Original Research Article

Effect of Nitrogen and Sulphur Levels on Growth and Yield of Quality Protein Maize (Zea mays L.)

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Abstract

A field experiment was conducted during kharif 2019 at Central Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, (U.P.). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 6.7), low in organic carbon (0.35%), available N (230 kg/ha), available P (20 kg/ha) and available K (189 kg/ha). The treatment consisted of 3 levels of Nitrogen viz. N₁ (90 Kg N/ha), N₂ (120 Kg N/ha), N₃ (150 Kg N/ha) and 3 levels of Sulphur S₁ (15 Kg S/ha), S₂ (30 Kg N/ha), S₃ (45 Kg S/ha). There were 9 treatments each replicated thrice. The experiment was laid out in Randomized Block Design. The result showed that growth parameters viz., plant height (129.6 cm) at 80 DAS, leaf area index (4.98) at 80 DAS, Dry weight (169.03 g/plant) at 80 DAS and yield and yield attributes viz., No. of rows/cob (13.65), No. of seeds/row (30.65), 100-Grain Weight (20.90 g), Grain Yield (4.87 t/ha), Stover Yield (9 t/ha) and Harvest Index (35.11%) were recorded maximum in treatment T₉ (150 Kg N/ha + 45 Kg/ha). Hence the application of 150 Kg N/ha along with 45 Kg S/ha gave the highest yield.

Keywords
Quality Protein Maize, Nitrogen, Sulphur

Introduction

Maize the American Indian word for corn means literally “that which sustains life”. Maize is emerging as an important world cereal crop after wheat and rice, which is considered “Queen of Cereals”, due to high productiveness, easy to process, low cost than others cereals (Jaliya et al., 2008).

The important goal for enhancing productivity of quality protein maize is to reduce the malnutrition through direct human consumption in tribal dominated area, where maize is a staple food. Nitrogen is a component of protein, nucleic acids and other compounds essential for plant growth process. Maize requires not only nitrogen, phosphorus or potassium but also sulphur (Kumar et al., 2015).

Sulphur, an essential for plant growth and development is considered a secondary nutrient because it is generally required in lower amounts than NPK (Jeet et al., 2014). The quality protein maize has widely adopted for cultivation in developing world to fight malnutrition.
Materials and Methods

A field experiment was conducted during kharif 2019 at Central Crop Research Farm, Department of Agronomy, SHUATS, Allahabad, (U.P.). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 6.7), low in organic carbon (0.35%), medium in available N (219 kg/ha), high in available P (20 kg/ha) and low in available K (189 kg/ha). The treatment consisted of 3 levels of Nitrogen viz. N₁ (90 Kg N/ha), N₂ (120 Kg N/ha), N₃(150 Kg N/ha) and 3 levels of Sulphur S₁(15 Kg S/ha), S₂ (30 Kg N/ha), S₃ (45 Kg S/ha). There were 9 treatments each replicated thrice. The experiment was laid out in Randomized Block Design. It was sown on 25th June 2019 with seed rate of 20 Kg/ha at spacing 50*20 cms. Phosphorus (60 Kg/ha) and Potassium (60 Kg/ha) are applied at basal and Nitrogen was applied in 2 splits (30 DAS and 60 DAS).

Results and Discussion

The growth parameters like plant height, leaf area index, chlorophyll and dry weight was significantly affected by the application of nitrogen and sulphur at different levels. Maize crop fertilized with 150 Kg N/ha along with 45 Kg S/ha significantly resulted in plant height (129.6 cm), Leaf area index (4.97) and dry weight (169.03 g/plant) at 80 DAS (Table.1). The nitrogen has beneficial effect on plant metabolism which effect physiological process of the crop and thereby increases the growth parameters (Jeet et al., 2014). Sulphur involve in synthesis of S containing of amino acids viz. cysteine, cystene and methionine, various enzymatic process resulting in greater meristimatic activities and apical growth thereby overall growth of the plant (Choudhary et al., 2013).

Yield and yield attributes were also significantly affected by nitrogen and sulphur at different levels. Maize crop fertilized with 150 Kg N/ha along with 45 Kg S/ha significantly resulted in rows/cob (13.65), Seeds/cob (30.65), Test weight (20.90 g), Grain yield (4.87 t/ha), Stover yield (9 t/ha) and Harvest Index (35.11%) (Table.2, 3).

This may be due to larger cob size, proper pollination, translocation of sugars and starch and finally proper grain set due to higher nitrogen fertilizer dose and high nitrogen use efficiency and sulphur provides better nutrition to reproductive parts being a qualitative nutrient. These findings are in conformity to recommendation of Alam et al., (2003).

| Treatments                   | Plant height (Cm) | Leaf area index | Dry weight (g/plant) |
|------------------------------|-------------------|-----------------|----------------------|
| 90 Kg N/ha + 15 Kg S/ha      | 104.53            | 3.60            | 118.77               |
| 90 Kg N/ha + 30 Kg S/ha      | 104.423           | 3.64            | 123.2                |
| 90 Kg N/ha + 45 Kg S/ha      | 111.41            | 3.73            | 134.77               |
| 120 Kg N/ha + 15 Kg S/ha     | 111.53            | 4.06            | 132.6                |
| 120 Kg N/ha + 30 Kg S/ha     | 103.06            | 4.08            | 138.67               |
| 120 Kg N/ha + 45 Kg S/ha     | 119.86            | 4.72            | 157.67               |
| 150 Kg N/ha + 15 Kg S/ha     | 118.32            | 4.70            | 152.03               |
| 150 Kg N/ha + 30 Kg S/ha     | 116.78            | 4.66            | 159.9                |
| 150 Kg N/ha + 45 Kg S/ha     | 129.6             | 4.97            | 169.03               |
| SEm (+)                      | 4.01              | 0.03            | 3.93                 |
| CD (P=0.05)                  | 12.0              | 0.09            | 11.78                |

Table.1 Effect of Nitrogen and Sulphur Levels on Growth Parameters of Quality Protein Maize (80 DAS)
Table 2: Effect of Nitrogen and Sulphur Levels on Yield Attributes and yield

| Treatments | Rows/cob (No.) | Seeds/row (No.) | Test weight (g) | Grain yield (t/ha) | Stover yield (t/ha) | Harvest index (%) |
|------------|----------------|-----------------|-----------------|-------------------|-------------------|------------------|
| 90 Kg N/ha + 15 Kg S/ha | 10.32 | 19.30 | 16.57 | 1.87 | 5.00 | 27.66 |
| 90 Kg N/ha + 30 Kg S/ha | 10.30 | 19.95 | 17.10 | 2.66 | 6.00 | 31.22 |
| 90 Kg N/ha + 45 Kg S/ha | 11.53 | 23.53 | 18.10 | 3.77 | 7.13 | 33.66 |
| 120 Kg N/ha + 15 Kg S/ha | 10.95 | 22.04 | 17.78 | 3.39 | 7.00 | 32.63 |
| 120 Kg N/ha + 30 Kg S/ha | 11.63 | 24.43 | 18.15 | 3.58 | 7.40 | 32.65 |
| 120 Kg N/ha + 45 Kg S/ha | 12.55 | 28.87 | 18.93 | 4.18 | 8.00 | 34.38 |
| 150 Kg N/ha + 15 Kg S/ha | 11.95 | 26.73 | 18.60 | 4.05 | 8.25 | 32.73 |
| 150 Kg N/ha + 30 Kg S/ha | 12.27 | 27.93 | 18.63 | 4.04 | 7.73 | 34.51 |
| 150 Kg N/ha + 45 Kg S/ha | 13.65 | 30.65 | 20.90 | 4.87 | 9.00 | 35.11 |

SEm(±) | 0.25 | 0.55 | 0.23 | 0.10 | 0.42 | 2.07 |

CD (P=0.05) | 0.76 | 1.66 | 0.7 | 0.33 | 1.27 | 6.22 |

Table 3: Effect of Nitrogen and Sulphur on Economics of Quality Protein Maize

| Treatments | Cost of cultivation (₹/ha) | Gross Returns (₹ /ha) | Net Returns (₹ /ha) | B:C Ratio |
|------------|---------------------------|----------------------|---------------------|-----------|
| 90 Kg N/ha + 15 Kg S/ha | 50815 | 87400 | 36585 | 0.72 |
| 90 Kg N/ha + 30 Kg S/ha | 55,825 | 113200 | 57375 | 1.03 |
| 90 Kg N/ha + 45 Kg S/ha | 60,835 | 146700 | 85865 | 1.41 |
| 120 Kg N/ha + 15 Kg S/ha | 51244 | 137800 | 86556 | 1.69 |
| 120 Kg N/ha + 30 Kg S/ha | 56254 | 145600 | 89346 | 1.59 |
| 120 Kg N/ha + 45 Kg S/ha | 61264 | 163600 | 102336 | 1.67 |
| 150 Kg N/ha + 15 Kg S/ha | 51667.8 | 163500 | 111832.2 | 2.16 |
| 150 Kg N/ha + 30 Kg S/ha | 56677 | 158100 | 101423 | 1.78 |
| 150 Kg N/ha + 45 Kg S/ha | 61687 | 187400 | 125713 | 2.04 |

The highest gross (Rs 18,7400) and net returns (Rs 12,5713) were obtained in T9 (150 kg N/ha + 45 kg S/ha) and B:C ratio was highest in T7 150 kg N/ha + 30 kg S/ha (2.16). The combined application of nitrogen and sulphur increases the grain yield, stover yield and quality of maize which ultimately increases the gross and net returns. These result were in line with results of (Jeet et al., 2012).

On the basis of one year experiment, application of 150 kg N/ha along with 45 kg S/ha is more productive whereas 150 kg N/ha + 30 kg S/ha was economically effective.

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