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Effect of Different Nitrogen and Phosphorus Levels on Quantitative and Qualitative Traits of Sugarcane

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Abstract: Studies pertaining to the response of different nitrogen and phosphorus levels on the yield and quality of sugarcane revealed that the significant interactive effect of 200 kg N along with 150 kg P_2O_5 ha^{-1} resulted in the highest cane yield of 76.64 t ha^{-1}. Increasing levels of nitrogen improved number of millable canes, plant height, cane length and harvest index; whereas CCS remained unaffected. However, increasing the phosphorus levels tended to increase number of millable canes m^{-2}, cane length, cane diameter, harvest index as well as CCS percentage.

Key words: Nitrogen, Phosphorus, interaction, sugarcane

Introduction

Sugarcane is a crop of great agro-economic importance and in Pakistan it is grown on an area of 1.056 million hectares with a total annual cane production of 53.104 million tones, giving an average yield of 50.3 tones per hectare (Anonymous, 1999).

Maximum stripped cane yield was obtained by the application of NPK @ 170-110-100 kg ha^{-1} (Malik *et al.*, 1993). Nasir *et al.* (1994) concluded that maximum number of millable canes and the highest cane yield was recorded in those plots where NPK was applied @ 100-100-50 kg ha^{-1}. Ahmad *et al.* (1997) reported that cane yield increased with the application of nitrogen up to 300 kg ha^{-1} with no effect on CCS. Ali (1999) obtained the highest cane yield by the application of NPK @ 250-100-100 kg ha^{-1}, which was mainly due to increase in the number of millable canes, cane diameter and internodal length. Nazir *et al.* (1999) observed that weight per cane and stripped cane yield increased significantly with the application of 100-100-100 kg NPK ha^{-1}. It was further reported that the effect of NPK levels on commercial cane sugar and harvest index was non significant. Chaudhry and Chatha (2000) noticed that maximum stripped cane yield of 71.12 t ha^{-1} was recorded when phosphorus was applied at the rate of 100 kg P_2O_5 in combination with 200 kg N ha^{-1}. It was further stated that phosphorus application did not affect significantly sucrose content and commercial cane sugar.

Nutrients requirement of the present highly yielding varieties are high and need to be precisely determined under our soil and climatic conditions. Therefore the present study was undertaken to determine the effect of different nitrogen and phosphorus levels on quantitative and qualitative traits of sugarcane under agro-climatic conditions of Faisalabad.

Materials and Methods

Investigations pertaining to the effect of different nitrogen and phosphorus levels on quantitative and qualitative traits of sugarcane variety SPSG-394 were carried out at the Research Area of Department of Agronomy, University of Agriculture, Faisalabad during the year 1999. The experimental soil was sandy clay loam in nature having 0.04% N, 7.15% available phosphorus and 172 ppm available potassium. The experiment was laid out in a randomized complete block design with split plot arrangement and with three replications. The nitrogen levels viz. Zero (control), 150 and 200 kg ha^{-1} were randomized in the main plots, while phosphorus levels viz. Zero (control), 100 and 150 kg P_2O_5 ha^{-1} were super imposed as subplot treatments. The net plot size measured 3.6 x 9 m. The whole of phosphorus along with 1/3 of nitrogen was applied at the time of planting while remaining nitrogen was top dressed 50 days after sowing. In addition a uniform basal dose of 100 kg K_2O ha^{-1} was applied to all the plots at sowing. All other agronomic practices such as irrigation, interculture, earthling up etc. were applied uniformly to all the experimental units. Data on number of millable canes m^{-2}, plant height, cane length, cane diameter, stripped cane yield, harvest index and commercial cane sugar (CCS) were recorded by following the standard procedures. The data were analyzed statistically by Fisher's Analysis of Variance Technique and treatment means were compared by using the least significant difference test at 0.05 P level (Steel and Torrie, 1984).

Results and Discussion

Data regarding the effect of different nitrogen and phosphorus levels on quantitative and qualitative traits of sugarcane is presented in Table 1.

The highest number of millable canes m^{-2} were obtained by the application of 200 kg N ha^{-1} which was followed by 150 kg N ha^{-1} treatment. On the other hand application of phosphorus @ 100 or 150 kg P_2O_5 ha^{-1} resulted in statistically similar number of millable canes m^{-2}. The interaction between nitrogen and phosphorus was also significant. The highest number of millable canes m^{-2} were obtained where NP was applied @ 200-150 and 200-100 kg ha^{-1} as against the lowest in the control (N_0P_0). These results are similar to those of Ali (1999).

Application of nitrogen @ 200 kg ha^{-1} resulted in maximum but statistically similar plant height obtained by 150 kg N ha^{-1}, however the effect of varying phosphorus levels on plant height was non significant. NxP interaction was also non significant. Similar results were reported by Banger *et al.* (1992).

Highest cane length of 1.97 m was recorded in those plots which were fertilized @ 200 kg N ha^{-1}. This was followed by 150 kg N ha^{-1} treatment. Minimum cane length of 1.64 m was recorded in control pbts. Similar results were reported by Mokadem (1998) who reported increased cane length when nitrogen was applied @ 180 kg Nfeddan^{-1} (1 Feddan = 0.42 ha). Application of 150 kg P_2O_5 ha^{-1} resulted in more cane length than application of 100 kg P_2O_5 ha^{-1} as well as control plots. NxP interaction was non significant.

The effect of nitrogen on cane diameter was non significant. These findings are contradictory with those of Bangar *et al.* (1992) who reported a positive and significant correlation between nitrogen levels and cane diameter. Maximum cane

Table 1: Effect of different nitrogen and phosphorus levels on quantitative and qualitative traits of sugarcane.

Treatment	No. of millable canes (m^{-2})	Plant height (cm)	Cane length (m)	Cane diameter (cm)	Stripped cane yield (t ha^{-1})	Harvest index	C.S.S. (%)
A. Nitrogen levels (kg ha^{-1})							
N_0. = control	6.40c	2.82b	1.64c	2.20	46.54c	69.98b	12.84
N_1 = 150	7.60b	3.00a	1.84b	2.25	57.74b	73.92a	13.37
N_2 = 200	8.79a	3.14a	1.97a	2.26	67.52a	76.14a	13.86
B. Phosphorus levels (kg ha^{-1})							
P_0 = Control	6.99b	2.99	1.80b	2.13c	51.31c	71.59c	13.22b
P_1 = 100	7.76a	2.96	1.80b	2.26b	58.05b	73.59b	13.20b
P_2 = 150	8.04a	3.00	1.84a	2.32a	62.44a	74.85a	13.66a
C. N x P interaction							
N_0P_0	6.24e	2.85	1.63	2.10	44.07g	69.08	12.96
N_0P_1	6.33e	2.84	1.62	2.22	45.77fg	69.46	12.51
N_0P_2	6.64de	2.77	1.66	2.28	49.79ef	71.39	13.06
N_1P_0	7.15cd	3.01	1.84	2.14	52.46de	72.19	13.13
N_1P_1	7.76b	2.94	1.83	2.29	59.87c	74.50	13.17
N_1P_2	7.88b	3.04	1.86	2.31	60.90c	75.06	13.81
N_2P_0	7.57bc	3.12	1.94	2.15	57.40cd	73.51	13.56
N_2P_1	9.19a	3.11	1.96	2.26	68.51b	76.82	13.91
N_2P_2	9.60a	3.20	2.01	2.38	76.64a	78.09	14.12

Any two means not sharing a common latter differ significantly at 0.05 P level (LSD test)

diameter of 2.32 cm was recorded in case of plots which received 150 kg P_2O_5 ha^{-1}. It was followed by 100 kg P_2O_5 ha^{-1} application treatment. These results are similar with those of Ali (1999).

The highest cane yield of 67.52 t ha^{-1} was obtained by the application of 200 kg N ha^{-1} which was followed by 150 kg N ha^{-1} treatment. Highest cane yield of 62.44 t ha^{-1} was recorded from those plots which were fertilized @ 150 kg P_2O_5 ha^{-1}. It was followed by 100 kg P_2O_5 ha^{-1} treatment which gave cane yield of 58.05 t ha^{-1}. These results are similar with those of Chaudhry and Chatha (2000). The interactive effect of nitrogen and phosphorus on stripped cane yield was also found significant. The highest stripped cane yield of 76.64 t ha^{-1} was recorded in those plots where NP was applied @ 200-150 kg ha^{-1}. N_0P_0 combination resulted in the lowest stripped cane yield of 44.07 t ha^{-1}. Rest of the treatment combinations were in between. These results are similar with those of Chaudhry and Chatha (2000).

Maximum harvest index value of 76.14 and 73.92% were recorded in those plots where nitrogen was applied @ 200 and 150 kg ha^{-1} respectively and both these treatments were at par with each other. The effect of phosphorus on harvest index was also significant. Maximum harvest index was found in plots which were fertilized @ 150 kg P_2O_5 ha^{-1}. It was followed by 100 kg P_2O_5 ha^{-1}. NxP interaction was non significant.

Commercial cane sugar percentage (CCS) indicates the sugar recovery of the cane. The effect of nitrogen on CCS was non significant. These results are contradictory with those of Bangar *et al.* (1992) who reported significant and positive correlation between nitrogen levels and commercial cane sugar. The effect of phosphorus on CCS was, however, significant. Highest CCS was recorded in plots where phosphorus was applied @ 150 kg P_2O_5 ha^{-1}. The interactive effect of nitrogen and phosphorus on CCS was non significant. The results indicate that sugarcane variety SPSG-394 responded positively to the highest levels of nitrogen and phosphorus under study on the given soil and climatic conditions. Further study is suggested to test the response of increasing levels of nitrogen and phosphorus to explore the maximum yield potential and cane quality of this promising sugarcane variety.

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