

Original Research Article

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

Mirwais Daoudi and Rajesh Singh*

Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad – 211007, U.P. India

*Corresponding author:

ABSTRACT

An experiment was conducted at Crop Research Farm, Department of Agronomy, SHUATS, Allahabad, (U.P) during *kharif* season of 2016. The study was conducted to find out the effect levels of nitrogen and sulphur on growth and yield of hybrid maize (*Zea mays* L.). The experiment was laid out in RBD having 12 treatments replicated thrice and it consisted of 3 levels of nitrogen *viz.* 100kg N, 120kg N and 140kg N and 4 levels of sulphur *viz.* control, 15kg S ha⁻¹, 30kg S ha⁻¹ and 45kg S ha⁻¹. The experimental findings record that the maximum plant height (198.67cm), maximum plant dry weight (178.09g), LAI (5.16), length of cobs with and without husk (27.67cm and 20.83cm), respectively. Grain rows cob⁻¹ (16.07) and grains row⁻¹ (30.15), 1000- grain weight (238.67g) and grain yield (9717kg ha⁻¹) were recorded in treatment T₁₁(140 kg N ha⁻¹+ 30 kg S ha⁻¹) followed by treatment T₇ (120kgNha¹+ 30 kg S ha⁻¹) and it was concluded that nitrogen and sulphur significantly influenced the growth parameters and yield of hybrid maize and higher level of sulphur *i.e.* 45kg/ha increased the cost of cultivation and also had antagonistic effect on yield attributes of maize.

Keywords

Hybrid maize,
Nitrogen levels,
Sulphur levels,
Yield parameters.

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Introduction

Maize (*Zea mays* L.) is one of the most important cereal crops, next to rice and wheat and is used as a food for men and feed for animals. This crop has been developed into a multi-dollar business in countries *viz.* Thailand, Tiwan, Singapore, Malaysia, USA, Canada and Germany, because of its potential as a value added product for export and a good food substitute (Mugalkhod *et al.*, 2011). Maize is gaining immense importance on account of its potential uses in manufacturing starch, plastics, rayon, adhesive, dye, resins, boot polish etc. and due to this large uses it is rightly called a Miracle crop and also known as 'Queen of cereals'

due to its high potential yield. In India, maize is grown in an area of 9.43million hectares with production of 24.35 m t and productivity of 2583 kg ha⁻¹ (Government of India, 2014). Maize yield is generally higher in high solar intensities, lower night temperature and lower pest infestation (Adesoji *et al.*, 2013). Optimum plant density leads to better utilization of solar radiation resulting into corn dry matter accumulation and biomass production (Moosari *et al.*, 2012). The production of maize in India is quite low as compared to the countries *viz.* Thailand, Tiwan, Singapore and USA. The probable reason may be due to nitrogen and sulphur

deficiency of our soils. It has been reported by many workers that most of the Indian soils are deficient in sulphur.

Nitrogen is a vital plant nutrient and a major yield determining macronutrient for most of the cereals. It is very essential for plant growth, as it makes up 1 to 4 % of dry matter of the plants. It is a major component of proteins and nucleic acids. It is also an essential constituent of chlorophyll and many other enzymes (Onasanyes *et al.*, 2009). Thus, availability of nitrogen in sufficient quantity throughout the growing season is essential for optimum growth and production of maize.

Sulphur, nowadays is considered as the 4th major plant nutrient after nitrogen, phosphorus and potassium (Nyborg and Bently, 1997). This nutrient helps the plant to perform many physiological functions like synthesis of sulphur containing amino acids *viz.* cysteine, cystine and methionine. It is also involved in various metabolic processes of plant. It is also a constituent of Glutathione, a compound supposed to be associated with the plant respiration and synthesis of essential oils. Sulphur also plays a vital role in chlorophyll formation. The plant requirement for sulphur is mainly responsible for nitrogen availability hence with the increasing rate of sulphur, the availability of nitrogen and its uptake increases (Metha *et al.*, 2005). Keeping the above facts in view and to increase the production of maize in India, an experiment entitled "Growth and Yield of Hybrid Maize (*Zea mays* L.) as influenced by levels of Nitrogen and Sulphur was conducted at SHUATS, Allahabad (U. P.).

Materials and Methods

The experiment was conducted at CRF (Crop Research Farm), Department of Agronomy, SHUATS, Allahabad, U.P during *kharif*

season of 2016. Geographically, the experimental site is located between 25° 24' 42" North latitude and 81°50' 56" East longitude and at an altitude of 98m above the mean sea level. The soil of the experimental field was sandy loam in texture having organic carbon 0.93%, available nitrogen 190.3kg ha⁻¹, available phosphorus 22.5kg ha⁻¹, available potassium 87kg ha⁻¹. The pH and EC of the soil was recorded as 7.5 and 0.27m⁻¹ respectively. The experiment was conducted in RBD (Randomized Block Design) comprising of 12 treatments each replicated thrice. There were 3 levels of nitrogen *viz.* 100, 120 and 140 kg ha⁻¹ and 4 Sulphur levels *viz.* control, 15, 30 and 45 kg ha⁻¹. The variety of maize used was Champion 61(Hybrid) and the seeds were sown at a spacing of 60 × 20 cm using a seed rate of 20 kg ha⁻¹.

Result and Discussions

Growth Attributes

An appraisal of table 1 reveals that growth parameter differed significantly among treatments. The plant height, dry weight, LAI, length of cobs with and without husk recorded maximum values in treatment T₁₁ (140 kg N ha⁻¹ + 30 kg S ha⁻¹) as 195.07 cm, 178.29 g, 5.16, 27.67 cm and 24.03 cm respectively followed by treatment T₇ which was found to be at par to treatment T₁₁ except LAI.

The probable reason for attaining maximum values of aforesaid parameters with nitrogen @140 kg N ha⁻¹ was because that nitrogen being major component of chlorophyll and proteins enhanced growth and development and hence produced plants with more leaf area and leaf area index (Kandif, 2013). The other reason may be due to better mineralization and availability of nitrogen to plants for plant metabolism which affects the physiological processes of the maize crop.

Table.1 Growth and yield of hybrid maize as influenced by levels of nitrogen and sulphur

Treatments	plant height(cm)	Dry Weight(g)	Leaf Area Index	Length of Cobs (cm)		
	80 DAS	80 DAS	80 DAS	With husk	Without husk	
T ₁	100 kg N ha ⁻¹ + 00 kg Sulphur ha ⁻¹	181.97	155.67	4.56	22.3	17.2
T ₂	100 kg N ha ⁻¹ + 15 kg Sulphur ha ⁻¹	186.67	170.89	4.53	26.23	20.23
T ₃	100 kg N ha ⁻¹ + 30 kg Sulphur ha ⁻¹	184.47	113.51	4.74	26.4	20.47
T ₄	100 kg N ha ⁻¹ + 45 kg Sulphur ha ⁻¹	189.73	162.28	4.61	27.03	20.33
T ₅	120 kg N ha ⁻¹ + 00 kg Sulphur ha ⁻¹	180.43	150.03	4.14	21.23	17.77
T ₆	120 kg N ha ⁻¹ + 15 kg Sulphur ha ⁻¹	191.13	117.19	4.5	26.9	20.73
T ₇	120 kg N ha ⁻¹ + 30 kg Sulphur ha ⁻¹	194.97	172.86	4.83	27.43	20.83
T ₈	120 kg N ha ⁻¹ +45 kg Sulphur ha ⁻¹	188.67	164.01	4.71	26.13	20.13
T ₉	140 kg N ha ⁻¹ + 00 kg Sulphur ha ⁻¹	187.53	121.58	4.37	24.2	19.27
T ₁₀	140 kg N ha ⁻¹ + 15 kg Sulphur ha ⁻¹	192.2	165.75	4.45	27.37	20.67
T ₁₁	140 kg N ha ⁻¹ + 30 kg Sulphur ha ⁻¹	195.07	178.29	5.16	27.67	24.03
T ₁₂	140 kg N ha ⁻¹ + 45 kg Sulphur ha ⁻¹	194.7	171.58	4.76	27.37	20.47
F- test	S	S	NS	S	S	S
S. Ed. (±)	2.75	21.563	0.362	1.554	0.735	
C. D. (P = 0.05)	5.676	44.505	-	3.207	1.516	

Table.2 Yield of hybrid maize as influenced by levels of nitrogen and sulphur

	Treatments	Grain Rows Cobs⁻¹(No.)	Grains Rows⁻¹(No.)	1000 grain weight(g)	Grain yield (kg ha⁻¹)
T ₁	100 kg N ha ⁻¹ + 00 kg Sulphur ha ⁻¹	15	28.87	188.67	6858.67
T ₂	100 kg N ha ⁻¹ + 15 kg Sulphur ha ⁻¹	14.33	27.13	215.33	7528.00
T ₃	100 kg N ha ⁻¹ + 30 kg Sulphur ha ⁻¹	14.13	29.60	194.00	7636.00
T ₄	100 kg N ha ⁻¹ + 45 kg Sulphur ha ⁻¹	14.87	29.93	184.00	7655.33
T ₅	120 kg N ha ⁻¹ + 00 kg Sulphur ha ⁻¹	14.47	28.80	212.67	7152.67
T ₆	120 kg N ha ⁻¹ + 15 kg Sulphur ha ⁻¹	14.6	28.27	214.00	7732.67
T ₇	120 kg N ha ⁻¹ + 30 kg Sulphur ha ⁻¹	16.05	30.67	218.67	8483.33
T ₈	120 kg N ha ⁻¹ +45 kg Sulphur ha ⁻¹	15.20	29.13	210.67	7419.33
T ₉	140 kg N ha ⁻¹ + 00 kg Sulphur ha ⁻¹	14.73	26.77	202.67	7175.33
T ₁₀	140 kg N ha ⁻¹ + 15 kg Sulphur ha ⁻¹	14.60	29.40	208.00	7167.33
T ₁₁	140 kg N ha ⁻¹ + 30 kg Sulphur ha ⁻¹	16.07	31.07	238.67	9717.33
T ₁₂	140 kg N ha ⁻¹ + 45 kg Sulphur ha ⁻¹	15.47	30.13	216.00	7896.67
	F- test	NS	NS	S	S
	S. Ed. (±)	0.758	2.193	13.656	485.026
	C. D. (P = 0.05)	-	-	28.187	1001.094

It was also observed that sulphur levels had non-significant effect on growth parameters due to the fact that sulphur has no role in vegetative growth as it is a qualitative nutrient. However, length of cobs with and without husk recorded maximum values in treatment T₁₁ may be due to optimum availability of nitrogen and sulphur and better translocation of these nutrients to the reproductive parts. These findings are in accordance to those of Rasheed *et al.*, (2004), Jeet *et al.*, (2012), Qahar and Ahmad (2015) and Alam *et al.*, (2003).

Yield parameters

Grains row⁻¹ and grain rows cob⁻¹

A perusal of table 2 reveals that number of grains rows cob⁻¹ and grains row⁻¹ show non-significant effect with respect to different levels of nitrogen and sulphur. However, maximum grain rows per cob (16.07) and grains row⁻¹ (31.07) was recorded in treatment T₁₁ followed by treatment T₇ (16.05 and 30.67) respectively. 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).

1000 grain weight

A critical review of the table 2 clearly depicts that there was significant influence of nitrogen and sulphur on test weight of maize hybrid under study and maximum test weight (238.67g) was recorded in treatment T₁₁ followed by treatment T₇ (218.67g) and was found to be at par to treatment T₁₁. This increase in test weight was due to better seed setting and better translocation of sugars and

starch as a result of increasing levels of nitrogen and sulphur application which enhanced crop growth rate, NAR and dry weight plant⁻¹, which ultimately increased test weight. Similar findings have also been reported by Rasheed (2003).

Grain Yield

An appraisal of table 2 reveals that there was significant effect of treatments on grain yield of maize. Maximum grain yield (9717.33 kg ha⁻¹) was recorded in treatment T₁₁ followed by treatment T₇ (8483.33 kg ha⁻¹). The increase in grain yield/ha as a result of increasing nitrogen and sulphur application is attributed to enhanced CGR, NAR and DWP which ultimately increased grain number ear⁻¹ and grain weight ear⁻¹. The other reason for increase in grain yield/ha with successive increase in nitrogen and sulphur was due to more leaf area and dry weight plant⁻¹. It was also observed that sulphur had significant influence on grain yield at 30 kg ha⁻¹ than 45 kg ha⁻¹ as it shows antagonistic effect thus reduced grain yield. These findings corroborate with the results of Shiraji *et al.*, (2000) and Pandey *et al.*, (2000).

In conclusion, based on the above findings it can be concluded that an application of 140kgN ha⁻¹ + 30kg of S ha⁻¹ is the best combination of nitrogen and sulphur for obtaining better growth attributes and higher yield of hybrid maize and can be recommended to the farmers of Allahabad region for sustaining productivity and profitability of maize.

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