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Research Article

Phonological Study of Maize Under Different Nitrogen Levels and Planting Densities

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Abstract

The experiment on "The phonological study of maize under nitrogen levels and planting density" was conducted at Toru Mardan, Khyber Pakhtunkhwa, Pakistan, during spring 2014. The experiment was laid out in randomize complete block design with four replications. The experiment consisted on plant population (46000, 56000, 66000 plants ha^{-1}) and three Nitrogen levels (200, 250, 300 kg N ha^{-1}). The study revealed that nitrogen had significant influence on days to silking, days to tasseling, internodes length, and number of nodes $plant^{-1}$, number of leaf $plant^{-1}$, plant height, and emergence $m^{-2.}$ The planting density and interaction was found non significant. Application of nitrogen at rate of 300 kg ha^{-1}. Delayed days to emergence were (5), Delayed silking (68), high days to tassling (62), high internodes length (15cm). More number of nodes $plant^{-1}$ (16), higher Number of leaf $plant^{-1}$ (15). However the plant density was found non-significant but plant population 46000 plant ha^{-1} higher in all parameter.

Keywords: *Planting Densities; Nitrogen; Internode Length*

Introduction

Maize (*Zea mays* L) is the third important cereal crop in Pakistan after wheat and rice. In Khyber Pakhtunkhwa, it ranked 2nd after wheat in its importance. About 36% of maize is grown on rain-fed area, while 64% is grown under irrigated areas. Maize is important sources of feed, food and fibers [1]. Maize is a rich source of cooking oil. Maize contains about 72% starch, 10% protein, 4.8% oil, 8.5% fiber, 3.0% sugar and 1.7% ash [2]. The ideal maize yield producers are India, France, Italy, United States and Brazil.

Maize being the highest yielding cereal crop in the world is of significant importance for countries. In Pakistan, grain yield of maize is very low as compared to other maize growing countries like Italy, Canada, China and Argentina [3]. In spite of high yield potential of maize, its yield still low with cultivation on large area of land. In 2010, maize was cultivated on an area of 1087 (000 ha) with a total production of 4338 (000 tones) in Pakistan, while during the same season its area of cultivation and production in KP was 422 (000 ha) and 740 (000 tones) respectively [4]. The application of nitrogen significantly increased the plant height, stem diameter and leaf area index of maize crop.

Approximately 8 to 10% of the maize crop is used for human consumption. It not only represents the source of food, fodder and feed but also gives rise to a range of by-products including glucose, starch and corn oil, etc. Maize starch is also now used extensively around the world for the production of biofuel (as ethanol) after its fermentation [5].

Among various maize yield limiting factors, lack of improved varieties, irrigation, sowing time, plant population and balance use of fertilizer each has an effective role in increasing the yield of crop. Plant population is an important determinant of grain yield of maize [7]. In case of thick population, most plants bear barren ears, smaller ears, become susceptible to lodging and pest attack. While in case of low plant density yield per unit area is low because of lesser than optimum plants [8].

Keeping in view the importance of pant density and nitrogen, the present study was conducted to find out optimum plant population and appropriate level of nitrogen for obtaining higher yield of maize. Keeping in view the importance of the research focus on to determine the suitable planting density for higher yield of maize and also to find out the optimum level of nitrogen for higher grain yield of maize. The best combination of nitrogen and planting density for obtaining best yield of maize were also put under observation.

Materials and Methods

A field experiment entitled "The effect of planting density and different nitrogen levels on maize yield and yield components" was conducted at village Toru District Mardan, KPK Pakistan during kharif season, 2014. The experiment was conducted in randomize complete block design (RCBD) with four replications. Maize cultivar Azam was sowed on 26th May, with plot size of 6x2 m2 having row to row distance of 70 cm and row length is 2m, width of 6m and number of 9 rows was maintained in each plot. Three nitrogen levels (200, 250, and 300 kg ha-1) was applied at sowing time with maintaining plant density of (20, 25, and 30 cm per plant). The basal dose of Phosphorus was applied at the time of sowing. Urea and DAP was used as a source of nitrogen and phosphorus respectively. All other agronomic practices were maintained.

The detail of experimental treatment follows as

T1	Control
T2	N1P1= 200 kg ha^{-1} + 20cm
T3	N1P2= 200 kg ha^{-1} + 25cm
T4	N1P3= 200 kg ha^{-1} + 30cm
T5	N2P1= 250 kg ha^{-1} + 20cm
T6	N2P2= 250 kg ha^{-1} + 25cm
T7	N2P3= 250 kg ha^{-1} + 30cm
T8	N3P1= 300 kg ha^{-1} + 20cm
T9	N3P2= 300 kg ha^{-1} + 25cm
T10	N3P3= 300 kg ha^{-1} + 30cm

Whereas,
N1 = 200 kg; N2 = 250 kg; N3 = 300 kg
P1 = 20 cm; P2 = 25 cm; P3 = 30 cm

The parameters studied during the experiment is days to emergence and it was recorded by counting number of days, when 80% of the plants emerged in all plots and emergence per m2 was recorded by counting the number of plants in one meter row at five various places randomly in each subplot, converting into m2 area then averaged. The days to tasseling was recorded by counting number of days from sowing to the date on which plants produced tassels as well as the days to silking was counted from the date of sowing to the date on which plants produced silks.

Plant height was recorded by selecting five plants randomly and measured their heights from the base to the tip of tassel by measuring tape in each treatment plot and averaged. The leaf number per plant were collected by counting five plants randomly selected in each plot and was converted into leaf number per plant. For recording data on number of nodes per plant, five plants were selected randomly in each plot and their nodes were counted and then averaged to find out number of nodes per plant. The data of internodes length was recorded by selecting five plants randomly in each plot and then average to find out internodes length.

Statistical Analysis

Data was analyzed statistically according to the procedure relevant to RCB design. Upon significant F test, least significance difference (LSD) test was be used for mean comparisons [9].

Results and Discussion

Days to emergence

The data regarding days to emergence resulted in table 1. Control vs rest had not significant effect on days to emergence. The influence of nitrogen and planting density was also found non-significant. The effect of nitrogen and planting density was found non-interaction between nitrogen and planting density was also found non-significant.

Plant ha^{-1}	200	250	300	Mean
46000	4.3	5.5	5.0	4.9
56000	4.8	5.0	5.5	5.1
66000	5.0	5.5	5.8	5.4
Mean	4.7	5.3	5.4	
Control	control Vs Rest			4.5
Rest				5.1
LSD (0.05)for N levels	Ns			

Table 1: Effect of planting density and nitrogen on days to emergence of maize nitrogen level kg ha^{-1}.

Days to silking

The data regarding days to silking resulted in table 2. The nitrogen had significant effect on the days to silking. Control vs rest was also found significant. The planting density and interaction was found non-significant. The application of 300 kg N ha^{-1} delayed days to silking. While increasing plant density (66000) plant ha^{-1} also delayed days to silking. Control vs rest showed that higher day to silking was found in rest plot as compare to control plot. Similar results were found by Muhammad., *et al*. 2002, Sadique., *et al*. 2005, who reported that increased application of nitrogen delayed days to silking. These results were similar to Hassan 1987 who reported that decreasing plant density delayed days to silking.

Plant ha^{-1}	200	250	300	Mean
46000	66.5	68.8	71.0	68.8a
56000	65.3	66.3	69.8	67.1a
6600	6.3	66.8	68.8	66.9a
Mean	65.7c	67.3b	69.8a	
Control	control Vs Rest			59.3
Rest				67.6
LSD (0.05) for N	0.7			

Table 2: *Effect of planting density and nitrogen on days to silking of maize nitrogen level kg ha^{-1}.*

Days to tasseling

The data regarding days to tasseling resulted in table 3. The nitrogen and plant density had significant effect on days to silking. Control vs rest also had considerable effect on days to silking. The interaction between nitrogen and planting was found non-significant. The nitrogen application at of 300 kg N ha^{-1} delayed days to testing. Increasing plant population to 66000 plants ha^{-1} delayed the days to testing. Control vs rest showed that there is significant difference between control plot and rest plot. These results were similar to [10] who reported increased nitrogen level delayed days to tasseling. The results of planting density were similar to Song., *et al*. 1995 who report that planting density significantly affect days to tasseling. Modarres., *et al*. 1998 observed that decreased plant density took more days to tasseling.

Plant ha^{-1}	200	250	300	Mean
46000	59.0	61.0	62.3	60.8c
56000	60.0	60.5	63.0	61.2b
66000	60.5	62.8	65.8	63.0a
Mean	59.8c	61.4b	63.7a	
Control	control Vs Rest			55.5
Rest				61.6
LSD (0.05) for N	1.7			
Lsd (0.05) for planting densities 0.5				

Table 3: Effect of planting density and nitrogen on days to tasselingof maize nitrogen level kg ha^{-1}.

Internodes Length (Cm)

The data regarding internodes length resulted in table 4. The nitrogen had significant effect on internodes length of maize. Control vs Rest and planting density had found non-significant. The interaction between nitrogen and planting was also found non-significant. The maximum internodes length (15 cm) was obtained when nitrogen level was 300 kg N ha^{-1} lower is obtained (14 cm) from 250 kg N h^{-1}. The internodes length was higher at planting density of 66000 plants ha^{-1} and lower was in 46000 plants ha^{-1}.

	200	250	300	Mean
46000	13.8	13.9	15.1	14.3a
56000	14.9	14.5	14.4	14.6a
66000	15.1	13.6	15.8	14.8a
Mean	14.6b	14.0c	15.1a	
Control	control Vs Rest			13.8
Rest				14.6a
LSD (0.05) for N levels	0.3			

Table 4: *Effect of planting density and nitrogen on Internode length (cm) of maize nitrogen level kg ha^{-1}.*

Node Plant-1

The data regarding node plant^{-1} resulted in table 5. The nitrogen had significant effect on node plant^{-1} of maize, while planting density and interaction was found non-significant. Control vs rest was also found non-significant. The maximum node per plant [16] obtained from 300 kg N ha^{-1} and lower [15] from 200kg N ha^{-1}.

Plant ha^{-1}	200	250	300	Mean
46000	14.5	15.5	15.8	15.3a
56000	15.5	15.8	16.0	15.8a
66000	15.0	15.0	17.3	15.8a
Mean	15.0b	15.4b	16.3a	
Control	control Vs Rest			14.5
Rest				15.6
LSD (0.05) for N	0.9			

Table 5: *Effect of planting density and nitrogen on number of nodes per plant of maize nitrogen level kg ha^{-1}.*

Leaves Plant-1

The data regarding leaves plant^{-1} resulted in table 6. The nitrogen and control vs rest had significant effect on leaf plant^{-1} of maize. While interaction and planting density had not significant effect on leaf plant^{-1} of maize. The maximum leaf plant^{-1} [16] was obtained from 300 kg Nh^{-1}. While lower leaf plant^{-1} [15] was obtained from 200 kg N ha^{-1}. Control vs plot as compare to rest plot. These results were similar to Park., *et al*. (1989) reported leaf per plant significantly affected by nitrogen level. These results were similar with who reported that increase in nitrogen level increase more leaves plant-1 which alternatively improved vegetative growth of maize.

Plant ha^{-1}	200	250	300	Mean
46000	15.0	15.5	15.0	15.2a
56000	15.0	15.5	15.5	15.3a
66000	14.8	15.0	17.3	15.7a
Mean	14.9bc	15.3ab	15.9a	
Control	control Vs Rest			14.3
Rest				15.4
LSD (0.05) for N	0.6			

***Table 6**: Effect of planting density and nitrogen on leaves plant^{-1} of maize nitrogen level kg ha^{-1}.*

Plant Height (Cm)

The data regarding plant height of maize shown in Table 7. The nitrogen had significant effect on plant height of maize control vs rest also found significant while planting density and interaction was found non-significant. The application of nitrogen at rest of 300 kg ha^{-1} had high plant height (254) while lower is obtained from 200kg N ha^{-1} (230 cm) control vs rest show that higher plant height is in rest plot as compare to control plot. As planting density was found as the nitrogen application rate increased plant height of maize increased. Similar result was reported Eltelib., *et al*. (2006) Shah., *et al*. (2009) who reported that plant height increases.

Plant ha^{-1}	200	250	300	Mean
66000	232.5	240.8	255.0	242.8
56000	230.8	240.5	253.5	241.6
46000	228.0	241.0	254.0	241.0
Mean	230.4c	240.8b	254.2a	
Control	control Vs Rest			208.8
Rest				241.8
LSD (0.05) for N	2			
LSD (0.05) for planting density	ns			
Interaction	ns			

***Table 7:** Effect of planting density and nitrogen on plant height (cm) of maize nitrogen level kg ha^{-1}.*

Conclusion and Recommendation

The 300 kg N ha-1 was concluded best for phonological parameters as well as plant stature and therefore is recommended for agro-climatic condition of mardan region.

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