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

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A B S T R A C T

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.*N_1(90 Kg N/ha), N_2(120 Kg N/ ha),N_3(150 Kg N/ha) and 3 levels of Sulphur S_1(15 Kg S/ha), S_2(30 Kg N/ha),S_3(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 (129.6cm) 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 T_9 (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.

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 enchancing 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.* N_1 (90 Kg N/ha), N_2 (120 Kg N/ha),N_3(150 Kg N/ha) and 3 levels of Sulphur S_1(15 Kg S/ha), S_2 (30 Kg N/ha), S_3 (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 enzyamatic 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).

Table.1 Effect of Nitrogen and Sulphur Levels on Growth Parameters of Quality Protein Maize (80 DAS)

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	104.442	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.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 T_9 (150 kg N/ ha + 45 kg S/ha) and B:C ratio was highest in T_7 150 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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