EFFECT OF NITROGEN, PHOSPHOURS AND POTASSIUM FERTILIZATION ON YIELD AND QUALITY OF SUGAR CANE

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Abstract

Two field trials were carried out at Mattana Agricultural Research Station, (Qena Governorate) on sugarcane grown in 2002/2003 and 2003/2004 seasons.

Each trail included eighteen treatments represent the combination between three levels of nitrogen (180, 210 and 240 kg N/fed), phosphorus fertilizer (30, 45 and 60 kg P_2O_5/fed) and two levels of potassium (24 and 48 kg K_2O/fed). Sugar cane was planted during the first week of March and harvested after 12 months. The commercial planted sugarcane variety viz. Ph. 8013 was used. A split plot design was used in both seasons. Nitrogen levels were allocated in the main plots while the combinations of phosphours and potassium levels were randomely distributed in the sub plots.

The results showed that increasing nitrogen fertilizer levels significantly number of plants/m^2, cane and sugar yields in the 1st season and sugar recovery% in the 2nd season, while stalk height and number of millable cane/fed were significantly in both seasons.

Increasing phosphours fertilizer levels significantly number of plants/m^2, stalk height, reducing sugars, purity% and sugar recovery% as well as cane yield and sugar yield in the 2nd season and number of millable cane/fed in both seasons.

Increasing potassium fertilizer levels significantly number of millable cane/fed in the 2nd season. While, leaf area and stalk height in both seasons.

The highest cane yields (46.60 and 49.77) (tons/fed) were obtained by applying 240 kg N/fed, 45 kg P_2O_5 and 24 kg K_2O/fed in the 1st season and 240 kg N/fed, 30 kg P_2O_5 and 48 kg K_2O/fed in the 2nd season, respectively.

The highest sugar yields (5.75 and 6.13) (tons/fed) were obtained by applying 240 kg N/fed, 45 kg P_2O_5 and 24 kg K_2O/fed in the 1st season and 210 kg N/fed, 30 kg P_2O_5 and 24 kg K_2O/fed in the 2nd season, respectively.

INTRODUCTION

Regarding to the effect of nitrogen fertilizer, Ahmed (1995) pointed out that increasing nitrogen fertilizer from 180 to 240 kg N/fed increased cane and sugar yields and that nitrogen levels had no significant effect on the number of millable cane.

Yousef *et al* (2000) found that adding 210 kg N/fed produced the highest number of millable cane/m^2, cane length, diameter and cane yield. Ahmed (2003) found that the application of 210 kg N/fed produced the highest values of purity% and sugar recovery% while the application of 240 kg N/fed gave the highest values of reducing sugars and number of millable cane/m^2, cane length, brix and cane and sugar yields. El-Geddawy *et al* (2003 a,b) found that nitrogen fertilization had a significant effect on number of millable cane/fed in both seasons. They reported that the highest value (12.933%) of sugar recovery% was recorded by the application of 180 kg N/fed. The highest sugar yield was gained when sugar cane was fertilized with 120 kg N/fed.

The positive effect of P is required more by the meristematic tissues. Phosphate compounds in plants are called the energy currency where they are involoved in the formation of energy phosphates. Phosphours occupies a critical position both in plant growth and in the biology of all life forms occurring in soils, only the mono ionic H_2PO_4 and di-ionic (HPO_4 --) are considred available for plants as mentioned Under alkaline conditions, the soluble form however, is readly rendered causing one of the most important fertilization problems in Egypt. Several workers, Lakshmikantham (1983) found that the application of phosphours at 112 kg P_2O_5/ha was recommended to give the highest yield and quality of sugar cane. Bangar *et al* (1995) found that application of phosphours showed significant favorable effect on tillers number, height and diameter, cane yield and sugar production/ha. They added that cane yield was improved significantly by the application of 35.2 kg P_2O_5/ha by 35.7 % over the control. Ismail *et al* (2000) fertilized sugarcane with six levels of phosphorus (0, 15, 30, 45, 60 and 75 kg P_2O_5/fed). He obtained a significant influence due to P levels on purity % while their effect on stalk length, diameter and cane and sugar yield were insignificant. They recommended that the best P-level is 60 kg P_2O_5/fed.

The effect of K on the translocation of photosynthates, therefore, appears to be a direct one and most likely relates to photophosphorelation processes. When K level in the plant is high, it is probably stimulates the production of ATP, which is needed in the loading of sieve tubes with photosynthates mentioned by Bonnet (1963). In respect to the effect of K fertilization a number of authors have shown that potassium enhances translocation of assimilates promotes the rate of CO_2 assimilation (Bonnet 1963). In addition, higher levels of K nutrition have also resulted in an increased translocation rate of photosynthesis. Ismail (1991) fertilized sugarcane crop

with 0, 48, 72 and 96 kg K_2O/fed. He indicated that potassium rates had no significant effect on number of stalks/m^2 and number of millable cane/fed. Potassium rates showed almost no effect on stalk length. The highest values of stalk diameter were obtained when 72 kg K_2O/fed. was added. Cane yield was not greatly affected by potassium rate, while sugar yield was significantly affected. Juice quality in terms of brix%, purity%, reducing sugars% and sugar recovery% was enhanced with the increase of potassium. Nassar (1996) found that potassium application significantly affected stalk length, stalk diameter, juice quality brix, purity, reducing sugars and sugar recovery percentages and sugar yield. This study aimed to find out the optimum NPK fertilization levels required to obtain the highest cane and sugar yields.

MATERIALS AND METHODS

Two field trials were carried out at Mattana Agricultural Research Station, (Qena Governorate) on sugarcane grown in 2002/2003 and 2003/2004 seasan .

Each trail included eighteen treatments represent the combination between three levels of nitrogen fertilizer 180, 210 and 240 kg N/fed, three levels of phosphorus fertilizer 30, 45 and 60 kg P_2O_5/fed and two levels of potassium fertilizer 24 and 48 kg K_2O/fed. Sugarcane was planted during the first week of March and harvested after 12 months. The commercial sugarcane variety viz. Ph. 8013 was planted. A split plot design was used in both seasons. Nitrogen levels were allocated in the main plots while the combination of phosphours and potassium levels were randomely distributed in the sub plots. Plot area was 42 m^2. Chemical and physical analysis of the experimental site showed that the upper 30-cm of the soil was clay loam including 38.4% sand, 10.4% silt and 51.61% clay, containing 80, 11, 200 ppm N, P, K, respectively with a pH of 7.6. Nitrogen fertilizer was applied in the form of Urea (46% N) in two equal doses, the 1^{st} one was added one month after the emergence of plants, while the 2^{nd} dose was applied one month later. Phosphorus fertilizer was broadcasted with the 1^{st} irrigation as calcium superphosphate (15% P_2O_5). Potassium was added in the form of potassium sulphate (48% K_2O) with the 2^{nd} N-dose. All required agricultural practices were done as recommended by Sugar Crops Research Institute.

Data recorded

I. Vegetative traits during the growth period and at harvest times

1. Number of plants/m^2 was recorded after 150 days from planting.

2. Elongation rate (cm/day): Cane stalk was measured twice at 210 and 330 days from planting and elongation rate was estimated according to the following formula:

$ER = L_2-L_1/ T_2-T_1$

where: L_1 = Stalk length at time T_1, L_2 = Stalk length at time T_2.

At harvest, a sample of 20 stalks represents each treatment was taken at random and the following data were recorded:

3. Stalk height (cm) was measured from soil surface to the top point of visible dewlap.
4. Stalk diameter (cm) was measured at the middle part of stalk.
5. Leaf area cm^2/plant for the third, fourth and fifth leaf was determined at harvest.

II. Juice quality traits

Samples collected at harvest were stripped and squeezed then juice was extracted using 3 rools lab mill, filterate and weighed. The analytical methods were as follows:

Juice extraction % was calculated from the following equation:

Juice extraction % = juice weight x 100/stalk weight.

juice extraction% (JEP%) was about 58-60% from cane weight.

6. Reducing sugars% was determined in the extracted cane juice according to the chemical control in the Egyptian production factories (Anonymous 1981).
7. Brix% was determined using a Brix hydrometer standardized at 20°C for laboratory technique to estimate the total soluble solids%.
8. The apparent juice purity% was calculated using the following formula according to Singh and Singh (1998).

juice purity% = sucrose% / brix% x 100.

9. Sugar recovery% was calculated according to the following equation:

Sugar recovery% = Richness% x Purity%

Where: Richness = (Sucrose in 100 g cane juice x factor)/100

Factor = 100 - [fiber% + physical impurties% + percent water free suga].

III. Yield and its attributes

At harvest, six guarded rows of each treatment were harvested, topped and cleaned to estimate the following traits:

10. Number of millable cane (1000 plants/fed) was recorded by counting the number of mature stalks in each plot after ten months from planting.
11. Cane yield (tons/fed) was calculated on plot basis.

12. Sugar yield (tons/fed) was estimated according to the following equation:
Raw sugar yield = cane yield (tons/fed) x sugar recovery%.

The collected data were statistically analyzed according to the procedures outlined by Snedecor and Cochran (1981). To compare between means, Duncan multiple range test was used according to Duncan (1955).

RESULTS AND DISCUSSION

I. Vegetative traits during the growth periods and at harvest time

1. Number of plants/m^2 at 150 days from planting

Results given in Table (1) showed that applying 240 kg N/fed produced higher number of sugarcane plants/m^2 compared with that recorded at 180 and 210 kg N/fed in both seasons but these differences was significant in the 1st season only. The increase was 1.02 and 9.76% in the 1st season and 3.07, 6.79% in the 2nd one. The positive effect of N fertilizer was mainly due to the essential role of N element in builiding up plant organs and growth potential in terms of increasing tillering ability of cane plant.

The results showed that application of 30 kg P_2O_5/fed produced higher number of plants/m^2 in both seasons compared with that at 45 or 60 kg P_2O_5/fed. The differences were significantly in the 2nd season. The increase in number of plants/m^2 of sugar cane due to P_2O_5 levels could be attributed to the important role of P fertilizer which is required more by the meristematic tissues. These results are in agreement with those obtained by Lakshmkantham (1983), Bangar *et al* (1995) and Ismail *et al* (2000).

The results showed that potassium fertilizer levels insignificantly in both seasons.

The interaction between A x B, was significantly in the 1st season, the highest mean value was 11.03 obtained by applying 240 kg N/fed and 30 kg P_2O_5/fed and A x B x C, was 11.10 obtained by applying 240 kg N/fed, 45 kg P_2O_5/fed and 24 kg K_2O/fed.

In the 2nd season significantly affected B x C, the highest mean value was 11.34 obtained by applying 30 kg P_2O_5/fed and 48 kg K_2O/fed.

In both seasons, significant affected A x C, the highest mean value was 11.54 obtained by applying 240 kg N/fed, 60 kg P_2O_5/fed and 24 kg K_2O/fed.

2. Leaf area

Data in Table (1) clear that leaf area was insignificantly affected by nitrogen and phosphours fertilizer levels in both seasons.

The results cleared that potassium fertilizer levels affected leaf area significantly in the 1st season. The results indicated that applying 48 kg K_2O/fed increased leaf area in the 1st season. While, applying 24 kg K_2O/fed was enough to attain higher LA/plant in the 2nd season.

Data in Table (1) indicate that leaf area was insignificantly affected by the interactions among studied factors in both seasons.

3. Elongation rate at 150 days from planting

The results in Table (1) indicate that elongation rate was insignificantly affected by nitrogen, phosphours and potassium fertilizer levels as well as their interactions in both seasons.

4. Stalk height

Data illustrated in Table (2) clear that nitrogen fertilizer levels affected stalk height significantly in both seasons. The results indicated that applying 180 kg N/fed increased were 285.6 and 298.0 cm in both seasons. The positive effect of N fertilizer was mainly due to the essential role of N element in builiding up plant organs and growth potential in terms of increasing stalk height. These results are in harmony with those reported by Yousef *et al* (2000) and Ahmed (2003).

Concerning the effect of P and K fertilizer levels affected stalk height significantly in the 2nd season. The results indicated that applying 30 kg P_2O_5/fed and 48 K_2O/fed increased were 290.6 cm and 6.09%. The increase in stalk height of sugar cane due to P_2O_5 levels could be attributed to the important role of P fertilizer which is required more by the meristematic tissues. These results are in agreement with those obtained by Ismail *et al* (2000) applying P fertilizer, Ismail (1991) and Nassar (1996) applying K fertilizer.

The interaction between A x B, was significantly in both seasons, the highest mean value obtained by applying 180 kg N/fed and 60 kg P_2O_5/fed.

5. Stalk diameter (cm)

The results in Table (2) indicate that nitrogen, phosphours and potassium fertilizer levels affected stalk diameter was insignificantly in both seasons. These results are in harmony with those reported by Yousef *et al* (2000) applying N, Ismail *et al.* (2000) applying P fertilizer, Ismail (1991) and Nassar (1996) applying K.

The interaction between A x B, significantly in both seasons, the highest mean value was 3.13 cm obtained by applying 210 kg N/fed and 30 kg P_2O_5/fed.

6. Reducing sugar% (RS%)

The results in Table (2) show that N and P fertilizers levels insignificantly in both seasons. The same conclusion was detected by Ahmed (2003) applying N fertilizer, Lakshmkantham (1983) and Ismail *et al* (2000) applying P fertilizer.

Data presented in Table (2) clear that potassium fertilizer levels affected insignificantly in the 2nd season. The results indicated that applying 48 K_2O/fed decreased RS% by 0.592. As potassium also promotes the rate of CO_2 assimilation. However, higher levels of K nutrition have also resulted in an increased translocation rate of photosynthesis. These results are in accordance with those cleared by Ismail (1991) and Nassar (1996).

The interaction between A x B, reducing sugar% was significantly in the 1st season, the lowest mean value were 0.567% obtained by applying 210 kg N/fed, 60 kg P_2O_5/fed and 48 kg K_2O/fed., respectively.

7. Brix%

The results in Table (3) indicate that N and K fertilizer levels insignificantly in both seasons. These results are in line with those reported by Lakshmkantham (1983), Ismail (1991), Nassar (1996), Ismail *et al* (2000) and Ahmed (2003).

The results obtained in Table (3) indicate that phosphours fertilizer level significantly in the 2nd season. The results show that the highest values was 23.93% which were recorded by adding 60 kg P_2O_5/fed. The increase in brix% of sugar cane due to P_2O_5 levels could be attributed to the important role of P fertilizer which is required more by the meristematic tissues. These results are in agreement with those obtained by Lakshmkantham (1983) and Ismail *et al.* (2000).

The interaction between A x B x C, significantly in the 2nd season, the highest mean value was 24.00% which were recorded by adding 210 kg N/fed, 45 P_2O_5/fed and 48 K_2O/fed, respectively.

8. Juice purity%

The results in Table (3) clear that nitrogen and potassium fertilizer levels insignificantly in both seasons. These results are in accordance with those cleared by Ismail (1991), Nassar (1996) and Ahmed (2003).

The results obtained in Table (3) indicate that phosphours fertilizer level significantly in the 2nd season. The results show that the highest values was 79.78%

which were recorded by adding 45 kg P_2O_5/fed. These results are in agreement with those obtained by Lakshmkantham (1983) and Ismail *et al* (2000).

The interaction between A x B x C, were significantly in the 2nd season, the highest mean value was 84.61% which were recorded by adding 180 kg N/fed, 45 kg P_2O_5/fed and 48 kg K_2O/fed., respectively.

9. Sugar recovery% (SR%)

Data in Table (3) clear that nitrogen and phosphours fertilizer levels affected sugar significantly recovery% in the 2nd season. The increase in SR% which were recorded 12.65 and 12.28% by adding 180 kg N/fed and 30 kg P_2O_5/fed. The positive effect of N fertilizer was mainly due to the essential role of N element in builiding up plant organs and growth potential in terms of increasing this traits. These results are in line with those reported by Ahmed (2003) and El-Geddawy *et al* (2003 a,b)

The increase in sugar recovery% of sugar cane due to P_2O_5 levels could be attributed to the important role of P fertilizer which is required more by the meristematic tissues. These results are in agreement with those obtained by Lakshmkantham (1983) and Ismail *et al* (2000).

The effect of potassium fertilizer levels affected sugar recovery% was insignificant in both seasons. These results are in accordance with those cleared by Ismail (1991) and Nassar (1996).

Data in Table (3) show that leaf area was insignificantly interactions among studied factors in both seasons.

10. Number of millable cane (1000/fed)

Results obtained in Table (4) pointed out that nitrogen fertilizer levels significantly in the 1st season. The results show that the increase in number of millable cane/fed were 13.99 which were recorded by adding 240 kg N/fed compared with 180 and 210 kg N/fed. The positive effect of N fertilizer was mainly due to the essential role of N element in builiding up plant organs and growth potential in terms of increasing number of millable cane. The same results were cleared by Ahmed (1995), Yousef *et al* (2000), Ahmed (2003) and El-Geddawy *et al* (2003 a,b).

The results in Table (4) indicate that P fertilizer levels was significantly in both seasons, the highest values was 49.01 and 53.12 which were recorded by adding 60 kg P_2O_5/fed compared with 30 and 45 kg P_2O_5/fed, in both seasons., respectively. The increase of P fertilizer which is required more by the meristematic tissues. These

results are in agreement with those obtained by Lakshmkantham (1983), Bangar *et al* (1995) and Ismail *et al* (2000).

The results showed that potassium fertilizer levels significantly in the 2nd season. The results show the increase was 2.68% in the 2nd season which were recorded by adding 24 kg K_2O/fed. Potassium also promotes the rate of CO_2 assimilation and translocation rate of photosynthesis. These results are in harmony with those reported by Ismail (1991).

The interaction between A x B, A x C, B x C and A x B x C, number of millable cane 1000/fed were significantly in the 2nd season, the highest number of millable cane 1000/fed were 56.90, 56.81, 53.20 and 57.03 were obtained by applying 240 kg N/fed and 60 Kg P_2O_5/fed, 240 kg N/fed and 48 kg K_2O/fed, 60 kg P_2O_5/fed and 24 kg K_2O/fed and 240 kg N/fed, 45 Kg P_2O_5/fed and 48 kg K_2O/fed., respectively.

11. Cane yield (tons/fed)

Data illustrated in Table (4) clear that nitrogen fertilizer levels significantly in the 1st season. The results show the increase was 9.75 and 8.72% in the 1st season and 6.71 and 3.55% in the 2nd season, which were recorded by applying 240 kg N/fed. The positive effect of N fertilizer was mainly due to the essential role of N element in builiding up plant organs and growth potential in terms of increasing cane yield (tons/fed). These conclusion was detected by Ahmed (1995), Yousef *et al* (2000), Ahmed (2003) and El-Geddawy *et al* (2003 a,b).

Data given in Table (4) show that P fertilizer levels significantly in the 2nd season. The results show the highest was 47.53, which were recorded by applying 30 kg P_2O_5/fed. The increase in cane yield of sugar cane due to the important role of P fertilizer which is required more by the meristematic tissues. These results are in agreement with those obtained by Lakshmkantham (1983), Bangar *et al* (1995) and Ismail *et al* (2000).

Regard to the effect of K fertilizer levels insignificantly in both seasons. These results are in line with those reported by Ismail (1991).

The interaction between A x B and A x B x C significantly in the 1st season, the highest mean value was 46.34 and 46.60 tons/fed obtained by applying 240 kg N/fed and 30 kg P_2O_5/fed and 240 kg N/fed, 45 kg P_2O_5/fed and 24 kg K_2O/fed., respectively.

In the 2nd season significantly affected by B x C, the highest mean value was 47.63 tons/fed obtained by applying 30 kg P_2O_5/fed and 48 kg K_2O/fed.

In both seasons, significantly affected by A x C, the highest mean value were 45.75 and 48.47 tons/fed obtained by applying 240 kg N/fed and 24 kg K_2O/fed.

12. Sugar yield (tons/fed)

Data obtained in Table (4) show that N fertilizer levels significantly in the 1st season. The increase by 8.54 and 8.33% which were recorded by adding 240 kg N/fed. The positive effect of N fertilizer was mainly due to the essential role of N element in builiding up plant organs and growth potential in terms of increasing sugar yield (tons/fed). The same conclusion was detected by Ahmed (1995), Ahmed (2003) and El-Geddawy *et al* (2003 a,b).

The effect of phosphours fertilizer levels significantly in the 2nd season. Application of 30 kg P_2O_5/fed produced higher sugar yield. The increase in sugar yield due to P fertilizer which is required more by the meristematic tissues. These results are in agreement with those obtained by Lakshmkantham (1983), Bangar *et al* (1995) and Ismail *et al* (2000).

Regard to the effect of potassium fertilizer levels insignificantly in both seasons. These results are in line with those reported by Ismail (1991) and Nassar (1996).

The interaction between A x B and B x C significantly in the 2nd season, the highest mean value were 6.07 and 5.88 tons/fed obtained by applying 210 kg N/fed and 30 kg P_2O_5/fed and 45 kg P_2O_5/fed and 24 kg K_2O/fed., respectively.

In both seasons, significantly A x C, the highest mean value were 5.64 and 5.82 tons/fed obtained by applying 240 kg N/fed and 24 kg K_2O/fed and 180 kg N/fed and 48 kg K_2O/fed., respectively.

Table 1. Effect of nitrogen, phosphours and potassium fertilizers on number of plants/m² at age of 150 days from planting, leaf area/plant (cm²) at harvest and elongation rate at (210-330 cm/day) days from planting of sugarcane crop at harvest in 2002/2003 and 2003/2004 seasons.

Traits		Number of plants/m² at age of 150 days						Leaf area (LA cm²/plant) at harvest						Elongation rate (cm/day)					
		2002/2003		Mean	2003/2004		Mean	2002/2003		Mean	2003/2004		Mean	2002/2003		Mean	2003/2004		Mean
		K_1	K_2		K_1	K_2		K_1	K_2		K_1	K_2		K_1	K_2		K_1	K_2	
N_1	P_1	d e 9.79	c d e 9.99	e f	10.69	10.79	10.74	524.4	536.7	530.5	567.3	549.0	558.2	0.439	0.497	0.468	0.469	0.460	0.465
	P_2	e	c d	e f 9.83	10.73	10.87	10.80	514.5	541.0	527.8	559.8	543.5	551.7	0.476	0.464	0.470	0.473	0.498	0.486
	P_3	d e 9.91	c d e 9.99	e f	10.49	10.94	10.71	536.3	553.1	544.7	558.0	551.9	555.0	0.483	0.521	0.502	0.451	0.458	0.454
Average		d	c	b	c	c	10.75	525.0	543.6	534.3	561.7	548.1	554.9	0.466	0.494	0.480	0.465	0.472	0.468
N_2	P_1	d e	d e 9.73	f	11.55	11.39	11.47	561.3	563.3	562.3	510.0	504.6	507.3	0.476	0.474	0.475	0.454	0.472	0.463
	P_2	d e 9.81	c	e	11.45	10.71	11.08	547.4	570.3	558.9	514.9	504.3	509.6	0.492	0.524	0.508	0.422	0.451	0.437
	P_3	c 10.10	c	d	10.71	10.68	10.70	546.5	557.3	551.9	497.6	474.6	486.1	0.478	0.479	0.478	0.441	0.443	0.442
Average		c	c	b	b	c	11.08	551.7	563.6	557.7	507.5	494.5	501.0	0.482	0.492	0.487	0.439	0.455	0.447
N_3	P_1	a	a	a	11.64	11.85	11.74	518.4	535.5	527.0	514.4	517.4	515.9	0.444	0.507	0.475	0.483	0.467	0.475
	P_2	a	b	b	11.73	11.18	11.45	549.4	537.5	543.5	540.8	535.1	537.9	0.429	0.467	0.448	0.476	0.456	0.466
	P_3	b	b	c	11.25	11.21	11.23	539.9	539.6	539.8	538.8	509.3	524.0	0.433	0.478	0.455	0.488	0.474	0.481
Average		a	b	a	a	b	11.48	535.9	537.5	536.7	531.3	520.6	526.0	0.435	0.484	0.460	0.482	0.466	0.474
P x K	P_1	10.19	10.24	10.22	a	a	a	534.7	545.2	539.9	530.6	523.7	527.1	0.453	0.493	0.473	0.469	0.466	0.468
	P_2	10.21	10.17	10.19	a	b	a	537.1	549.6	543.4	538.5	527.6	533.1	0.466	0.485	0.475	0.457	0.469	0.463
	P_3	10.17	10.18	10.18	b	b	b	540.9	550.0	545.5	531.5	511.9	521.7	0.465	0.493	0.479	0.460	0.458	0.459
Total average		10.19	10.20	10.19	11.14	11.07	11.10	b	a	542.9	533.5	521.1	527.3	0.461	0.490	0.476	0.462	0.464	0.463

Nitrogen N_1, N_2 and N_3 application of 180, 210 and 240 kg N/fed, respectively.
Phosphours P_1, P_2 and P_3 application of 30, 45 and 60 kg P_2O_5/fed
Potassium K_1 and K_2 application of 24 and 48 kg K/fed, respectively.

Table 2. Effect of nitrogen, phosphours and potassium fertilizers on stalk height, diameter (cm) and reducing sugars% of sugarcane crop at harvest in 2002/2003 and 2003/2004 seasons.

Traits		Stalk height (cm)						Stalk diameter (cm)						Reducing sugars%					
		2002/2003		Mean	2003/2004		Mean	2002/2003		Mean	2003/2004		Mean	2002/2003		Mean	2003/2004		Mean
		K_1	K_2		K_1	K_2		K_1	K_2		K_1	K_2		K_1	K_2		K_1	K_2	
N_1	P_1	270.7	280.7	a 275.7	290.2	297.8	a 294.0	2.97	2.90	b 2.93	2.90	2.83	a b 2.87	0.530	0.510	b c 0.520	0.650	0.610	0.630
	P_2	275.7	296.1	a 285.9	291.8	307.0	a 299.4	3.07	3.17	a 3.12	2.77	2.77	b 2.77	0.517	0.537	a b c 0.527	0.613	0.607	0.610
	P_3	293.5	297.2	a 295.3	295.8	305.8	a 300.8	3.07	3.03	a 3.05	2.83	2.77	b 2.80	0.603	0.560	a 0.582	0.633	0.610	0.622
Average		280.0	291.3	a 285.6	292.6	303.5	a 298.1	3.03	3.03	3.03	2.83	2.79	2.81	0.550	0.536	0.543	0.632	0.609	0.621
N_2	P_1	282.9	289.5	a 286.2	292.4	299.5	a 295.9	3.17	3.10	a 3.13	2.77	2.80	b 2.78	0.503	0.517	b c 0.510	0.727	0.733	0.730
	P_2	263.3	286.3	a 274.8	266.1	293.6	b 279.9	2.93	2.90	b 2.92	2.93	2.90	a 2.92	0.510	0.517	b c 0.513	0.720	0.533	0.627
	P_3	231.3	245.1	b 238.2	268.9	279.2	b c 274.1	2.88	2.88	b c 2.88	2.95	2.90	a 2.93	0.483	0.483	c 0.483	0.600	0.533	0.567
Average		259.2	273.6	b 266.4	275.8	290.8	b 283.3	2.99	2.96	2.98	2.88	2.87	2.88	0.499	0.506	0.502	0.682	0.600	0.641
N_3	P_1	219.1	237.0	b c 228.1	275.8	287.6	b 281.7	2.75	2.78	d 2.77	2.78	2.78	b 2.78	0.567	0.550	a b 0.558	0.600	0.567	0.583
	P_2	199.5	226.3	c 212.9	253.4	282.3	c 267.9	2.77	2.82	c d 2.79	2.75	2.83	b 2.79	0.550	0.533	a b c 0.542	0.617	0.567	0.592
	P_3	210.8	230.6	b c 220.7	233.5	265.1	d 249.3	2.85	2.83	b c d 2.84	2.82	2.85	a b 2.83	0.517	0.483	b c 0.500	0.583	0.567	0.575
Average		209.8	231.3	c 220.6	254.3	278.4	c 266.3	2.79	2.81	2.80	2.78	2.82	2.80	0.544	0.522	0.533	0.600	0.567	0.583
P x K	P_1	257.6	269.1	263.3	286.1	295.0	a 290.6	2.96	2.93	2.94	2.82	2.81	2.81	0.533	0.526	0.529	0.659	0.637	0.648
	P_2	246.1	269.6	257.9	270.5	294.3	b 282.4	2.92	2.96	2.94	2.82	2.82	2.83	0.526	0.529	0.527	0.650	0.569	0.609
	P_3	245.2	257.6	251.4	266.1	283.4	c 274.7	2.93	2.92	2.93	2.87	2.84	2.85	0.534	0.509	0.522	0.606	0.570	0.558
Total average		249.7	265.4	257.5	b 274.2	a 290.9	282.6	2.93	2.94	2.94	2.82	2.83	2.83	0.531	0.521	0.526	a 0.638	b 0.592	0.615

Nitrogen N_1 , N_2 and N_3 application of 180, 210 and 240 kg N/fed, respectively.
Phosphours P_1, P_2 and P_3 application of 30, 45 and 60 kg P_2O_5/fed
Potassium K_1 and K_2 application of 24 and 48 kg K/fed, respectively.

Table 3. Effect of nitrogen, phosphours and potassium fertilizers on brix, purity and sugar recovery% of sugarcane crop at harvest in 2002/2003 and 2003/2004 seasons.

Traits		Brix%						Purity%						Sugar recovery%					
		2002/2003		Mean	2003/2004		Mean	2002/2003		Mean	2003/2004		Mean	2002/2003		Mean	2003/2004		Mean
		K_1	K_2		K_1	K_2		K_1	K_2		K_1	K_2		K_1	K_2		K_1	K_2	
N_1	P_1	23.87	23.72	23.79	d e f 23.30	a b c d e f 23.67	23.48	80.06	80.89	80.48	a 84.01	c d 79.98	82.00	12.30	12.38	12.34	12.50	12.90	12.70
	P_2	23.94	24.40	24.17	a b c d e f 23.63	e f 23.07	23.35	79.84	81.60	80.72	c d e 79.46	a 84.61	82.03	12.42	12.58	12.50	12.90	12.90	12.90
	P_3	24.25	24.28	24.27	c d e f 23.43	a b c d 3.83	23.63	83.03	80.92	81.97	b c 80.42	d 79.85	80.14	12.40	12.67	12.53	12.20	12.50	12.35
Average		24.02	24.13	24.08	23.46	23.52	23.49	80.97	81.14	81.06	81.30	81.48	81.39	12.37	12.54	12.46	12.53	12.77	a 12.65
N_2	P_1	24.20	23.43	23.82	b c d e f 23.57	e f 23.10	23.33	82.26	83.20	82.73	e f g h 76.51	c d e f 78.49	77.50	12.47	12.42	12.44	12.63	12.57	12.60
	P_2	24.57	23.50	24.03	f 23.03	a 24.33	23.68	79.58	83.52	81.55	a b 83.53	e f g h 76.58	80.06	12.55	12.30	12.43	12.73	11.72	12.23
	P_3	23.53	23.60	23.57	a b 24.23	a b c 24.03	24.13	85.03	84.04	84.54	h 74.27	g h 75.17	74.72	12.17	12.23	12.20	11.50	11.47	11.48
Average		24.10	23.51	23.81	23.61	23.82	23.72	82.29	83.59	82.94	78.10	76.75	77.43	12.39	12.32	12.36	12.29	11.92	b 12.10
N_3	P_1	23.50	23.90	23.70	a b c d e f 23.70	a b 24.20	23.95	82.76	80.62	81.69	c d e f 78.32	f g h 75.63	76.97	12.17	11.97	12.07	11.57	11.50	11.53
	P_2	23.43	23.57	23.50	a b c d e 23.77	a b c d 24.00	23.88	82.65	85.30	83.97	c d e f g 77.42	d e f g h 77.10	77.26	12.33	12.47	12.40	11.58	11.60	11.59
	P_3	23.77	23.47	23.62	a b c 24.02	a b c 24.03	24.03	83.20	85.03	84.12	f g h 76.06	f g h 76.13	76.09	12.47	12.50	12.48	11.53	11.70	11.62
Average		23.57	23.64	23.61	23.83	24.08	23.95	82.87	83.65	83.26	77.27	76.29	76.78	12.32	12.31	12.32	11.56	11.60	c 11.58
P x K	P_1	23.86	23.68	23.77	23.52	23.66	b 23.59	81.69	81.57	81.63	79.61	78.03	a 78.82	12.31	12.26	12.28	12.23	12.32	a 12.28
	P_2	23.98	23.82	23.90	23.48	23.80	b 23.64	80.69	83.47	82.08	80.14	79.43	a 79.78	12.43	12.45	12.44	12.41	12.07	a 12.24
	P_3	23.85	23.78	23.82	23.89	23.97	a 23.93	83.76	83.33	83.54	76.92	77.05	b 76.98	12.34	12.47	12.41	11.74	11.89	b 11.82
Total average		23.90	23.76	23.83	23.63	23.81	23.72	82.05	82.79	82.42	78.89	78.17	78.53	12.36	12.39	12.38	12.13	12.09	12.11

Nitrogen N_1 , N_2 and N_3 application of 180, 210 and 240 kg N/fed, respectively.
Phosphours P_1, P_2 and P_3 application of 30, 45 and 60 kg P_2O_5/fed
Potassium K_1 and K_2 application of 24 and 48 kg K/fed, respectively.

Table 4. Effect of nitrogen, phosphours and potassium fertilizers on on number of millable cane (1000/fed), cane and sugar yields (tons/fed) of sugarcane crop at harvest in 2002/2003 and 2003/2004 seasons.

Traits		Number of millable cane (1000/fed)						Cane yield (tons/fed)						Sugar yield (tons/fed)					
		2002/2003		Mean	2003/2004		Mean	2002/2003		Mean	2003/2004		Mean	2002/2003		Mean	2003/2004		Mean
		K_1	K_2		K_1	K_2		K_1	K_2		K_1	K_2		K_1	K_2		K_1	K_2	
N_1	P_1	43.20	40.47	41.83	a 53.97	c 41.63	b 47.80	e f 41.10	d e f 41.57	e f 41.33	44.90	45.30	45.10	5.06	5.15	5.10	5.62	5.84	b c 5.73
	P_2	40.53	45.43	42.98	c 41.56	c 41.60	d 41.58	f 40.83	c d e 41.77	e f 41.30	45.07	45.67	45.37	5.07	5.26	5.16	5.81	5.89	a b 5.85
	P_3	47.60	47.37	47.48	b 47.37	b 46.27	b c 46.82	e f 41.20	d e f 41.57	e f 41.38	44.07	45.93	45.00	5.11	5.27	5.19	5.37	5.74	c 5.56
Average		43.78	44.42	c 44.10	b 47.63	c 43.17	45.40	d 41.04	c 41.63	b 41.34	c 44.68	c 45.63	45.16	c 5.08	b 5.22	b 5.15	b c 5.60	a 5.82	5.71
N_2	P_1	44.60	44.63	44.62	b 46.77	b 45.23	b c 46.00	e f 41.20	f 40.87	f 41.03	48.50	47.83	48.17	5.14	5.07	5.11	6.13	6.01	a 6.07
	P_2	44.43	48.40	46.42	b c 44.47	b 44.93	c 44.70	e f 41.20	c d 42.25	e 41.73	48.08	44.97	46.53	5.17	5.20	5.19	6.12	5.27	b c 5.70
	P_3	49.40	50.27	49.83	a 55.43	a 55.83	a 55.63	c 42.43	c d 42.40	d 42.42	45.00	44.87	44.93	5.16	5.19	5.18	5.18	5.15	d 5.16
Average		46.14	47.77	b 46.96	b 48.89	b 48.67	48.78	c 41.61	c 41.84	b 41.73	b 47.19	c 45.89	46.54	b c 5.16	b c 5.15	b 5.16	a b 5.81	c 5.48	5.64
N_3	P_1	49.57	51.33	50.45	a 55.63	a 56.41	a 56.02	a 46.13	a 46.55	a 46.34	48.87	49.77	49.32	5.61	5.57	5.59	5.65	5.72	b c 5.69
	P_2	50.77	50.53	50.65	a 55.95	a 57.03	a 56.49	a 46.60	b 44.17	b 45.38	49.27	46.93	48.10	5.75	5.51	5.63	5.71	5.45	c 5.58
	P_3	49.50	49.90	49.70	a 56.80	a 57.00	a 56.90	b 44.50	b 44.30	c 44.40	47.27	47.07	47.17	5.55	5.54	5.54	5.45	5.51	c 5.48
Average		49.94	50.59	a 50.27	a 56.13	a 56.81	56.47	a 45.75	b 45.01	a 45.37	a 48.47	b 47.92	48.19	a 5.64	a 5.54	a 5.59	b c 5.60	c 5.56	5.58
P	P_1	45.79	45.48	b 45.63	a 52.12	b 47.76	b 49.94	42.81	42.99	42.90	a 47.42	a 47.63	a 47.53	5.27	5.26	5.27	a 5.80	a 5.86	a 5.83
x	P_2	45.24	48.12	b 46.68	b 47.33	b 47.86	c 47.59	42.88	42.73	42.80	a 47.47	b 45.86	a 46.66	5.33	5.23	5.33	a 5.88	b 5.53	a 5.71
K	P_3	48.83	49.18	a 49.01	a 53.20	a 53.03	a 53.12	42.71	42.76	42.73	b 45.44	b 45.96	b 45.70	5.27	5.33	5.30	b 5.33	b 5.46	b 5.40
Total average		46.62	47.59	47.11	a 50.88	b 49.55	50.22	42.80	42.83	42.81	46.78	46.48	46.63	5.29	5.31	5.30	5.67	5.62	5.65

Nitrogen N_1 , N_2 and N_3 application of 180, 210 and 240 kg N/fed, respectively.
Phosphours P_1, P_2 and P_3 application of 30, 45 and 60 kg P_2O_5/fed
Potassium K_1 and K_2 application of 24 and 48 kg K/fed, respectively.

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تأثير التسميد النيتروجيني والفوسفاتي والبوتاسي على حاصل وجودة قصب السكر

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أقيمت تجربتان حقليتان بمحطه البحوث الزراعيه بالمطاعنة بمحافظه قنا لدراسه تأثير التسميد النيتروجيني والفوسفاتي والبوتاسي على حاصل قصب السكر. أشتملت الدراسة على ١٨ معاملة تمثل التفاعل بين: ثلاثة مستويات من التسميد النيتروجيني وثلاثة مستويات من التسميد الفوسفاتي ومستويان من التسميد البوتاسي وزعت المعاملات فى تصميم قطع منشقه مرة واحدة حيث وضعت مستويات التسميد الازوتي فى القطع الرئيسية بينما التوافق بين مستويات التسميد الفوسفاتي والبوتاسي في القطع الفرعية وكانت مساحة القطعة التجريبية ٤٢ متر مربع اشملت على ٦ خطوط بطول ٧ متر وعرض ١ متر وتمت الزراعة خلال الاسبوع الاول من مارس فى كلا الموسمين.

أوضحت النتائج المتحصل عليها:

- تفوق مستوى السماد الازوتى ٢٤٠ كجم ن/فدان على المستويات الاخرى للازوت معنويا فى الموسم الاول فى عدد النباتات فى المتر المربع وحاصلى العيدان والسكر طن/فدان وزاد معنويا فى الموسم الثانى فى صفة ناتج السكر ومعنويا فى كلا الموسمين فى صفات ارتفاع النبات وعدد العيدان القابلة للعصير ١٠٠٠/فدان.
- تفوق مستوى السماد الفوسفاتى ٣٠ كجم فوسفور/فدان بالمقارنة للمستويات الاخرى للفوسفور معنويا فى الموسم الثانى فى صفات عدد العيدان فى المتر المربع وارتفاع الساق والنسبة المئوية للسكريات المختزلة والنقاوة وناتج السكر وحاصلى العيدان والسكر طن/فدان. ومعنويا فى كلا الموسمين لعدد العيدان الكلية القابلة للعصير ١٠٠٠/فدان.
- تفوق مستوى السماد البوتاسى ٢٤ كجم بوتاسيوم/فدان معنويا مقارنة بمستويات السماد البوتاسى فى الموسم الثانى فى صفة عدد العيدان القابلة للعصير ١٠٠٠/فدان. وزاد معنويا فى كلا الموسمين في صفات مساحة الأوراق وارتفاع النبات
- اوضحت النتائج ان احسن حاصل عيدان نتج من التفاعل بين ٢٤٠ كجم ن/فدان و ٤٥ كجم فوسفور/فدان و٢٤ كجم بوتاسيوم/فدان فى الموسم الاول وكانت القيمة ٤٦,٦٠ طن/فدان بينما فى الموسم الثانى نتج من التفاعل بين ٢٤٠ كجم ن/فدان و ٣٠ كجم فوسفور و ٤٨ كجم بوتاسيوم/فدان فكانت القيمة ٤٩,٧٧ طن/فدان.
- اوضحت النتائج ان اعلى حاصل سكر نتج من التفاعل بين ٢٤٠ كجم ن/فدان و ٤٥ كجم فوسفور/فدان و ٢٤ كجم بوتاسيوم/فدان فى الموسم الاول وكانت القيمة ٥,٧٥ طن/فدان بينما فى الموسم الثانى نتج من التفاعل بين ٢١٠ كجم ن/فدان و ٣٠ كجم فوسفور/فدان و ٢٤ كجم بوتاسيوم/فدان فكانت القيمة ٦,١٣طن/فدان.. a