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Impact of different doses of nitrogen on growth and yield of maize in agro-ecological zone of district Vehari

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Abstract

A field trial was conducted to evaluate the effect of four nitrogen levels (N_1 @ 75 kg ha^{-1}, N_2 @ 150 kg ha^{-1}, N_3 @ 225 kg ha^{-1}, N_4 @ 300 kg ha^{-1}) and three maize cultivars (FH-810,DTC,C-20) on growth and yield of maize under agro-ecological zone of District Vehari during Spring 2016. The result showed that nitrogen rates significantly affected on plant height (cm). The maximum plant height (189.61cm) was recorded by N_4 followed by N_1 (175.67 cm). Maximum number of grains per cob (498.67) was recorded by N_4 and minimum (453.00) was produced by N_1. The cultivar FH-810 of maize showed maximum number of grains per cob (500.25) over cv. DTC (479.42) and cv. C-20 (450.75) respectively. Maximum cob diameter (4.08 cm) was recorded in N_4 followed by N_1 (3.23 cm). N_4 showed highest 1000-grain weight compared to N_3, N_2 and N_1 237.26g, 245.48g, 254.04g and 266.77g in N_1, N2, N3 and N_4 treatments, respectively. Whereas maximum 1000-grain weight was recorded by cv.FH-810 (266.38g) followed by DTC (253.27g) and C-20 (233.00g). However maximum grain yield (7.56 t ha^{-1}) was recorded by N_4 followed by N_3 (6.42 t ha^{-1}) N_2 (5.74 t ha^{-1}) and N_1 (5.27 t ha^{-1}). Cultivar FH-810 also showed maximum grain yield (7.11 t ha^{-1}) over DTC (6.17 t ha^{-1}) and C-20 (5.46 t ha^{-1}). At the end it is concluded that the farmers are advised to grow FH-810 with nitrogen level N_4 for obtaining maximum yield of maize crop with the consultation of Plant Doctors of Extension Department.

Keywords: Nitrogen; doses; Maize; yield, Vehari, Punjab Pakistan

Introduction

Maize (*Zea mays* L.) known as king of grain crop is the third most important crop in the world after wheat and rice. Approximately 8 to 10% of the corn crop is used as food for human consumption. It is not only a source of food, fodder and feed but also many by-products like glucose, starch and corn oil. Corn are being used in the manufacturing of soaps, varnishes, paints etc. Maize is extensively grown in temperate, subtropical and tropical regions of the world. Maize grains have greater nutritional value as it contains 72% starch, 10% protein, 4.8% oil, 8.5% fibre, 3.0% sugar and 1.7 % ash (Chaudhary, 1983). Maize starch is used for producing bio-fuel (as ethanol) after its fermentation (Ahmad *et al.*, 2007). In Pakistan maize was cultivated on an area of 1.08 million hectares with total annual grain production of 4.08 million tones and grain yield of 3264 kg ha^{-1} (Anonymous, 2009). Nitrogen plays a dominant role in plant growth as it is an integral part of chlorophyll, constituent of enzymes, proteins and nucleic acids (Marschner, 1986).

Nitrogen is a constituent of plant compounds including nucleotides, amides and amines. N plays a key role in many metabolic reactions, however N present in chlorophyll molecule. Nitrogen is also a structural constituent of cell walls (Schrader, 1984). Maize is a nitro-positive crop which needs heavy doses of nitrogenous fertilizer for its better production. Two types of cultivars are being used that is synthetic and hybrid cultivars. Maize hybrids have a pivotal role while deciding about the type and amount of fertilizer in order to meet the requirements for growth and development through out life span of crop (Chandrashekra *et al*., 2000). Nitrogen supply positively enhances grain yield in all hybrids, primarily by increasing kernel (Uribelarrea *et al*., 2004).

Materials and Methods

A field trial was conducted to evaluate the effect of four nitrogen levels (N_1 @ 75 kg ha^{-1}, N_2 @ 150 kg ha^{-1}, N_3 @ 225 kg ha^{-1}, N_4 @ 300 kg ha^{-1}) and three maize cultivars (FH-810,DTC,C-20) on growth and yield of maize under agro-ecological zone of District Vehari during Spring 2016. The land was prepared by cultivating the soil 2-3 times with tractor mounted cultivator each followed by planking however maize varieties and the crop was cultivated on 75 cm apart ridges by dibbling method (by placing two seeds manually per hill at 25 cm apart hills) using seed rate of 30 kg ha^{-1}. The amount of P and K (each 125 kg ha^{-1}) was remain constant in all the treatments. The sources of NP and K in all the treatments were Urea, SSP and SOP respectively. All P, K and 1/3rd N was applied at the time of sowing, 1/3 rd N was applied at knee height and remaining amount of N was applied at the time of flowering stage. Total eleven irrigations were applied in the field. First irrigation was applied twenty five days after sowing and other irrigations were applied fifteen days intervals till flowering. Thinning was done at 3-4 leaf stage to maintain a single plant at each hill. Crop was kept free of weeds by hoeing twice to avoid crop competition. All other agronomic practices were kept constant and uniform to avoid any biasness.

Results and Discussion

Table.1 indicated that the maize cultivar FH-810 (V_1) produced significantly maximum height (188.96 cm) which was followed by DTC (182.87 cm) V_2 and C-20 (174.00 cm) V_3. Cultivar FH-810 produced maximum plant height which was due to high genetic potential. The effect of nitrogen levels on plant height was also showed significant effect compared to all other treatments. Maximum plant height (189.61 cm) was recorded by N_4 (300 kg N ha^{-1}) and minimum plant height (175.67 cm) was recorded by treatment N_1 (75 kg N ha^{-1}). The interaction between cultivars and nitrogen levels showed non significant effect. These results were similar with the findings of Akhtar *et al*., (1996) and Hussan (2005). Cob diameter of maize as affected by maize cultivars and N rates showed that cv. V_1 (FH-810) produced maximum cob diameter (4.39 cm) while the minimum was found with cv. V_3 (C-20) i.e 2.70 cm. However the effect of nitrogen levels on cob diameter it showed significant effect. Maximum cob diameter (4.08 cm) was recorded at 300 kg N ha^{-1} (N_4).While the minimum cob diameter (3.23 cm) was produced where 75 kg N ha^{-1} (N_1) was applied. However interaction between cultivars and nitrogen levels affecting the cob diameter showed significant result. Maximum cob diameter (4.70 cm) was produced by cv. FH-810 at 300 kg N ha^{-1} (N_4) and statistically at par with V_1 N_3 (FH-810+225 kg N) and with V_2 N_4 (DTC+300 kg N) and minimum cob diameter (2.4 cm) was recorded at N_1 (75 kg N ha^{-1}) which was statistically at par with V_3 N_2 (C-20+150 kg N). These results were closely related to the findings of Oktum and Oktern (2005) who recorded that increasing nitrogen application up to 350 kg N ha^{-1} increased cob length, cob diameter and grains per cob. However the effect of cultivars on the number of grains per cob showed highly significant result. Maize cv. FH-810 (V_1) produced significantly higher number of grains per cob (500.25) followed by DTC (479.42) and C-20 (450.75). The effect of nitrogen levels on number of grains per cob showed highly significant result. Maximum number of grains per cob (498.00) was found at 300 kg N ha^{-1} (N_4) however minimum result was recorded by N_1 (453.00). Higher level of nitrogen increased the size of individual cob resulting maximum number of grains per cob was produced. The interaction between the maize cultivars and N levels showed significant result however maximum number of grains (533.00) per cob were produced by cv.FH-810 (V_1) at N_4 where N was applied at the rate of 300 kg ha^{-1} and minimum number of grains (439.00) per cob was recorded by cv.C-20 (V_3) at N_1 (75 kg ha^{-1}). Similar results were reported by Alam *et al*., (2003) who recorded similar effects of these nitrogen applications.

Table.1. Effect of different doses of nitrogen on yield and yield components of maize

Individual comparison of treatment means

Treatments Varieties	Plant height (cm)	No. of grains per cob	Cob diameter (cm)	1000-grain weight (g)	Grain yield (tha^{-1})
FH-810	188.96a	500.25a	4.39a	266.38a	7.11a
DTC	182.87b	479.42b	4.07b	253.27b	6.17b
C-20	174.00c	450.75c	2.70c	233.00c	5.46c
LSD	2.80	1.5731	0.1262	2.0962	0.0427
Nitrogen levels					
N_1(75 $kgha^{-1}$)	175.67d	453.00d	3.23d	237.26d	5.27d
N_2(150 kg ha^{-1})	179.00c	469.89c	3.64c	245.48c	5.74c
N_3(225 kg ha^{-1})	183.50b	485.67b	3.92b	254.04b	6.42b
N_4= (300 kg ha^{-1})	189.61a	498.67a	4.08a	266.77a	7.56a
LSD%	3.24	1.8164	0.1457	2.4205	0.0494
Interaction	NS	**	**	**	**

Table I, indicated that maize cv. FH-810 (V_1) recorded maximum 1000-grains weight (266.38 g), followed by cv. DTC (253.27 g) and cv. C-20, which gave 233.00 g. The nitrogen level of 300 kg ha^{-1} (N_4) showed significantly maximum (266.77 g) 1000-grain weight (g) compared to minimum 1000-grains weight of N_1 (237.26 g). Cultivar FH-810 gave the maximum 1000-grain weight (291.30 g) at N_4, while minimum was recorded by C-20 (225.00g) at N_1 nitrogen level and it also gave the same with C-20 (V_3). The differences in grain weight due to different nitrogen application could be attributed to variation in nutrition. These results are in accordance to Waqas (2002) and Khan *et al*., (1999).

From table II the comparison of treatment means (Table 1) showed that FH-810 (V_1) yielded maximum (7.11 t ha^{-1}) compared to C-20 (5.46 t ha^{-1}). The N_4 (300 kg N ha^{-1}) treatment produced significantly higher grain yield (7.56 t ha^{-1}) and minimum grain yield was produced in treatment fertilized at the rate of 75 kg N ha^{-1} (5.27).

Table.II. Interaction between varieties and fertilizer

Treatments	Cob diameter (cm)	No. of grains per cob	1000-grain weight (g)	Grain yield (t ha^{-1})
FH-810+ 75 kg N ha^{-1}	3.91c	470.00d	246.77c	5.710d
FH-810+150 kg N ha^{-1}	4.43b	495.00c	262.43b	6.32c
FH-810+225 kg N ha^{-1}	4.54ab	503.00b	265.02b	7.46b
FH-810+300 kg N ha^{-1}	4.70a	533.00a	291.30a	8.95a
DTC+ 75 kg N ha^{-1}	3.40d	450.00f	240.00d	5.20f
DTC+150 kg N ha^{-1}	3.91c	469.67d	246.00c	5.71d
DTC+225 kg N ha^{-1}	4.43b	495.00c	262.10b	6.32c
DTC+300 kg N ha^{-1}	4.54ab	503.00b	265.00b	7.46b
C-20+75 kg N ha^{-1}	2.40g	439.00h	225.00f	4.90g
C-20+150 kg N ha^{-1}	2.60fg	445.00g	228.00f	5.19f
C-20+225 kg N ha^{-1}	2.80ef	459.00e	235.00e	5.50e
C-20+300 kg N ha^{-1}	3.00e	460.00e	244.00cd	6.28c
LSD %	0.2524	3.1461	4.1924	0.0855

It is clear that grain yield increases with in increase in nitrogen levels. Statistically higher grain yield (8.95 t ha^{-1}) was obtained by (V_1) FH-810 with 300 kg N ha^{-1} (N_4) compared to minimum grain yield (4.90 t ha^{-1}) was recorded by C-20 with N_1 (75 kg N ha^{-1}). These results are in accordance to Mkhabela *et al*., (2001) and Younas *et al*., (2002) who reported that higher levels of nitrogen enhanced the grain yield.

Conclusion

At the end it is concluded that the farmers are advised to grow FH-810 with nitrogen level N_4 for obtaining maximum yield of maize crop with the consultation of Plant Doctors of Extension Department.

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