

Research Article

Response of maize varieties to different Nitrogen levels under agro-climatic condition of Gilgit-Baltistan

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Abstract

A field experiment was conducted at Mountain Agricultural Research Centre, district Gilgit, Northern Area of Pakistan to evaluate the effect of different N levels (0, 45, 90, and 135 kg ha⁻¹) on different varieties of maize (Pahari, Azam, Jalal). This experiment was laid out in Randomized Complete Block Design with three replications while N was applied in two split doses half each at sowing and at first irrigation. The results indicated the improved performance of all parameters (plant height, grain weight, number of rows cob⁻¹, number of grains cob⁻¹ and Grain Yield (kg ha⁻¹) by increasing the amount of nitrogen fertilizer from control to 135 kg N ha⁻¹. The application of 90 kg ha⁻¹ seems sufficient to acquire the optimum yield. At this nitrogen level maximum number of grains Cob⁻¹ (527.67) and maximum thousand grain mass (374.67) were recorded in Azam, maximum plant height was recorded in Pahari (216.67), maximum grain yield kg ha⁻¹ and maximum number of rows Cob⁻¹ were recorded in Azam. Which were 3740.0 and 10.00.

Keyword: Factorial; Variety nitrogen; Yield

Introduction

Maize (*Zea mays L.*) belongs to the Poaceae family and was instigated in Mexico [1]. After wheat and rice, Maize is ranked as a third chief cereal crop in the world. This crop has an extensive array of consumptions including human food, industrial administered food production of starch and used as fodder to foraging animals. Maize with its various cultivars and different mellowness periods has broader tolerance to various environmental circumstances [2]. In Pakistan, it is grown on 1016.9 thousand

hectares yielding 3088.4 thousand tones of grain [3]. Many biotic and abiotic constrictions are interfering in the low production of maize in Pakistan, fungal diseases like leaf blights, smuts and stalk are most common among them. Other causes for low yield per unit area include lack of resilient and high yielding varieties, inappropriate cultural practices, no or less use of fertilizers, fungicides, and the presence of many other bacterial and nematode diseases [4]. In many developing countries eco-friendly agricultural production is the

demand of the recent period, where there is no control over the impacts of N fertilization on soil and environment. Most of the N fertilizer in Pakistan many N fertilizers are applied in the form of urea and it is subject to frequent damages. Nitrogen is the most limiting nutrient element in the production of crops. Nonetheless, the considerable agricultural yield has amplified with the application of chemical fertilizers. According to FAO [5] During initial growth, the uptake of nitrogen was little but amplified at tasseling. Though relatively small quantities of fertilizers are essential during the very early stages of plant growth, however, high concentrations in root zones are very helpful in the early growth of [6]. The timings of nitrogen applications are important and are considered the most important choice for the high production of crossbreed maize [7].

Apart from using as fodder for livestock as well as feed-in poultry farms maize is utilized as human food in various forms. It is regarded as nutritionally important because it contains approximately 6-16% of protein, 76-88% of carbohydrate, 4-5.7% fat and 1.3% of minerals. The productivity of this crop is very low in various maize growing countries due to various factors poor soil fertility, poor agronomic performs. Among these factors, inadequate consumption of nitrogen fertilizers is most important. Therefore, the purpose of this study is:

To assess the outcome of nitrogen fertilizer on maize growth and yield.

Materials and methods

The study was conducted at Mountain Agricultural Research Centre, Farm district Gilgit Northern Area of Pakistan. Randomized Complete Block Design (RCBD) with three replications was used for this experiment. Design with split plot arrangement having three replications under natural epiphytotic conditions. Three varieties of maize (Azam, Pahari and local) were sown in main plots four N levels (0, 45,

90, and 135 kg N/ha) with three repetitions. Plot size was 4 X 4.5 m and row to row distance was maintained as 75 cm. Nitrogen fertilizers were applied in two split doses half at first irrigation and half at sowing.

Documented parameters under different treatments

The return of all treatments were documented after harvesting by changing into kg ha⁻¹. For the Grain Yield (kg ha⁻¹) weight (g) of hundred Grains for each treatment was taken thrice and then its averages were recorded. To document Grains Cob⁻¹ five cobs were selected from each treatment, averages were recorded after counting number of grains on each cob. Similarly for the Rows Cob⁻¹ ten to twelve cobs were randomly selected from each treatment and used for counting the number of rows on each cob and these were averaged. For measuring the Plant Height (cm) randomly ten plants were selected from each treatment. After measuring their heights averages were recorded. For measuring 1000-Grain Weight thousand grains from treatment were taken. After measuring the weight averages were recorded. All the recorded data were analyzed statistically using Analyses of Variance (ANOVA) and Least Significant Difference (LSD) test [8-10].

Results

Among all three varieties maximum mean was 469.00 in Azam while minimum mean was 419.42 in Local cultivars. Combined maximum mean of all three varieties at 135Nitrogen kg ha⁻¹ was 514.44. Maximum number of grains Cob⁻¹ was 557.33 at 135Nitrogen kg ha⁻¹ in Azam while it was 352.67 at 0 Nitrogen kg ha⁻¹. Maximum mean for grain weight was 337.25 and minimum was 262.00in Azamand Local respectively. While the combined maximum mean was 377.22 at 0 Nitrogen kg ha⁻¹. Maximum 1000 grain weight was 422.33 in Azam at 135Nitrogen kg ha⁻¹ while minimum was 205 in local at 0 Nitrogen kg ha⁻¹. Maximum

mean for plant height was 201.33 cm and minimum was 165.92 cm in Azam and Local respectively. Maximum plant height was 228.67 cm in Pahari at 135 Nitrogen kg ha⁻¹ while minimum was 156 cm in Local at 45 Nitrogen kg ha⁻¹. Maximum combined mean of all three varieties was 209.11 cm at 135 Nitrogen kg ha⁻¹. Maximum mean for grain yield was 3499.3 kg ha⁻¹ in Azam while minimum was 2238 kg ha⁻¹ in Local. Combined minimum mean was 2101.2 kg ha⁻¹ for first treatment while maximum mean

was 3779.7 kg ha⁻¹ at 135 Nitrogen kg ha⁻¹. Maximum grain yield was 4761.0 kg ha⁻¹ for Azam at 135 Nitrogen kg ha⁻¹ while minimum was 1844.3 kg ha⁻¹ for Azam at 0 Nitrogen kg ha⁻¹. Maximum mean for number of rows Cob⁻¹ was 9.33 in Azam while minimum was 7.50 in Local. Combined maximum mean for all three varieties was 9.77 at 135 Nitrogen kg ha⁻¹. Maximum number of rows cob⁻¹ was 11.667 in Azam at 135 Nitrogen kg ha⁻¹ while minimum was 6.00 in local at 0 Nitrogen kg ha⁻¹ (Table 1-5).

Table 1. Grains Cob⁻¹

Nitrogen kg ha ⁻¹	Varieties			Mean
	Azam	Pahari	Local	
0	352.67 ⁱ	308.67 ^j	316.00 ^j	325.78^d
45	438.33 ^f	397.67 ^h	412.00 ^g	416.00^c
90	527.67 ^b	483.00 ^h	471.00 ^e	493.89^b
135	557.33 ^a	507.33 ^c	478.67 ^{de}	514.44^a
Mean	469.00^a	424.17^b	419.42^c	

Means in for each row followed by the similar letter are not significant at LSD test P = 0.05

Table 2. Thousand grain mass (TGM)

Nitrogen kg ha ⁻¹	Varieties			Mean
	Azam	Pahari	Local	
0	246.33 ^f	225.00 ^g	205.00 ^h	377.22^a
45	305.67 ^d	245.00 ^f	218.33 ^{gh}	316.56^b
90	374.67 ^b	309.33 ^d	265.67 ^e	256.33^c
135	422.33 ^a	359.33 ^c	350.33 ^c	225.44^d
Mean	337.25^a	282.42^b	262.00^c	

Means in for each row followed by the similar letter are not significant at LSD test P = 0.05

Table 3. Plant height in cm

Nitrogen kg ha ⁻¹	Varieties			Mean
	Azam	Pahari	Local	
0	163.33 ^f	170.00 ^e	145.33 ^h	159.56^d
45	171.33 ^e	190.00 ^d	156.00 ^g	172.44^c
90	193.33 ^d	216.67 ^b	173.00 ^e	194.33^b
135	209.33 ^c	228.67 ^a	189.33 ^d	209.11^a
Mean	201.33^a	184.33^b	165.92^c	

Means in for each row followed by the similar letter are not significant at LSD test P = 0.05

Table 4. Grain yield kg ha⁻¹

Nitrogen kg ha ⁻¹	Varieties			Mean
	Azam	Pahari	Local	
0	2354.0 ^g	2105.3 ^h	1844.3 ⁱ	2101.2^d
45	3142.3 ^d	2634.3 ^e	2129.0 ^h	2635.2^c
90	3740.0 ^c	3236.3 ^d	2400.3 ^{fg}	3125.6^b
135	4761.0 ^a	4059.7 ^b	2578.3 ^{ef}	3799.7^a
Mean	3499.3^a	3008.9^b	2238.0^c	

Means in for each row followed by the similar letter are not significant at LSD test P = 0.05

Table 5. No of rows Cob⁻¹

Nitrogen kg ha ⁻¹	Varieties			Mean
	Azam	Pahari	Local	
0	7.667 ^{cd}	7.333 ^{de}	6.00 ^e	7.00^c
45	8.00 ^{cd}	7.667 ^{cd}	7.667 ^{cd}	7.77^{bc}
90	10.00 ^b	8.00 ^{cd}	7.667 ^{cd}	8.55^b
135	11.667 ^a	9.00 ^{bc}	8.667 ^{bcd}	9.77^a
Mean	9.33^a	8.00^b	7.50^c	

Discussion

The results of this study indicates that application of nitrogenous fertilizers in different doses for different varieties greatly influences the plant height, yield, grains cob⁻¹ and weight as well. Positive response of nitrogen fertilizers has been also stated by Koul, Omer and Gasim [11-13]. Sharma [14] concluded plant height is amplified by adding nitrogen fertilizer. Proliferation in plant height is followed by increase in leaf number per plant [15].

Number of grains cob⁻¹ of different varieties getting different nitrogen levels was different from each other. Among all three varieties (Local, Pahari, Azam) maximum mean for grains cob⁻¹ was 469.00 in Azam. Combined maximum mean of all three varieties at level of Nitrogen 135 kg ha⁻¹ was 514.44. Maximum number of grains Cob⁻¹ was 557.33 at 135 Nitrogen kg ha⁻¹ in Azam. Similar study was conducted in Agricultural Research Farm of the NWFP Agricultural University, Peshawar, in this research maximum number of grains cob⁻¹ was 375.9 was noted in variety Jalal 2003, while the lowermost was recorded 313.8 grains cob⁻¹ in Pahari [9].

Maximum mean for grain weight was 337.25 and minimum was 262.00 in Azam and Local respectively. While the combined maximum mean was 377.22 at 0 Nitrogen kg ha⁻¹. Maximum 1000 grain weight was 422.33 in Azam at 135 Nitrogen kg ha⁻¹ while minimum was 205 in local at 0 Nitrogen kg ha⁻¹. According to the study conducted in Agricultural University, Peshawar the maximum yield was recorded 9409 kg ha⁻¹ for Jalal and minimum was 8490 kg ha⁻¹ for Azam. Maximum seed production was 4535 kg ha⁻¹ for Jalal and 3706 kg ha⁻¹ for Azam. Treatment 150 kg Nitrogen application yielded highest seed production which was 4827 kg ha⁻¹, for 120 kg Nitrogen use it was 3962 kg ha⁻¹ and for 90 kg Nitrogen 3327 kg ha⁻¹ [16]. While in present research maximum mean for grain yield was 3499.3 in Azam whereas minimum was 2238 in Local. Maximum grain yield was 4761.0 for Azam at 135 Nitrogen kg ha⁻¹ while minimum was 1844.3 for Azam at 0 Nitrogen kg ha⁻¹.

The use of diverse nitrogen levels amplifies plant height by 25-50% than crop without Nitrogen fertilizers [9]. In this study maximum mean for plant height was 201.33 and minimum was 165.92 in Azam and Local

respectively. Maximum plant height was 228.67 in Pahari at 135 Nitrogen kg ha⁻¹ while minimum was 156 in Local at 45 Nitrogen kg ha⁻¹. Alimi and Alofe [17] testified that crop yield of maize at 100 kg he⁻¹ and 200 kg he⁻¹ of Nitrogen was more commercial than without fertilizer. According to Gokmen *et al.* [18] plant height amplified at 100 kg Nitrogen per ha. They also reported the increased weight of 1000 grains. Khalid [19] reported that application of nitrogen fertilizer indicated healthy crop with more cobs plant⁻¹ with a good and uniform grain size. Plant height and cob length could be increased significantly by nitrogenous and phosphoric fertilizers [20]. Maximum mean for number of rows Cob⁻¹ was 9.33 in Azam while minimum was 7.50 in Local. Combined maximum mean for all three varieties was 9.77 at 135 Nitrogen kg ha⁻¹. Maximum number of rows cob⁻¹ was 11.667 in Azam at 135 Nitrogen kg ha⁻¹ while minimum was 6.00 in local at 0 Nitrogen kg ha⁻¹ in present research.

Conclusion

The results of this study confirms the role of nitrogenous fertilizers in cumulative growth, plant height, yield, number of grains and rows cob⁻¹ and grain weight in maize. After the results of this experiment, application of 90-135 kg ha⁻¹ of nitrogen fertilizer is suggested for amassed maize yield mainly in the study area. Conversely, application of 90 kg ha⁻¹ of nitrogen fertilization is considered adequate for optimum performance of all parameters observed in this study because there was no significant difference in performances of all parameters at 90 kg ha⁻¹ and 135 kg ha⁻¹.

Authors' contributions

Conceived and designed the experiments: M Arshad & SU Din, Performed the experiments: M Arshad, SU Din & Sharista, Analyzed the data: MA Nafees, Sharista & S Ahmed, Contributed materials/ analysis/

tools: S Ahmed, S Ullah, A Karim & MA Nafees, Wrote the paper: Sharista & SU Din.

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