber *et al.* [8] suggested that crude protein content of corn could be significantly altered with nitrogen application. Application of 50 pounds of nitrogen per acre gave significantly higher protein content in grain than where no nitrogen was applied. Faqir [9] indicated that protein contents of grain were increased with the increased doses of ammonium sulphate (N).

The mineral matter content of maize grain as influenced by various fertilizer treatments is presented in Table 4. The data was statistically analysed and found that the increase in mineral matter content was significantly increased by the application of various fertilizers. The increase was greatest at the higher level of the fertilizers and the combined effect of N and P or N, P and K fertilizers was also greater as compared to the same dose of N fertilizer alone. Hussain *et al.* [10] showed the mineral content of maize stover was reduced by application of N fertilizer as compared to the control. But when it was applied with P alone or in combination with K fertilizer, the mineral matter showed a significant increase. Khan [11] reported that nitrogen phosphorus and nitrogen-phosphorus-potassium treatments gave a significant increase in the ash contents of wheat grain.

Table 5 shows the calcium content in maize grain as affected by the various fertilizer treatments. The calcium concentration of grains obtained from various treatments ranged from 14.63 to 19.50 mg/100 g. Statistically the difference of means due to treatments was highly significant in comparison with control. It was depicted from the results that the application of various fertilizers increased the calcium content of the maize grain.

The data for the effect of different fertilizer treatments on phosphorus concentration in maize grain are presented in Table 6. The phosphorus content in grain ranged from 250.59 to 302.08 mg/100 g. The statistical analysis of data showed the results highly significant among themselves.

It was noted that the application of various levels of N fertilizer alone did not increase the P content of the grain except 107.04 kg/ha. However, the application of P increased the P content of grains. The concentration of phosphorus was greater at the higher levels of P application.

Table 4. Effect of N, P and K fertilizers on mineral matter content of maize grain.

| Treatments | Average of four replications |
|---|------------------------------|
| T ₇ 017.04 kg N-58.14 kg P -58.14 kg K | 1.678 |
| T ₄ 107.04 kg N | 1.595 |
| T ₆ 80.28 kg N-58.14 kg P | 1.550 |
| T ₃ 80.28 kg N | 1.532 |
| T ₅ 53.52 kg N-26.76 kg P | 1.508 |
| T ₂ 53.52 kg N | 1.496 |
| T ₁ Control | 1.327 |
| LSD P 0.05 | 0.031 |
| P0.01 | 0.043 |

Table 5. Effect of N, P and K fertilizers on calcium content of maize grain.

| Treatments | Average of four replications (mg/100 g) |
|---|---|
| T ₇ 107.04 kg N-58.14 kg P -58.14 kg K | 19.50 |
| T ₅ 53.52 kg N-26.76 kg P | 19.44 |
| T ₆ 80.28 kg N-58.14 kg P | 19.15 |
| T ₃ 80.28 kg N | 17.79 |
| T ₄ 107.04 kg N | 17.45 |
| T ₂ 53.52 kg N | 17.00 |
| T ₁ Control | 14.63 |
| LSD P 0.05 | 0.80 |
| P 0.01 | 1.09 |

Table 6. Effect of N, P and K fertilizers on phosphorus content of maize grain.

| Treatments | Average of four replications (mg/100 g) |
|---|---|
| T ₇ 107.04 kg N-58.14 kg P -58.14 kg K | 302.08 |
| T ₆ 80.28 kg N-58.14 kg P | 291.26 |
| T ₅ 53.52 kg N-26.76 kg P | 287.31 |
| T ₄ 107.04 kg N | 263.14 |
| T ₃ 80.28 kg N | 260.42 |
| T ₂ 53.52 kg N | 259.26 |
| T ₁ Control | 250.59 |
| LSD P 0.05 | 9.18 |
| P0.01 | 13.61 |

Khan [11] pointed out that nitrogen, phosphorus–potassium combination gave highest phosphorus content in grain. Reichman *et al.* [4] reported that nitrogen fertilization tended to decrease phosphorus concentration in kernels and stover, but increased the total amount of phosphorus absorbed by corn plants. P application increased both phosphorus percentage in grain and total phosphorus absorbed. Faqir [9] indicated that phosphorus contents of grain was increased with the increased doses of N applications.

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