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IMPACT OF NITROGEN AND SULFUR APPLICATION ON GROWTH AND YIELD OF MAIZE (*ZEA MAYS* L.) CROP

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Abstract: The experiment was laid out in randomized complete block design (RCBD) having three replications with net plot of 4.2 x 7.5 m to evaluate the effect of nitrogen and sulfur on growth, yield and quality of double cross hybrid (DCH) maize (Cargil-707). Application of fertilizers at the rate of 150 + 30 and 150 + 20 kg of nitrogen and sulfur per hectare respectively greatly increased dry weight per plant (DWP), plant grains number per ear (GNE) and grain weight per ear (GWE) over other treatments. Similarly, the highest grain yield of 8.59 tons per hectare was recorded from the plot fertilized at the rate of 150 kg N and 30 kg S per hectare, while maximum grain oil content (GOC) and grain protein contents (GPC) were recorded from plot fertilized at the rate of 150 + 30 and 150 + 20 kg N and S per hectare respectively.

Keywords: Hybrid maize, leaf area, nitrogen, sulfur.

INTRODUCTION

Among cereals, maize (*Zea may* L.) is an important food and feed crop which ranks third after wheat and rice in the world. Because of its expanded use in the agro-industries it is recognized as a leading commercial crop of great agro-economic value. Pakistan grows about 0.97 m ha of maize with total annual production of 1.73 million ton of grain giving an average yield of 1790 kg ha^{-1} [Govt. of Pakistan 2003] that is tremendously lower than other growing countries of the world. There are many reasons 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 of better quality.

Balanced nutrition is an essential component of nutrient management and plays a significant role in increasing crop production and its quality. For the major processes of plant development and yield formation the presence of nutrients like N, P, K, S and Mg etc. in balanced form is essential [Mahmood 1994, Randhawa and Arora 2000]. Nitrogen is the motor of plant growth and makes up 1 to 4 percent of dry matter of the plants [Anonymous 2000]. Nitrogen is a component of protein and nucleic acids and when N is sub-optimal, growth is reduced [Haque *et al*. 2001]. 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 [Tandon 1989]. The nutrition value of cereals is also determined by the proportion of S containing amino acids [Katyal *et al*. 1987]. Thus there is

a need to carry out a systematic research on these two nutrient elements in order to develop comprehensive information regarding N and S.

MATERIALS AND METHODS

The experiment was conducted at the research area of the Department of Agronomy, University of Agriculture, Faisalabad during the autumn of 1998 and 1999 on a sandy clay loam soil having 0.043% total N, 1 ppm available P and 125 ppm available K. The treatment comprised i.e. 0, 100 and 150 kg N and 0, 10, 20 and 30 kg S ha^{-1} respectively. Double cross hybrid maize (Cargil-707) was sown on a well prepared seed bed with the help of dibbler. Full dose of phosphorus, potash, sulfur and half of N was applied at time of sowing while remaining half of N was applied at first irrigation. The crop was thinned at 3-4 leaf stage in order to maintain the required plant population. First irrigation was given 12 days after sowing while the subsequent irrigation was adjusted according to the need of the crop strictly avoiding over irrigation. All the other agronomic practices were kept normal and uniform for all the treatments. The crop was harvested on maturity and observations recorded were dry weight per plant (DWP) at tasselling, grain number per ear (GNE), grain weight per ear (GWE), grain yield per hectare (GYH), stover yield per hectare (SYH), grain oil content (GOC), grain crude-protein content (GPC). The GYH was recorded after allowing the ears at a moisture level of about 14 percent. To determine the significant difference among the treatment means, LSD test at 5 percent probability level was applied [Steel and Torrie 1984].

RESULTS AND DISCUSSION

Grain number per ear (GNE) was significantly affected by the application of N and S (Table 1). Maize crop fertilized at the rate of 150 and 20 kg N and S ha^{-1} respectively produced significantly maximum GNE (271.7) but was statistically at par with F_3, F_4, F_5 and F_6, treatments while significantly minimum GNE was recorded in case of control plot. The increase in GNE by increasing N and S was mainly due to more grain number per row (GNR) and cob length. Maize crop fertilized at the rate of 150 and 20 kg of N and S ha^{-1} respectively took significantly maximum GWE (153.2 g) than that fertilized at 100 and 20 kg of N and S ha^{-1} respectively but was on a par with that of F_7, F_5 and F_4 treatments while significantly minimum GWE (96.86 g) was recorded from control plot which is also statistically at par with F_2 in which 100 and 10 kg N, S ha^{-1} respectively was applied. The increase in grain weight per ear (GWE) was due to more GNE and ear length.

N and S application significantly increased DWP at tasselling over control (Table-I). Maximum dry weight per plant (87.42 g) was recorded from plot fertilized at 150 and 30 kg of N and S ha^{-1} respectively over that fertilized with 100 and 20 kg of N and S ha^{-1} but the differences among F_7, F_6, F_3 and F_4 treatments were found to be non-significant while significantly

lowest DWP (43.50 g) was obtained from control plot. The increase in DWP at tasselling due to increase in N and S application is ascribed to its positive effects, though non-significant on plant height, stem diameter and leaf number per plant (LNP). Greater DWP with sulfur application was also reported by Kochar *et al*. [1990], Mahmood [1994] and Grobler *et al*. [1999].

Table-1: Growth, yield and quality characteristic of hybrid as affected by N and S application

Treatments (kg ha^{-1}) N+S	Grain number per ear (GNE)	Grain weight per ear (GWE)	Dry weight per plant (DWP) at tasselling (g)	Grain yield per hectare (GYH) ton ha^{-1}	Stover yield per hectare (SYH) ton ha^{-1}	Grain oil contents (GOC) %	Grain protein content (GPC) %
F_1 = 0 + 0	271.7 c	96.86 a	43.50 c	3.76	9.65 d	4.20 b	8.21 c
F_2 = 100+10	280.8 bc	118.3 cd	66.66 b	6.62	16.21 c	4.64 a	8.57 bc
F_3 = 100+20	315.3 abc	126.3 bc	69.43 b	6.68	16.60 c	4.78 a	8.63 bc
F_4 = 100+30	329.0 ab	141.7 ab	78.23 ab	7.65	17.37 bc	4.80 a	8.86 b
F_5 = 150+10	329.0 ab	135.2 abc	75.61 ab	8.18	17.04 c	4.78 a	8.73 b
F_6 = 150+20	347.6 a	153.1 a	86.72 a	8.38	19.29 a	4.88 a	9.93 a
F_7 = 150+30	349.7 a	151.7 a	87.42 a	8.59	19.23 ab	4.90 a	9.77 a
LSD =	32.34	21.62	12.19	0.50	1.91	0.33	0.45

Mean followed by different letters are significantly different at 0.05 probability level.

Significantly maximum GYH (8.59 ton ha^{-1}) of maize was obtained from F_7 plot fertilized with 150 and 30 kg of N and S ha^{-1} respectively followed by plot fertilized at 100 and 20 kg of N and S ha^{-1} respectively but was statistically at par with F_5 and F_6 treatments while significantly minimum GYH (3.76 ton ha^{-1}) was obtained from control. The increase in GYH as a result of increasing N and S application is attributed to enhanced crop growth rate (CGR), net assimilation rate (NAR) and DWP which ultimately increased GNE and GWE (Table 1). Higher GYH in response to N and S application was also stated by Balko and Russel [1980], Aulakh and Chhibba [1991], Vilela *et al.* [1995] and Rasheed *et al*. [2003].

Significantly maximum SYH (19.29 ton ha^{-1}) was recorded in case of 150 and 20 kg of N and S ha^{-1} respectively followed by 100 and 30 kg of N and S ha^{-1} but differences in SYH between F_6 and F_7 and F_4 were statistically at par with each other respectively. The increase in GYH with successive increase in N and S was due to the more leaf area (LA) and DWP (Table-1). The successive increase in N and S fertilizer increased the grain oil content (GOC). This increase in GOC by the application of S was due to requirement for disulphide bond formation between polypeptide chains sulfur is required for the synthesis of various metabolites e.g. Co-enzyme A which is involved in the oxidation and synthesis of fatty acids [Tisdale *et al*. 1990]. These results are in conformity to those reported by Sachdev and Deb [1990].

Maximum GPC (9.93%) was obtained from F6 which is statistically at par with F7, while significantly minimum GPC (8.231%) was recorded in case

of control plot (Table-1). The increase in GPC may be due to the fact that N is an integral constituent of amino acids, which are the basic units of the protein. These results are in consonance to those reported by Singh *et al*. [1988].

Hybrid maize (Cargil-707) should be fertilized at the rate of 150 kg N and 30 kg S ha^{-1} to maximize its GYH as well as to improve the quality of oil and protein contents under the agro-ecological conditions of Faisalabad.

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Keywords: Maize (Zea mays L.), Nitrogen levels, Grain Yields, Acid soils. INTRODUCTION.Â Nitrogen and phosphorus are very essential for good vegetative growth and grain development in maize production. The quantity required of these nutrients particularly nitrogen depends on the pre-cleaning vegetation, organic matter content, tillage methods and light intensity (Kang, 1981).Â The response of maize plant to application of N-fertilizers varies from variety to variety, location to location and also depends on the availability of the nutrients (Onasanya et al., 2009). Various studies have shown that maize varieties differ in grain yield response to nitrogen fertilization (Bundy and Carter, 1988). 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.Â 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. PDF | Nitrogen and Sulphur application, significantly affected the phonological, growth and yield parameters of maize except, number of cobs per plant | Find, read and cite all the research you need on ResearchGate.Â 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.