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# Response of *rabi* maize (Zea mays L.) to nitrogen and zinc levels under middle Gujarat conditions

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**Abstract**

**A Field experiment was carried out on during *Rabi* season of 2005-06 at Anand to assess the response of *rabi* maize cv. GM-3 to nitrogen and zinc levels under middle Gujarat conditions. Results revealed that application of nitrogen upto 120 kg/ha significantly increased the grain yield of maize. Thereafter the response was not significant. Similarly, application of $ZnSO_4$ upto 12.5 kg/ha. significantly increased the grain yield of *rabi* maize.**

**Keywords :** Maize, nitrogen and zinc

## Introduction

Traditionally maize has been widely cultivated as a rainfed crop during *kharif* season in the country but recent studies have been shown that it can be also successfully grown during *rabi* season in many part of the country where assure irrigation facilities are available. It is cultivated during *rabi* season in an area of about 0.52 million ha with the production of 2.23 million tones having an average productivity of 4288 kg/ha (1). Nutrient management is the most important limiting factor particularly for *rabi* maize cultivation. Maize responds well to the management practices like irrigation and nitrogen (2). Among the major plant nutrients required for cultivation of maize, nitrogen is one of the most important for increasing crop yield but at the same time it is expensive if not utilized properly. Moreover, application of micronutrient also significant role in improvement of grain yield of maize, wherein, zinc plays an important role in photosynthesis, nitrogen metabolism and regulates auxin concentration in the plants. Dangarwala *et al.* (3) reported the Zn deficiency has been observed in middle and north Gujarat regions at the extent of 25 per cent in maize crop. Keeping these in view, the present experiment was planned to find out the response of *rabi* maize to nitrogen and zinc levels under middle Gujarat conditions.

## Material and methods

A field experiment was laid out on maize cv. GM-3 at College Agronomy Farm, Anand Agricultural University, Anand during *Rabi* season of the year 2005-06. The soil of the field was loamy sand in texture having low in organic carbon and nitrogen and medium in available phosphorus and potassium with pH 8.2. Twelve treatment combinations consisted of four levels of nitrogen (100, 120, 140 and 160 kg/ha) and three zinc levels (0, 12.5 and 25 kg/ha) were studied in factorial randomized block design with four replications. The seeds of GM-3 @ 20 kg/ha were sown by manually keeping the distance of 60 cm between and 20 cm within the row. The crop was fertilized as per respective nitrogen treatments i.e. 100, 120, 140 and 160 kg N/ha in the form of urea. One third quantity of nitrogen was given as a basal at time of preparation of land and remaining two third quantities was applied as topdressing in two equal splits at around 33 days after sowing at about 52 days after sowing of the crop. Entire quantity of phosphorus (50 kg $P_2O_5$/ ha) was applied as a common basal dose in furrow to all the plots in form of singly super phosphate. Entire quantity of zinc was applied as basal in the form of zinc sulphate ($ZnSO_4$) as per treatments. The other package of practices was adopted to raise to raise the maize crop as per the recommendations. The grain and stover yield was harvested from the net plot area and subjected to statistical analysis. Net realization and BCR values were also worked out by considering the prevailing market price on the basis of grain and stover yields.

## Results and discussion

### Effect of nitrogen

Plant height and days to 50% tasseling and silking were increased with the increase in levels of nitrogen,

wherein, 160 kg N/ha recoded maximum plan height as well as days to 50 % tasseling and silking, while the lowest values were observed under 100 kg N/ha. The higher plant height under the highest level of nitrogen ($N_{160}$) could be attributed to higher levels of applied nitrogen, which is a structural component of protein molecules and protoplasm, which might have increased synthesis of protein and carbohydrates in favour of increasing cell division and elongation. The enhanced vegetative resulted in delayed days to 50 % tasseling and silking. Similar results are also reported by Patel *et al.* (4). Further, nitrogen applied @ 160 kg/ha recorded maximum values of cob length, test weight and protein content, while grain rows / cob was recorded maximum under 140 kg N/ha and minimum values were registered under treatment $N_{100}$. These results are akin to those reported by Shanti *et al.* (5) and Shivay *et al.* (6). Increasing levels of nitrogen from 100 to 160 kg N/ha grain and stover yields were increase but significant response was observed upto 120 kg N/ha. The variation in grain and stover yields might be due to the fact that nitrogen was related to the differences in size of photosynthetic surface and to the relative efficiency of total sink activity, possibly a function of growth and yield attributes. The present findings lend support from the results of Padmaja *et al.* (7) and Paliwal *et al.* (8). Application of 120, 140 and 160 kg N/ha recorded net realization of Rs.18263, 19002 and 19608/ha, respectively while the lowest net return was noticed under treatment $N_{100}$ (Rs. 12743/ha) with the BCR value of 1.96.

**Effect of zinc**

Plant height at 30 DAS was not affected due to zinc levels, while at harvest it was recorded significantly higher under application of 25 kg zinc/ha than other levels. The higher plant height under application of zinc in soil might have favoured the availability of Zn resulted in more uptake of Zn by the maize crop and it also acts as a catalyst in various growth processes and in hormone production thereby increased the plant height. Similarly, increased in plant height under application of zinc was also observed by Manohar *et al.* (9). Days to 50 % tasseling and silking were found to be not-significant due to application of zinc. The cob length and test weight significantly influenced due to treatments. These showed that application of zinc had profound affect through acts as a catalyst in various growth and yield parameters. These results are in accordance with those reported by Paliwal *et al.* (8) and Arya and Singh (10). Application of 25 kg zinc/ha recorded significantly higher grain yield (4728 kg/ha) as compared to 0 kg zinc / ha (4266 kg/ha), but was at par with application of 12.5 kg zinc/ha. While levels of zinc failed to reflect their significant effect on stover yield of maize. Treatment $Zn_{25}$

**Table 1.** Effect of nitrogen and zinc levels on growth and yield attributes of maize

| Treatment | Plant height (cm) | | Days to 50% tasseling | Days to 50% silking | Cob length (cm) | No. of grain rows/cob | Test weight (g) | Protein content (%) | Harvest Index (%) |
|---|---|---|---|---|---|---|---|---|---|
| | 30 DAS | At harvest | | | | | | | |
| **Nitrogen (N)** | | | | | | | | | |
| $N_{100}$ | 63 | 191 | 53 | 65 | 15.16 | 16.00 | 21.28 | 8.15 | 40.35 |
| $N_{120}$ | 67 | 215 | 55 | 69 | 16.00 | 17.25 | 23.50 | 9.55 | 42.01 |
| $N_{140}$ | 68 | 226 | 57 | 71 | 16.33 | 17.91 | 24.47 | 10.14 | 42.42 |
| $N_{160}$ | 71 | 228 | 59 | 72 | 16.34 | 17.41 | 24.83 | 10.52 | 43.00 |
| S. Em. ± | 1.21 | 3.94 | 0.86 | 1.65 | 0.23 | 0.23 | 0.37 | 0.16 | 1.79 |
| C. D. (P=0.05) | 3.49 | 11.31 | 2.47 | 4.75 | 0.67 | 0.65 | 1.06 | 0.46 | NS |
| **Zinc ($ZnSO_4$)** | | | | | | | | | |
| $Zn_0$ | 67 | 206 | 55 | 69 | 15.10 | 16.81 | 22.96 | 9.41 | 41.55 |
| $Zn_{12.5}$ | 67 | 218 | 56 | 69 | 16.27 | 17.31 | 23.44 | 9.59 | 41.84 |
| $Zn_{25}$ | 69 | 221 | 56 | 69 | 16.52 | 17.31 | 24.16 | 9.78 | 42.45 |
| S. Em. ± | 1.05 | 3.41 | 0.75 | 1.43 | 0.20 | 0.20 | 0.32 | 0.14 | 1.55 |
| C. D. (P=0.05) | NS | 9.80 | NS | NS | 0.58 | NS | 0.92 | NS | NS |
| N X Zn Interaction | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| C. V. (%) | 6.24 | 6.35 | 5.32 | 8.29 | 5.05 | 5.21 | 5.41 | 5.79 | 14.79 |

**Table 2.** Effect of nitrogen and zinc levels on yield and economics of maize

| Treatment | Yields (kg/ha) | | Gross realization (Rs./ha) | Cost of cultivation (Rs./ha) | Net realization (Rs./ha) | BCR |
|---|---|---|---|---|---|---|
| | Grain Yield | Stover yield | | | | |
| **Nitrogen (N)** | | | | | | |
| $N_{100}$ | 3786 | 6717 | 26074 | 13332 | 12743 | 1.96 |
| $N_{120}$ | 4531 | 8299 | 31884 | 13621 | 18263 | 2.34 |
| $N_{140}$ | 4768 | 8566 | 32891 | 13890 | 19001 | 2.37 |
| $N_{160}$ | 4905 | 8700 | 33778 | 14170 | 19608 | 2.38 |
| S. Em. ± | 147 | 279 | - | - | - | - |
| C. D. (P=0.05) | 423 | 803 | - | - | - | - |
| **Zinc ($ZnSO_4$)** | | | | | | |
| $Zn_0$ | 4266 | 7907 | 29775 | 13380 | 16394 | 2.23 |
| $Zn_{12.5}$ | 4499 | 8102 | 31230 | 13779 | 17450 | 2.27 |
| $Zn_{25}$ | 4728 | 8202 | 32466 | 14100 | 18366 | 2.30 |
| S. Em. ± | 127 | 242 | - | - | - | - |
| C. D. (P=0.05) | 366 | NS | - | - | - | - |
| N X Zn Interaction | NS | NS | - | - | - | - |
| C. V. (%) | 11.32 | 11.97 | - | - | - | - |

registered the highest net return of Rs.18366/ha with the BCR value of 2.30, while treatment $Zn_0$ recorded the lowest net profit of Rs.16394/ha with the BCR value of 2.23.

**Interaction effect**

Interaction of effect of nitrogen and zinc levels was found to be non significant with respect to growth, yield attributes and yield of *rabi* maize.

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