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# Response of African tall maize (*Zea mays*) to nitrogen application at varying levels of plant population

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## Abstract

**A field experiment was conducted during the rainy seasons of 2002 and 2003 at research farm of Seed Production Unit, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur to work out the suitable plant population and nitrogen requirement for grain and seed production of African tall maize (*Zea mays*). Lower population of 44,444 plants/ha with row to row spacing of 90 cm resulted in significantly higher plant height, cobs per plant, cob length, cob girth, lines per cob, grains per cob and 1000-grain and seed weight, seed recovery percentage, seedling length and vigour index of seed. However, grain yield was significantly higher at higher population of 66,666 plants/ ha whereas seed yield of 4.82 t/ha was significantly highest at 53,333 plants/ha. Yield attributes, seed yield and quality parameters increased significantly with increase in nitrogen application up to 200 kg N/ha. Seed germination percentage, however, was not influenced by nitrogen and plant population.**

## Introduction

Maize is the most important *Kharif* season crop of Himachal Pradesh. Although the State average yield (2.17 t/ha) is more than the national average, but still, there is a tremendous scope for increasing its yield on account of favourable environmental conditions in Himachal Pradesh. African tall variety of maize is mainly grown for fodder production due to its gigantic growth and high dry matter production potential. It is a heavy feeder of plant nutrients which respond well to applied inputs particularly nitrogen. The variety being tall and vigorous in growth habit, its spacing/plant population is likely to be different from other composite varieties. Information on plant population and nitrogen requirement of African tall variety for grain as well as quality seed production is meager. The present study was, therefore, planned to find out optimum level of plant population and nitrogen for grain and seed production of African tall maize

## Material and Methods

A field experiment was conducted during the *Kharif* seasons of 2002 and 2003 at the research farm of Seed Production Unit, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur representing a Typical Hapludalf soil, situated 32.6° N and 76.3° E at an elevation of 1291.0 m above mean sea level. The silty clay loam soil was medium in available nitrogen (296.0 kg/ha) and phosphorus (16.8 kg/ha) and high in available potash (304.0 kg/ha). The pH and organic carbon percentage of surface soil were 5.7 and 1.1 respectively. The experiment with twelve treatment combinations comprising of three plant populations (66666, 53333 and 44444 plants/ha with a row to row spacing of 60, 75 and 90 cm respectively) and four nitrogen levels (80, 120, 160 and 200 kg N/ ha) was laid out in randomized block design with three replications. A uniform plant to plant distance of 25 cm was maintained in all treatments. African tall maize was sown on June 13 and 19 during 2002 and 2003, respectively. One-third of nitrogen as per the treatment along with entire dose of phosphorus and potash @ 60 kg $P_2O_5$ and 40 kg $K_2O$/ha was applied at the time of sowing and the remaining two-third of nitrogen was applied in two equal splits, one at knee-high stage of the crop and another at pre-tasselling stage. All other recommended package of practices for maize were followed. Plant height was recorded at grain filling stage. The produce was graded using Agrosaw (Deluxe) seed grader. Grain yield, graded seed yield, percentage of graded seed recovery and other quality parameters were recorded. The seedling length was measured on 7th day after soaking as per standard procedure. Seed vigour index was worked

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out by multiplying seed germination percentage by the seedling length.

## Results and Discussion

### *Growth and yield attributes*

Significantly higher plant height and all yield attributes viz. cobs per plant, cob length, cob girth, number of lines per cob, grains per cob and 1000-grain weight were recorded with lower plant population of 44,444 per hectare (Table 1). The plant population of 66,666 plants/ha resulted in significantly lowest plant height and yield attributes. These effects could be attributed to less competition for nutrients, water, air and solar radiation at lower population. Significant increase in plant height and all yield attributes except cobs per plant was observed with the consecutive increase in nitrogen up to 200 kg/ha (Table 1). Significant increase in cobs per plant was observed at 200 kg N/ha. Similar effects of plant population on growth and yield attributes of baby corn were also reported by Thakur *et al.* (1997).

### *Yield*

Significantly higher grain yield of 6.2 t/ha was recorded with population of 66,666 plants/ha which decreased to 5.5 and 4.6 t/ha with decrease in population to 53,333 and 44,444 plants/ha. The results indicate that the higher yield attributes (at lower population) could not compensate the yield loss due to decreased plant population. Seed yield, however, was significantly highest at 53,333 plants/ha which decreased significantly both with increase as well as decrease in population. Raja (2001) also reported similar effects of plant population on yield of maize. Response to nitrogen in grain and seed yield was similar. Consistent and significant increase in yield was recorded with successive increase in N application

**Table 1. Effect of plant population and nitrogen on growth and yield attributes of maize (pooled data of 2 years)**

| Treatments | Plant height (cm) | Cobs/ plant | Cob length (cm) | Cob girth | Lines/ cob | Grains/ cob | 1000-grain weight (g) |
|---|---|---|---|---|---|---|---|
| *Plant population/ha* | | | | | | | |
| 66666 | 262.6 | 1.2 | 19.0 | 15.6 | 13.2 | 267.4 | 308.8 |
| 53333 | 284.4 | 1.3 | 23.4 | 16.9 | 14.2 | 270.1 | 320.6 |
| 44444 | 304.9 | 1.3 | 25.6 | 17.9 | 14.5 | 275.8 | 345.0 |
| CD (P=0.05) | 2.9 | 0.07 | 0.13 | 0.08 | 0.07 | 1.96 | 10.2 |
| *N (kg/ha)* | | | | | | | |
| 80 | 257.0 | 1.2 | 19.8 | 15.3 | 13.2 | 227.3 | 307.6 |
| 120 | 273.9 | 1.2 | 22.0 | 16.3 | 13.8 | 260.3 | 312.6 |
| 160 | 293.6 | 1.2 | 24.0 | 17.5 | 14.3 | 288.4 | 333.0 |
| 200 | 311.4 | 1.3 | 24.8 | 18.0 | 14.6 | 308.2 | 346.0 |
| CD (P=0.05) | 3.29 | 0.08 | 0.15 | 0.09 | 0.08 | 2.26 | 12.40 |

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from 0 to 200 kg N/ha (Table 2). These results are in conformity with the findings of Singh *et al.* (2000), Thakur *et al.* (1997) and Tyagi *et al.* (1998).

Interaction effect of population and nitrogen levels on yield (grain and seed) was significant (Table 3). Like main effects, grain as well as seed yield increased consistently and significantly with each increasing level of N, but the magnitude of increase at 200 kg/ha over 80 kg/ha decreased with decrease in population. Similarly, yield levels at each N level revealed that the seed yield at 80 kg N/ha was not significantly influenced by varying population. Whereas at high N doses of 160 and 200 kg/ha, there was a significant decrease in seed yield due to decreased plant population of 44,444. In nutshell, application of 200 kg N/ha with 60x25 cm plant geometry (66,666 plants/ha) could be recommended for increasing the grain production of African tall maize. Whereas for seed production 60x25 cm (66,666 plants/ha) or 75x25 cm (53,333 plants/ha) with 200 kg N/ha may be recommended.

***Seed quality parameters***

Effect of plant population on germination of the seed (Table 2) was not significant. However 1000-seed weight, seed recovery, seedling length and vigour index were significantly higher with lower population of 44,444 plants/ha while these parameters were significantly lower at higher population. Further, increase in N levels up to 200 kg N/ha significantly improved all the seed quality parameters except the germination percentage.

From this two years study it can be concluded that nitrogen application to African tall maize should be increased from the existing recommendation of 120 to 200 kg N/ha with planting geometry of 60x25 cm (66,666 plants/ha). However for quality seed production, plant population can be decreased from present recommended level of 66666 (60x25 cm) to 53333 (75x25 cm) without any significant decrease in seed yield.

**Table 2. Effect of plant population and nitrogen on seed yield (t/ha) and seed quality parameters of maize (pooled data of 2 years)**

| Treatments | Grain yield (unprocessed/ raw seed) (t/ha) | Seed yield (Processed/ graded seed) (t/ha) | Seed recovery (%) | 1000-seed weight (g) | Germination (%) | Seedling length (cm) | Vigour index |
|---|---|---|---|---|---|---|---|
| *Plant population/ha* | | | | | | | |
| 66666 | 6.20 | 4.70 | 75.3 | 367.2 | 97.4 | 23.18 | 2258.4 |
| 53333 | 5.49 | 4.82 | 87.6 | 389.5 | 97.5 | 25.12 | 2449.1 |
| 44444 | 4.56 | 4.31 | 94.5 | 412.7 | 97.5 | 27.13 | 2645.8 |
| CD (P=0.05) | 0.12 | 0.10 | 0.57 | 2.02 | NS | 0.28 | 29.7 |
| *N (kg/ha)* | | | | | | | |
| 80 | 4.15 | 3.42 | 83.2 | 374.4 | 97.2 | 21.0 | 2042.0 |
| 120 | 5.11 | 4.33 | 85.3 | 385.0 | 97.5 | 24.7 | 2414.0 |
| 160 | 5.96 | 5.10 | 85.8 | 394.1 | 97.3 | 26.9 | 2619.1 |
| 200 | 6.43 | 5.58 | 87.9 | 404.7 | 97.7 | 27.9 | 2729.3 |
| CD (P=0.05) | 0.14 | 0.12 | 0.66 | 2.32 | NS | 0.32 | 34.3 |

**Table 3. Interaction effect of plant population and nitrogen on unprocessed and processed seed yield (t/ha) of maize (pooled data of 2 years)**

| Plant population/ha | Grain yield (t/ha) | | | | Seed yield (t/ha) | | | |
|---|---|---|---|---|---|---|---|---|
| | N (kg/ha) | | | | N (kg/ha) | | | |
| | 80 | 120 | 160 | 200 | 80 | 120 | 160 | 200 |
| 66666 | 4.73 | 5.45 | 7.06 | 7.55 | 3.44 | 4.07 | 5.39 | 5.86 |
| 53333 | 4.07 | 5.55 | 5.94 | 6.39 | 3.44 | 4.81 | 5.27 | 5.77 |
| 44444 | 3.66 | 4.35 | 4.87 | 5.34 | 3.38 | 4.12 | 4.54 | 5.12 |
| CD (P=0.05) | 0.24 | | | | 0.21 | | | |

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