EFFECT OF NITROGEN AND SULPHUR ON PHENOLOGY, GROWTH AND YIELD PARAMETERS OF MAIZE CROP.

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ABSTRACT: *Nitrogen and Sulphur application, significantly affected the phonological, growth and yield parameters of maize except, number of cobs per plant and 1000- grain weight. Application of fertilizers at the rate of 175 + 25 and 175 + 35 kg of nitrogen and sulfur per hectare, respectively greatly increased the number of days to tasseling & silking, leaf area at tasseling, cob length, number of grains per row except number of cobs per plant and 1000- grain weight over other treatments. However, maximum harvest index (32.65 %) was recorded from the plot fertilized at the rate of 175 kg N and 15 kg S per hectare, respectively.*

Keywords: Harvest index, hybrid, leaf area, nitrogen, sulfur

INTRODUCTION.

Maize (*Zea mays* L.) is an important cereal crop which ranks third after wheat and rice in the world. Maize grains are used for both human and livestock consumption. The whole plant is used as forage and to produce silage for ruminant livestock. Maize grain is the major cereal used for animal feed. Because of its expanded use in the agro- based industries it is considered as a leading commercial crop of great agro-economic value. In Pakistan maize production has increased from 3,262 thousand tons in 2009-10 to 3,341thousand tons in 2010-11, showing an increase of 2.4 percentage GOP [1], however, that is tremendously lower than other growing countries of the world. There are several causes of low productivity. Among them mismanagement of plant nutrition is considered to be the major one. Hence there is a need to improve this major component of the production technology for getting higher maize production. Balanced fertilization is an essential component of nutrient management and plays a significant role in enhancing crop production. Application of nutrients like; N, P, K, S and Mg etc. in balanced form is essential for the major processes of plant development and yield formation, Randhawa and Arora [2]. Saleem *et al.* [3] and Negrila *et al.* [4] applied nitrogen to maize crop @ 50, 150 and 200 kg ha^{-1} and observed maximum grain yield from the plot fertilized @ 200 kg nitrogen per hectare. It was concluded that with increasing levels of nitrogen, grain yield increased up to a certain level Pal [5]. Hammad *et al.* [6] demonstrated that without application of N, grain yield and quality was greatly reduced. Nitrogen is a component of protein and nucleic acids and when N is sub-optimal, growth is reduced. Haque *et al.*[7]. Likewise sulfur is recognized as the fourth major nutrient after N, P and K. On an average maize crop absorbs as much S as it absorbs P. When S is deficient in soil, full yield potential of the crop cannot be realized regardless of other nutrients even under good crop husbandry practices. Grain yield per hectare can be increased significantly by the application of nitrogen and sulphur. Rasheed *et al.* [8].The present work was done to study the effect of different doses of nitrogen and sulphur application on maize productivity under normal agrological conditions of Punjab.

Materials and Methods. The experiment was conducted in spring season to investigate the impact of different doses of nitrogen and sulphur fertilizers on hybrid maize cv. Pioneer 31-R-88. Experiment was laid out according to Randomized Complete Block Design (RCBD) with three replications. The treatments comprised of 0, 125, 175 kg N and 0, 15, 25 and 35 kg S ha^{-1}. A basal dose of 100 kg ha^{-1} each of phosphorus and potash was used. All of P, K, S and half of N was applied at the time of sowing in the form of DAP, K2So4, and urea, respectively. Remaining half of nitrogen was applied at first irrigation (15 days after sowing). All the agronomic practices were kept normal and uniform for all treatments. Phenological, growth and yield components data were recorded. The data collected was analyzed statistically by using Fisher's Analysis of Variance Techniques and Least Significant Difference (LSD) test at 5% probability level was applied to compare the treatment means after Steel *et al.* [9].

RESULTS AND DISCUSSIONS:

Number of days taken in tasseling

The data along with analysis of variance are presented in table 1, which indicate that nitrogen and sulphur had significant effect on number of days taken to tasseling. The comparison of individual treatments means showed that maize crop fertilized @ 175 & 25 kg N & S ha^{-1}, respectively took significant maximum number of days to tasseling than that fertilized @ 125 & 25 kg N & S ha^{-1}, respectively but was on a par with that of 175 & 35 or 125 & 35 kg N & S ha^{-1}, respectively. Similarly, the differences among T_3, T_5 & T_2 were statistically at par with one another. While control plot where no fertilizer applied took significantly minimum number (37.47) of days taken to tasseling which was statistically at par with T_2 in which 125 & 15 kg N & S ha^{-1} was applied. These results suggest that application of N & S @125 & 15 kg ha^{-1}, respectively delays tasseling as shown in table 1. The results are in accordance with the findings of Nawaz [10].

Days taken to silking

The effects of nitrogen and sulphur on number of days taken to silking were highly significant as shown by data in table

1. The comparison of individual treatments means showed

TABLE: 1. Effect of nitrogen and sulphur on days to tasseling and silking, leaf area at tasseling and cobs per plant.

Treatments Nitrogen & Sulphur (kg ha^{-1}),	No. of days taken in tasseling	Days taken to silking	Leaf area at tasseling (cm^2)	No. of cobs per plant
T1 (0 + 0)	37.47c	43.12c	2234e	0.73b
T2 (125 + 15)	39.45bc	44.33bc	2457e	0.87ab
T3 (125 + 25)	41.10b	45.19bc	2972d	1.02ab
T4 (125 + 35)	43.47a	46.23b	3216bc	1.02ab
T5 (175 + 15)	40.30b	44.23bc	3016cd	1.02ab
T6 (175 + 25)	45.07a	49.58a	3511a	1.06a
T7 (175 + 35)	44.07a	49.01a	3275b	1.06a
LSD	2.326	2.63	231.4	0.11

Means having similar letters (s) do not differ significantly at P<0.05.

TABLE: 2. Effect of nitrogen and sulphur on cob length, number of grains per row, 1000- grain weight and harvest index.

Treatments Nitrogen & Sulphur (kg ha^{-1}),	Cob length (cm)	Number of grains per row	1000-grain weight (g)	Harvest index (%)
T1 (0 + 0)	12.18c	19.31d	265.38	25.05c
T2 (125 + 15)	12.52c	21.13cd	266.15	28.48b
T3 (125 + 25)	12.57bc	22.00cd	271.90	27.75b
T4 (125 + 35)	13.35ab	22.90abc	284.33	29.50b
T5 (175 + 15)	12.78bc	22.47bc	280.55	32.65a
T6 (175 + 25)	13.68a	24.77ab	293.61	29.34b
T7 (175 + 35)	13.73a	25.29a	295.19	31.58ab
LSD	0.5447	2.763	NS	0.4498

Means having similar letters (s) do not differ significantly at P<0.05.

that maize crop fertilized @ 175 & 25 kg N & S ha^{-1}, respectively significantly delayed silking over that fertilized @ 125 and 35 kg N & S ha^{-1}, respectively but did not differ significantly with plot fertilized @ 175 & 35 kg N & S ha^{-1}, respectively. Similarly, the difference among T_4, T_3, T_2 and T_5 were statistically at par with one another. While control plot where no fertilizer applied took significantly minimum number (43.12) of days taken to silking which was statistically at par with T_2, T_3 and T_5.The delay in silking of the crop rose with higher dose of nitrogen and sulphur might be due to more vegetative growth of plants. These results are in line with the finding of Nawaz [10] and Khaliq *et al.* [11] who reported that application of nitrogen delayed the silking of maize crop.

Leaf area at tasseling (cm^2)

The data along with analysis of variance are presented in table 1, which indicates that nitrogen and sulphur had significant effects on leaf area (cm^2) at tasseling.The comparison of individual treatments means showed that maize crop fertilized @ 175 & 25 kg N & S ha^{-1}, respectively took significant maximum leaf area (3511 cm^2 plant^{-1}) at tasseling than that fertilized @ 175 & 35 kg N & S ha^{-1} respectively, which was on a par with that of @ 125 & 35 kg N & S ha^{-1}, respectively, The difference between T_4 & T_5 was statistically at par with each other. Similarly, the treatment T_3 was statistically at par with T_5. The minimum leaf area (2234 cm^2 plant^{-1}) at tasseling was recorded from control plant which was statistically at par with T_2 in which 125 & 15 N & S ha^{-1} respectively was applied. The results are in accordance with the finding of Haq *et al.* [7] and Nawaz [10], Khaliq *et al.* [11].

Number of cobs per plant

The data regarding the number of cobs per plant are presented in table 1, which indicated that application of nitrogen and sulphur partly affected the number of cobs per plant. It seems that number of cobs per plant is basically a genetic character and not too much influenced by crop nutrition. The difference in number of cobs per plant in all fertilizer treatments statistically at par with one another, but significantly maximum number of cobs (1.06) per plant was

recorded in case of T_6 & T_7 plot where nitrogen and sulphur fertilizer were applied @ 175 & 25 and 175 & 35 kg ha^{-1}, respectively over control which produce minimum number of cobs (0.83) per plant but did not differ significantly with T_2, T_3, T_4 and T_5. These results are in line with the finding of Khaliq *et al.* [12] and Mahmood [13].

Cob length (cm)

The data regarding cob length (cm) is presented in table 2, which indicate that nitrogen and sulphur had significant effect on cob length. The maize crop fertilized @ 175 & 25 kg N & S ha^{-1} respectively exhibited significantly maximum cob length (13.73cm) than that fertilized @ 175 & 15 kg N & S ha^{-1}, respectively but was on a par with that of T_6 and T_4. Similarly, the difference among T_4, T_5 and T_3 were found to be non-significant, while significantly minimum cob length (12.18cm) was noted from control plot which did not differ significantly with T_2, T_3 and T_5. These results are in accordance with the findings of Mahmood [13].

Number of grains per row

The data in table 2 show that application of Nitrogen & Sulphur had significant effect on number of grain per row of maize. Significantly maximum number of grain per row (25.29) was recorded from plot fertilized @ 175 & 35 kg N & S ha^{-1}, respectively than that fertilized @ 175 & 15 kg N & S ha^{-1}, respectively but was on a par with that of fertilized @ 175 + 25 and 125 + 35 kg N & S ha^{-1} respectively. Similarly, differences among T_4, T_5 and T_6 were statistically at par with one another. Similarly, the differences among T_2, T_3, T_4 & T_5 were also statistically at par with one another. While significantly minimum number of grains per row (19.31) was recorded from control plot which was statistically similar with T_2 and T_3.The increase in number of grain per row in case of increasing nitrogen & sulpher level was mainly due to more cob length. These findings are similar with the results of Khaliq *et al.* [12] , Mahmood [13] and Rasheed *et al.* [14].

1000-grains weight (g)

The data of 1000-grain weight (g) are given in table 2. It showed that nitrogen and sulphur had no significant effect on 1000-grain weight. The comparison of individual treatments means showed that average 1000-grains weight was ranged from 265.38 to 295.19 g. These results are in line with the findings of Khaliq *et al.* [12].

Harvest Index (%)

The data in table 2 indicated that nitrogen and sulphur had significant effects on harvest index value. The comparison of individual treatments mean showed that maize crop fertilized @ 175 & 15 kg N & S ha^{-1}, respectively took significantly maximum harvest index value (32.65%) but was on a par with that of @ 175 & 35 kg N & S ha^{-1}, respectively obtaining 31.58 % harvest index. Similarly differences among T_2, T_3, T_4, T_6 & T_7 were statistically at par with one another. While the minimum harvest index value (25.05%) was in case of control where no fertilizer was applied. The results indicate that harvest index value increase with increase in N & S values. These findings are in agreement with that of Hammad *et al.* [6].

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