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INFLUENCE OF NPK FERTILIZATION ON PRODUCTION POTENTIAL OF AUTUMN PLANTED SUGARCANE

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A field investigation were carried out to study the effect of NPK fertilization alone or in combination on the production potential of September planted sugarcane under irrigated at University of Agriculture, Faisalabad, conditions. The results showed that nitrogen application increased cane yield and its components except cane thickness significantly, while phosphorus and potassium alone or in combination with each other had non-significant affect. The sucrose content was non-significantly affected. For the soil with an initial productive potential of 60 tonnes cane/ha, a fertilizer dose of $N_{200}P_{100}K_{100}$ kgs/ha is required to obtain yield of 146 tonnes per ha.

Key words: Sugarcane, Autumn planted crop, NPK fertilization.

INTRODUCTION

Sugarcane (*Saecharum officinarum* L.) supplies over 60% of the world sugar and it is an important sugar crop of Pakistan and is second to textiles. In Pakistan, it is grown in an area of 0.903 million hectares with total annual production of 32.14 million tonnes of cane, with an average production of 35.6 tonnes per hectare [1].

In Pakistan, it is usual to plant sugarcane in the months of February-March, but recently its plantation has also been extended to autumn season, i.e. in the month of September-October, which appears to be more productive and profitable. A lot of research work has been done in the past on spring sugarcane. Many researchers [2, 4, 9] reported that application of nitrogen increased tillering, cane weight, girth and weight cane significantly over no nitrogen fertilization. De Faria *et al.* [4] also observed significant decrease in sugar content due to accumulation of excess nitrogen in heavy nitrogenous fertilized crop. Many researchers [2, 4, 6] reported that cane yield and its component were significantly affected by the addition of nitrogenous fertilizers in combination with phosphatic fertilizers compared to application of nitrogen alone. However, potassic fertilization had no significant influence either alone or in combination with NP fertilization. Maximum cane yield was obtained earlier in sugarcane by the application of different doses of NPK [3, 5, 6]. Amongst the many factors responsible for low cane yield in our country, malnutrition is the one which deserves special attention [7]. But much work has not been carried out on this aspect, particularly of the autumn planted crop. Therefore, the present study was planned to determine the effects of NPK application in various combinations under the irrigated conditions at University of Agriculture, Faisalabad.

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MATERIALS AND METHODS

Field investigations were carried out on sandy clay loam in a representative of Lyallpur soil series at Agronomic Research Area, University of Agriculture, Faisalabad during the year 1984-85. The soil contained 0.02 percent N, 7.5 ppm available P and 263 ppm available K and preceeding crop was wheat.

The sugarcane cultivar BL-4 was planted on September 15, 1984 in a paired row strips. 90 cm apart with 30 cm between the rows of each strip, using two budded double setts end to end in each furrow (1,30,000 setts per hectare) in factorial randomized block design, replicated three times with net plot size of 3.6m x 14m. The fertilizer treatments comprised of $N_0P_0K_0$, $N_{200}P_0K_0$, $N_0P_{100}K_0$, $N_0P_0K_{100}$, $N_{200}P_{100}K_0$, $N_{200}P_0K_{100}$, $N_0P_{100}K_{100}$ and $K_{200}P_{100}K_{100}$ kg per hectare. The whole phosphatic and potassic fertilizers in the form of single super phosphate and sulphate of potash, alongwith 1/3 'N' in the form of urea were applied at planting. The remaining 'N' was top dressed in two equal splits, on 1st March and in the first week of April, 1985. The standard crop husbandry practices were adopted throughout the growing season and crop was harvested on November 4, 1985.

Data on yield and its components were recorded at maturity from randomly selected 20 canes from each treatment. The sucrose content was determined by method described by Spencer and Meade [8]. The data were subjected to statistical analysis as per the methods described by Steel and Torrie [9].

RESULTS AND DISCUSSION

The statistically analysed data in Table 1 showed significant effect of NPK fertilizers application on stripped cane yield and its components. The addition of N_{200}, P_{100} and $N_{200}P_{100}$ kg per hectare increased the yield and its compo-

Table 1. Effect of different doses of NPK fertilizers on sugarcane yield and its components.

Treatments N (kg/ha)	P	K	Number of millable cane (per m²)	Length of cane (m.)	Cane girth (cm.)	Cane weight (kg)	Stipped cane weight (ton/ha)	Tops weight (ton/ha)	Trash weight (ton/ha)
0	0	0	7.8^{c}	2.3^{b}	2.5	0.66^{b}	60.4^{c}	9.8	7.4^{b}
200	0	0	10.8^{b}	3.0^{a}	2.7	1.15^{b}	125.0^{b}	12.0	9.0^{a}
0	100	0	8.6^{c}	2.4^{b}	2.6	0.70^{b}	63.6^{c}	11.1	8.6^{ab}
0	0	100	8.3^{c}	2.2^{b}	2.5	0.69^{b}	62.0^{c}	10.6	7.2^{b}
200	100	0	11.4^{ab}	2.9^{a}	2.7	1.22^{a}	140.2^{a}	12.1	9.6
200	0	100	10.8^{b}	2.8^{a}	2.7	1.18^{a}	127.6^{b}	11.6	9.2^{a}
0	100	100	8.5^{c}	2.4^{b}	2.6	0.70^{b}	63.8^{c}	9.6	8.4^{ab}
200	100	100	11.8^{a}	3.0	2.7	1.24^{a}	146.0^{a}	12.4	9.8^{a}
LSD (P = 0.05)			0.97	0.36	N.Sig	0.11	10.89	N.Sig	1.37
C.V.%			5.65	7.93	4.07	6.55	6.33	8.45	9.06
(a) Main effects									
N			H. Sig	H. Sig	H. Sig	H. Sig	H.Sig	H.Sig	H. Sig
P			N. Sig	N. Sig	N. Sig	N. Sig	H.Sig	N.Sig	N. Sig.
K			N. Sig	N. Sig	N. Sig	N. Sig	N.Sig	N.Sig	N.Sig
(b) Interaction effects									
NP			N. Sig	N. Sig	N. Sig	N. Sig	N. Sig.	N. Sig	N. Sig
NK			N. Sig	N. Sig	N. Sig	N. Sig	N. Sig	N. Sig	N. Sig
PK			N. Sig	N. Sig	N. Sig	N. Sig	N. Sig	N. Sig	N. Sig
NPK			N. Sig	N. Sig	N. Sig	N. Sig	N. Sig	N. Sig	N. Sig

Table 2. Effect of different doses of NPK fertilizers on sucrose content of sugarcane.

Treatments N (kgs/ha)	P	K	Sucrose content (%)
0	0	0	13.86
200	0	0	12.36
0	100	0	14.18
0	0	100	13.72
200	100	0	12.91
200	0	100	12.77
0	100	100	13.50
200	100	100	13.18
LSD (P = 0.05)			N. Sig.
C.V.%			10.45
Main effects			
N			N. Sig.
P			N. Sig.
K			N. Sig.
Interaction effects			
NP			N. Sig.
NK			N. Sig.
PK			N. Sig.
NPK			N. Sig.

nents significantly over control. The differences within K_{100}, $N_{200}K_{100}$, $P_{100}K_{100}$ and $N_{200}P_{100}K_{100}$ kg per hectare were non-significant, which may be attributed to initial high potassium content in the investigated site. The cane thickness did not vary significantly due to NPK treatments, indicating that vegetative growth in sugarcane is more or less a vertical rather than horizantal phenomenon. It could be concluded that for a soil with initial production potential of 60 tonnes cane/ha, a fertilizer dose of $N_{200}P_{100}K_{100}$ per hectare is required to raise the yield level to 160 tonnes cane/ha. These results are well supported by researchers [2, 3, 5, 6].

Table 3. Effect of different doses of NPK fertilizers on growth and development of sugarcane.

Treatments N (kgs/ha)	P	K	Cane top ratio	Harvest index (%)
0	0	0	6.2^{b}	77.86^{b}
200	0	0	10.45^{a}	85.61^{a}
0	100	0	5.76^{b}	76.38^{b}
0	0	100	5.84^{b}	77.83^{b}
200	100	0	11.58^{a}	86.54^{a}
200	0	100	11.04^{a}	85.98^{a}
0	100	100	6.65^{b}	78.00^{b}
200	100	100	11.76^{a}	86.72^{a}
C.D. (P = 0.05)			1.28	2.82
C.V.%			8.48	1.97
Main effects				
N			H. Sig.	H. Sig.
P			N. Sig.	N. Sig.
K			N. Sig.	N. Sig.
Interaction effects				
NP			N. Sig.	N. Sig.
NK			N. Sig.	N. Sig.
PK			N. Sig.	N. Sig.
NPK			N. Sig.	N. Sig.

Table 4. Economic analysis.

Treatments N (kgs/ha)	P	K	Cane yield (tonnes/ha)	Income (Rs/ha)	Cost (Rs/ha)	per day	Net income per day* (Rs)	Benefit cost ratio
0	0	0	60.4	16610	8194	8416	20	2.0
200	0	0	125.0	34375	9315	25060	60	3.7
0	100	0	63.6	17490	8638	8852	21	2.0
0	0	100	62.0	17050	8354	8696	21	2.0
200	100	0	140.2	38555	9759	28796	69	4.0
200	0	100	127.6	35090	9475	25615	62	3.7
0	100	100	63.8	17545	8798	8747	21	2.0
200	100	100	146.0	40150	9919	30231	73	4.0

*Total growth period = 415 days.

Data presented in Table 2 showed non-significant differences in sucrose content due to NPK fertilizer treatments. However, highest sucrose content of 14.18 and 13.86 percent was observed in $N_0P_{100}K_0$ and $N_0P_0K_0$ compared to the minimum of 12.36 percent in $N_{200}P_0K_0$ and

Table 5. Multiple regression and correlation equations.

Character	Regression equation	Correlation coefficient R	Determination co-efficient R2	S.E. of estimate
Yield tonnes/ha on number of millable cane/m^2 (Y on X_1)	$Y = 139.0174 + 24.362X_1$**	0.992	0.985	5.252
Yield tonnes/ha_2 on number of millable cane/m^2 ind cane length (Y on X_1 and X_2)	$Y = 151.7703 + 20.485**X_1 + 19.218X_2$ N.S.	0.993	0.987	5.345
Yield ton/ha on number of millable cane/m^2, cane length and cane girth (Y on X_1, X_2 and X_2)	$Y = 375.8104 + 33.835X_1$** $23.456X_2$ N.S. + $25.532X_3$ N.S.	0.997	0.994	4.052
Yield ton/ha on number of millable cane/m^2 cane girth and weight/cane (Y on X_1, X_3 and X_4)	$Y = 294.5155 + 19.425X_1$** + $178.63SX_3$** + $87.659X_4$**	1.000	0.999	1.230
Yield tonn/ha on number of millable cane/m^2 cane length, cane girth and weight/cane (Y on = X_1 X_2, X_3 and X_4)	$Y = 297.9337 + 19.617X_1$** $1.7935X_2$ N.S. + $18.162X_3$** + $85.379X_4$	1.000	0.999	1.430

13.18 percent in $N_{200}P_{100}K_{100}$ treatments. The reduction in sucrose contents with the application of nitrogen has been reported by [2, 3, 5].

The statistically analyzed data in Table 3 showed that cane top ratio and harvest index differed significantly due to different fertilizer treatments. The plots treated with N_{200} alone recorded significantly higher cane top ratio and harvest index than those treated with other treatments. It indicates that balanced application of fertilizers is utilized by the sugarcane crop more effectively and economically towards cane growth and its development. These results substantiate with those of [2, 3, 5].

The economic analysis provided in Table 4 revealed that maximum net income of Rs. 30231 per hectare and BCR of 4.0 was recorded from $N_{200}P_{100}K_{100}$ per hectare fertilized plot compared to other treatments. Similar results have been reported by [10] who obtained maximum profit of 3.85 US$ per dollar invested for NPK treatments applied at the rate of $N_{200}P_{100}K_{100}$ kg per hectare.

The relation between cane yield and its components (sample taken from across the treatments) are presented by the regression equations in Table 5. The multiple correlation co-efficient (R) of cane yield on number of millable cane/m^2, cane girth and weight per cane was positive and highly significant while it was non-significant on cane length. These data reveal that an increased by one millable cane per m^2 would results in an increase in cane yield by 19.62 tonnes per ha, similarly an increase in cane girth by 1mm and weight per cane 100 g would increase the cane yield by 18.16 and 8.59 tonnes per hectare respectively.

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