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EFFECT OF SOURCES, LEVELS AND NUMBER OF APPLICATIONS OF NITROGEN FERTILIZER ON YIELD AND QUALITY OF SUGAR CANE.

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ABSTRACT

A field experiment was carried out at Shandaweel Agricultural Research Station, Sohag Governorate for two successive seasons of 2006/2007 and 2007/2008 to study the effect of sources, levels, number of nitrogen applications and their interactions on yield and quality of sugarcane var PH 8013. A split- split plot design with four replications was used, sources of nitrogen were allocated in the main-plots, nitrogen levels were randomly distributed in the sub plots while number of applications were distributed in the sub-sub plots. Results showed that nitrogen sources had significant effects on stalk length, millable cane/fed., sugar yield per feddan and purity percentage in the second season only, while, number of internodes per stalk, cane yield (ton/fed.), brix, sucrose and sugar recovery were significantly affected in both seasons. Using urea fertilizer gave the highest values of yield and its components while, ammonium sulphate gave the highest values of juice quality percentages in both seasons.

Increasing nitrogen levels attained a positive and significant effects on stalk height, number of internodes/stalk, millable cane/fed., cane yield (ton/fed.), sugar yield per feddan and sugar recovery. Fertilizing sugar cane with 240 kg N/fed. recorded the highest values of these traits. Also, increasing number of nitrogen application attained a positive and

significant effects on stalk height, diameter/stalk, number of internodes, millable cane/fed., cane yield (ton/fed.), sugar yield per feddan and sugar recovery. The present results revealed that applying urea fertilizer at the rate of 240 kg N/fed. in 4-equal doses gave the highest yield under the condition of Sohag Governorate when cane tonnage is considered, while ammonium nitrate at 180 kg N and 4 doses and 210 kg N and 4 doses in the first and second seasons proved to be the best in terms of sugar yield/fed.

INTRODUCTION

Sugarcane (*Saccharum spp L.*) is considered the main crop for sugar industry in Egypt and through the world. Nitrogen is the most important fertilizers to sugarcane as all sugarcane cultivated areas contain insufficient available nitrogen under varying conditions of soil and climate. The differences among sources of nitrogen, are expected to have consequence effects on growth, yield and quality parameters that could affect sugar processing. Faria *et al.* (1983); Tishchenko *et al.* (1991); Mokadem (1998) and Mokadem *et al.* (2008) found that the sources of nitrogen (urea, ammonium nitrate and ammonium sulphate) caused significant increase in yield with increasing nitrogen rates. While, Quintero-Duran (1993) reported that, cane yield and quality were not significantly affected by the different nitrogen sources and found that high rates of N tended to decrease sucrose content.

In Egypt, several investigators reported that cane yield was increased with increasing nitrogen rate, but increasing N application from 100 up to 200 kg decreased quality parameters (Abd El-Latif *et al*, 1993; Ismail *et al*, 2000; El-Geddawy *et al*, 2005; Mohamed and Ahmed, 2005; Ismail *et al*, 2008; Mokadem *et al*, 2008 and Taha *et al*, 2008).

It has bean reported that, number of application of nitrogen fertilizer affect cane and sugar yields as well as juice quality. (Kadam *et al*, 1991; Chaudhury *et al*, 1992; Singh *et al*, 2001; Pannerselvam and Durai 2004 and Nigade *et al*, 2006). Applying nitrogen in 4 splits improved growth and yield attributes resulting in higher cane yield compared to 3-split applications.

Therefore, the present investigation was designed to study the effect of sources, level, number of nitrogen applications on yield and quality of sugarcane var pH 8013 at sohag Governorate.

MATERIALS AND METHODS

A field experiment was carried out at Shandaweel Agricultural Research Station, Sohag Governorate for the two successive seasons of 2006/2007 and 2007/2008 to study the effect of sources, levels, number of applications of N and their interactions on yield and quality of sugarcane. A split-split plot design with four replications was used, sources of nitrogen were allocated in the main-plots, nitrogen levels were randomly distributed in the sub plots while number of applications were distributed in the sub-sub plots. Each plot area was 21 m^2 with 6 ridges of 3.5 meters in length and 1.0 m apart. Sugarcane variety var Ph. 8013 was planted on March 15th in the first season and on March 8th in the second season and harvested after 12 months. The previous cultivated crop was maize . The studied factors were:

Nitrogen sources: Urea 46.5%nitrogen [$CO(NH_2)_2$], Ammonium nitrate 33.5% nitrogen [NH_4NO_3] and Ammonium sulphate 20.6% nitrogen [$(NH_4)_2SO_4$].

Nitrogen fertilizer levels: 180, 210 and 240 kg N/fed.

Number of nitrogen applications: Two, three and four applications.

The four N applications were carried out after 60, 90, 120 and 150 days from planting,.

Calcium super phosphate (15% P_2O_5) was applied during land preparation at 30 kg P_2O_5. Potassium fertilizer was applied once as potassium sulphate (48% K_2O) with the second addition of nitrogen fertilizer at rate 100 kg. Laser land leveling was made to control water supply. All other cultural practices were carried out as recommended. Chemical and physical properties of the experimental soil are presented in Table 1.

Table 1: Physical and chemical properties of the upper 40 cm of the experimental soil sites.

Season		2006/2007	2007/2008
Physical analysis	Sand%	56.34	51.57
	Silt	28.44	26.30
	Clay	15.22	22.13
Soil texture		Sandy loam	Sandy loam
Chemical analysis	N Available(ppm)	0.20	0.17
	$CaCO_3$%	1.20	1.34
	CO_3 Meq/100g	0	0
	$H CO_3$ Meq/100g	0.30	0. 26
	CL^- Meq/100g	0.89	0.79
	$SO_4^=$ Meq/100g	1.02	1.02
	Ca^{++} Meq/100g	0.53	0.50
	Mg^{++} Meq/100g	0.27	0.23
	Na^+ Meq/100g	1.25	1.19
	K^+ Meq/100g	0.16	0.15
	EC(ds/m) (1:5)	0.24	0.23
	pH	7.5	7.6

Data recorded:

Yield and its components:

At harvest ten plants were ranadmly taken to determine, stalk height (cm), stalk diameter (cm) and number of internodes/stalk. Plants of the four guarded rows were harvested, cleaned, topped number of millable cane per feddan, cane yield (ton/fed.) were recorded and sugar yield (ton/fed.) was estimated according to the following equation:

Raw sugar production = cane yield (tons/feddan)x sugar recovery %.

Quality traits:

At harvest, a sample of 20 stalks from each treatment was taken at random for the determination of :

Brix % of juice using brix hydrometer.

Sucrose % of juice using sacharemeter according to A.O.A.C. (1995).

Purity percentage was calculated according to the following equation:

$$\text{Purity \%} = \frac{\text{sucrose \%}}{\text{brix \%}} \times 100$$

and Sugar recovery percentage was calculated as follows:

Sugar recovery % = Richness % x Purity %

Where Richness = (sucrose in 100 grams x factor) /100

Factor = 100- [fiber% + physical impurities% + percent water free from sugar].

The obtained data were subjected to the statistical analysis of split-spilt plot design according to the procedure outlined by Snedecor and Cochran (1981). For comparison between means, L.S.D. at 5% level of probability was used.

RESULTS AND DISCUSSIONS

The effect on yield and its components.

Results in Tables 2, 3 and 4 reveal that cane stalk height and diameter did not response significantly to the nitrogen sources, but the effect was more pronounced and statistically different in respect to stalk height in the second season only. Application of urea gave the highest values of stalk height while the lowest values were obtained from applying ammonium sulphate in both seasons. Results also showed that nitrogen sources had a significant effect on number of internodes/stalk and cane yield (ton/fed.) in both seasons. However, the highest values of number of internodes and cane yield (20.15 & 20.30 and 59.71& 58.86 ton/fed.) were produced by using urea fertilizer and the lowest values (19.48 & 18.00 and 56.29 & 55.95 ton/fed.) were resulted by using ammonium sulphate in first and second seasons, respectively. This finding could be due to the quick loss of ammonium sulphate through volatilization from the soil especially under hot climate. Nitrogen source significantly affected the number of millable canes/fed and sugar yield (ton/fed) in the second season only. Similar results were reported by Tishchenko *et al.* (1991) who found that sources of nitrogen (urea, ammonium nitrate and ammonium sulphate) caused significant increases in yield with increasing nitrogen rates.

The obtained data clearly showed that the applied nitrogen levels attained a positive and significant effects on stalk height in both seasons.

Table 2: Effect of nitrogen sources, levels, number of N applications and their interactions on stalk height and diameter (cm) in 2006/2007 and 2007/2008 seasons.

Nitrogen source (A)	N level, kg N/fed (B)	Stalk highest (cm)								Stalk diameter (cm)							
		2006/2007 season				2007/2008 season				2006/2007 season				2007/2008 season			
		Number of N applications (C)			Mean	Number of N applications (C)			Mean	Number of N applications (C)			Mean	Number of N applications (C)			Mean
		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses	
Urea 46%	180	283.00	291.33	296.33	**290.22**	291.00	292.67	295.00	**292.89**	2.80	2.90	2.78	**2.83**	2.88	2.93	2.88	**2.90**
	210	288.67	294.67	299.67	**294.33**	294.00	296.00	298.67	**296.22**	2.80	2.93	2.83	**2.86**	2.95	3.00	2.97	**2.97**
	240	294.67	296.00	304.00	**298.33**	300.00	301.00	302.67	**301.22**	2.87	2.80	2.70	**2.79**	2.88	2.92	2.97	**2.92**
Mean		**288.78**	**294.11**	**300.00**	**294.30**	**295.00**	**296.56**	**298.78**	**296.78**	**2.82**	**2.88**	**2.77**	**2.82**	**2.91**	**2.95**	**2.94**	**2.93**
Ammonium nitrate	180	277.67	282.67	285.33	**281.89**	295.00	296.00	298.00	**296.33**	2.83	2.93	2.83	**2.87**	2.90	2.93	2.93	**2.92**
	210	289.00	297.00	297.67	**294.56**	294.00	295.00	298.33	**295.78**	2.83	2.93	2.83	**2.87**	2.97	3.00	2.97	**2.98**
	240	299.00	302.33	304.67	**302.00**	294.67	298.33	301.33	**298.11**	2.87	2.97	2.80	**2.88**	2.93	3.02	2.97	**2.97**
Mean		**288.56**	**294.00**	**295.89**	**292.82**	**294.56**	**296.44**	**299.22**	**296.74**	**2.84**	**2.94**	**2.82**	**2.87**	**2.93**	**2.98**	**2.96**	**2.96**
Ammonium sulphate	180	280.33	284.67	288.33	**284.33**	284.67	287.33	288.67	**286.89**	2.83	2.93	2.80	**2.86**	2.92	2.97	2.93	**2.94**
	210	280.33	288.33	294.67	**284.78**	291.00	292.33	295.00	**292.78**	2.87	2.90	2.83	**2.87**	2.98	3.03	2.93	**2.98**
	240	298.33	301.67	308.00	**302.67**	293.67	294.67	296.33	**294.89**	2.87	2.97	2.93	**2.92**	2.88	2.92	2.90	**2.90**
Mean		**286.22**	**291.56**	**297.00**	**291.59**	**289.78**	**291.44**	**293.33**	**291.52**	**2.86**	**2.93**	**2.86**	**2.88**	**2.93**	**2.97**	**2.92**	**2.94**
Average of N-level	180	280.22	286.22	290.00	**285.48**	290.22	292.00	293.89	**292.04**	2.82	2.92	2.81	**2.85**	2.90	2.94	2.92	**2.92**
	210	286.00	293.33	297.33	**292.22**	293.00	294.44	297.33	**295.37**	2.83	2.92	2.83	**2.86**	2.97	3.01	2.96	**2.98**
	240	297.33	300.11	305.56	**301.00**	296.11	298.00	300.11	**297.93**	2.87	2.91	2.81	**2.86**	2.90	2.95	2.94	**2.93**
Mean of N. applications		**287.85**	**293.22**	**297.63**		**293.11**	**294.82**	**297.11**		**2.84**	**2.92**	**2.82**		**2.92**	**2.97**	**2.94**	

LSD at 0.5 level for:					
Nitrogen sources	(A)	NS	0.84	NS	NS
Nitrogen levels	(B)	4.18	1.03	NS	0.04
Number of N application	(C)	1.92	0.78	0.04	0.03
A x B		NS	1.78	0.04	NS
A x C		NS	NS	NS	NS
B x C		NS	NS	NS	NS
A x B x C		NS	NS	NS	NS

Table 3: Effect of nitrogen sources, nitrogen levels, number of N applications and their interaction on number of internodes/stalk and number of millabe cane (thousand/fed)in 2006/2007 and 2007/2008 seasons.

Nitrogen source (A)	N level, kg N/fed (B)	Number of internodes/stalk								Millabe cane (thousand/fed)							
		2006/2007 season				2007/2008 season				2006/2007 season				2007/2008 season			
		Number of N applications (C)			Mean	Number of N applications (C)			Mean	Number of N applications (C)			Mean	Number of N applications (C)			Mean
		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses	
Urea 46%	180	18.67	19.67	20.33	**19.56**	19.67	20.33	20.67	**20.22**	41.30	41.86	44.10	**42.40**	40.40	41.53	42.60	**41.51**
	210	19.33	20.67	21.00	**20.33**	19.67	20.33	21.00	**20.33**	43.86	45.08	46.76	**45.17**	45.33	47.20	48.73	**47.09**
	240	19.67	20.67	21.33	**20.56**	19.67	20.67	20.67	**20.33**	46.20	47.88	49.70	**47.93**	48.53	49.60	50.57	**49.57**
Mean		**19.22**	**20.33**	**20.89**	**20.15**	**19.67**	**20.44**	**20.78**	**20.30**	**43.73**	**44.94**	**46.85**	**45.17**	**44.76**	**46.11**	**47.30**	**46.06**
Ammonium nitrate	180	18.33	19.00	19.67	**19.00**	18.00	18.67	19.33	**18.67**	39.92	41.02	43.69	**41.21**	41.33	43.20	45.37	**43.00**
	210	19.33	20.33	20.67	**20.11**	18.67	19.67	20.67	**19.67**	41.30	44.94	44.94	**43.73**	43.30	44.50	45.53	**44.44**
	240	19.33	20.67	20.67	**20.22**	18.67	20.00	20.67	**19.78**	47.04	48.25	48.89	**48.06**	43.70	45.10	46.77	**45.19**
Mean		**19.00**	**20.00**	**20.33**	**19.78**	**18.44**	**19.44**	**20.22**	**19.37**	**42.42**	**44.74**	**45.84**	**44.33**	**42.78**	**44.27**	**45.89**	**44.31**
Ammonium sulphate	180	18.00	18.67	19.33	**18.67**	17.00	17.67	18.67	**17.78**	39.49	42.14	45.08	**42.24**	39.93	42.53	43.23	**41.90**
	210	20.33	20.33	20.67	**20.44**	17.00	17.67	18.67	**17.78**	41.86	44.80	46.90	**44.52**	44.87	45.13	45.73	**45.24**
	240	18.33	19.33	20.33	**19.33**	17.67	18.67	19.00	**18.44**	44.24	45.64	48.23	**46.04**	44.60	45.25	46.33	**45.39**
Mean		**18.89**	**19.44**	**20.11**	**19.48**	**17.22**	**18.00**	**18.78**	**18.00**	**41.86**	**44.19**	**46.74**	**44.26**	**43.13**	**44.31**	**45.10**	**44.18**
Average of N-level	180	18.33	19.11	19.78	**19.07**	18.22	18.89	19.56	**18.89**	39.90	41.67	44.29	**41.96**	40.56	42.42	43.73	**42.24**
	210	19.67	20.44	20.78	**20.30**	18.44	19.22	20.11	**19.26**	42.28	44.94	46.20	**44.47**	44.50	45.61	46.67	**45.59**
	240	19.11	20.22	20.78	**20.04**	18.67	19.78	20.11	**19.52**	45.83	47.26	48.94	**47.34**	45.61	46.65	47.89	**46.72**
Mean of N. applications		**19.04**	**19.93**	**20.44**		**18.44**	**19.30**	**19.93**		**42.67**	**44.62**	**46.48**		**43.56**	**44.89**	**46.10**	

LSD at 0.5 level for:				
Nitrogen sources	**(A)**	**0.47**	**0.41**	**NS**	**0.20**
Nitrogen levels	**(B)**	**0.27**	**0.29**	**1.29**	**0.30**
Number of N application	**(C)**	**0.30**	**0.28**	**0.70**	**0.26**
A x B		**0.47**	**0.51**	**NS**	**0.53**
A x C		**NS**	**NS**	**NS**	**0.45**
B x C		**NS**	**NS**	**NS**	**0.45**
A x B x C		**NS**	**NS**	**NS**	**0.78**

Table 4: Effect of nitrogen sources, nitrogen levels, number of N applications and their interaction on cane and sugar yields (ton/fed) in 2006/2007 and 2007/2008 seasons.

Nitrogen source (A)	N level, kg N/fed (B)	Cane yield (ton/fed)								Sugar yield (ton/fed)							
		2006/2007 season				2007/2008 season				2006/2007 season				2007/2008 season			
		Number of N applications (C)			Mean	Number of N applications (C)			Mean	Number of N applications (C)			Mean	Number of N applications (C)			Mean
		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses	
Urea 46%	180	58.24	59.06	60.10	59.13	56.46	58.70	59.57	58.24	6.99	7.52	7.57	7.36	6.40	6.54	6.68	6.54
	210	59.54	59.90	60.53	59.99	57.01	59.17	60.05	58.74	6.92	7.22	7.20	7.11	6.58	6.61	6.58	6.59
	240	59.85	59.91	60.25	60.00	57.50	60.18	61.06	59.58	6.59	6.75	6.93	6.75	6.48	6.88	7.25	6.87
Mean		59.21	59.62	60.29	59.71	56.99	59.35	60.23	58.86	6.83	7.16	7.23	7.08	6.49	6.68	6.84	6.67
Ammonium nitrate	180	58.10	57.57	59.11	58.26	55.79	57.01	58.83	56.87	6.92	7.33	7.65	7.30	6.89	7.42	7.08	7.13
	210	58.42	59.93	59.35	58.90	57.51	59.09	59.79	58.80	7.04	7.36	7.37	7.26	7.13	7.20	7.44	7.26
	240	59.38	60.35	59.41	59.71	58.33	59.29	59.79	59.14	7.12	7.11	7.02	7.08	7.04	7.25	7.04	7.11
Mean		58.63	58.95	59.29	58.96	57.21	58.46	59.13	58.27	7.03	7.26	7.35	7.21	7.02	7.29	7.19	7.16
Ammonium sulphate	180	55.44	56.02	56.65	56.04	53.92	55.46	56.05	55.15	6.69	6.81	6.86	6.78	6.80	6.83	6.86	6.83
	210	56.10	56.18	56.33	56.40	54.80	56.57	57.14	56.17	6.88	7.16	7.00	7.01	7.02	7.11	7.27	7.13
	240	56.01	56.18	57.16	56.45	55.12	57.05	57.47	56.54	7.34	7.01	7.21	7.18	6.97	7.19	7.04	7.07
Mean		55.85	56.32	56.71	56.29	54.61	56.36	56.89	55.95	6.97	6.99	7.02	6.99	6.93	7.04	7.06	7.01
Average of N-level	180	57.26	57.55	58.62	57.81	55.39	57.06	58.82	56.75	6.86	7.22	7.36	7.15	6.70	6.93	6.87	6.83
	210	58.02	58.53	58.74	58.43	56.44	58.28	58.99	57.90	6.95	7.25	7.19	7.13	6.91	6.97	7.10	6.99
	240	58.41	58.81	58.94	58.72	56.98	58.84	59.44	58.42	7.02	6.95	7.05	7.01	6.83	7.10	7.11	7.02
Mean of N. applications		57.90	58.30	58.77		56.27	58.06	58.75		6.94	7.14	7.20		6.81	7.00	7.03	
LSD at 0.5 level for:																	
Nitrogen sources	(A)				1.01				0.96				NS				0.23
Nitrogen levels	(B)				0.42				0.17				NS				0.12
Number of N application	(C)				0.35				0.33				0.09				0.11
A x B					NS				0.29				0.21				0.21
A x C					NS				0.58				0.15				NS
B x C					NS				NS				0.15				NS
A x B x C					NS				NS				NS				0.33

However, stalk diameter was significantly affected in the second season only. The tallest stalk was recorded with fertilizing sugar cane with 240 kg N/fed in both seasons. Increasing fertilization level of nitrogen caused a relative increases in the number of internodes/stalk, number of millable (canes/fed), cane yield (ton/fed) in the two seasons, while sugar yield (ton/fed) was significantly affected in the second season only. The increases in cane yield/fed due to the application of nitrogen fertilizer could be explained by the fact that nitrogen has a vital role in building up metabolites, activating enzymes and carbohydrates accumulation which transferred from leaves to stalks which in turn enhanced stalk length, diameter, number of internodes/plant as well as cane yield per unit area. These results are in harmony with those obtained by Abd El-Latif *et al* (1993); Mokadem (1998); Ismail *et al.* (2008) and Mokadem *et al.* (2008).

All studied traits for yield and its components i.e., stalk height, diameter internodes/stalk, number of millable canes/fed, cane yield/fed and sugar yield (ton/fed) increased gradually with increasing nitrogen application doses from 2 to 4 doses in both seasons. These results could be attributed to the fact that increasing the splitting of N-level participates in a continuous availability of nitrogen as an essential element for cane plants, which ensures better nutrition, reflected in better growth appearance. On the contrary, decreasing N-dose lead to losing soluble nitrogen beyond root zone without utilization by cane plants, especially at the younger stages ages of growth. Similar trends were reported by Pannerselvam and Durai (2004) and Nigade *et al.* (2006).

The interaction effects between nitrogen sources x nitrogen levels was significant on stalk height, number of millable canes/fed, and cane yield/fed in the second season only. Moreover, this interaction significantly affected the number of internodes/stalk and sugar yield (ton/fed.) in both seasons.

Nitrogen sources x number of nitrogen doses interaction had significant effect on number of millable canes/fed and cane yield (ton/fed) in the second season. Meanwhile, this interaction increased sugar yield (ton/fed) values in both seasons but differences reached the significant level only in the first season.

Nitrogen fertilization levels x number of nitrogen doses interaction had significant effect on number of millable cane/fed in the second season and sugar yield/fed in the first season only. The second order interaction among the three studied factors had a significant effect on number of millable canes/fed and sugar yield/fed in the second season only. In this season, applied urea as a nitrogen source at a rate of 240 kg N/fed in 4-equal doses recorded the highest number of millable cane/fed. The maximum sugar yield/fed. (7.44 ton/fed) was recorded by using ammonium nitrate at a rate of 210 kg N/fed and applied in 4-equal doses, without significant difference from that obtained with using urea at rate 240 kg N/fed in 4-equal doses or ammonium sulphate at a rate of 210 kg N/fed in 4-equal doses.

The effect on juice quality.

Results in Tables 5 and 6 show the effect of nitrogen sources, levels, number of nitrogen applications as well as their interactions on brix, sucrose, purity, and sugar recovery percentages in 2006/2007 and 2007/2008 seasons. Date indicated that the evaluated three nitrogen sources differed significantly in brix, sucrose, and sugar recovery percentages in both seasons. While, purity percentage differed significantly in the second season only. The highest values were recorded using ammonium sulphate followed by ammonium nitrate and the lowest values was obtained by using urea fertilizer. These results are in line with those reported by Tishchenko *et al.* (1991); Mokadem (1998) and Mokadem *et al.* (2008).

Nitrogen rates showed significant effects on brix and sucrose percentages in both seasons. Gradual increases in brix and sucrose values were noticed as nitrogen rate increased from 180 up to 210 kg N/fed, thereafter additional nitrogen was not accompanied by a marked increase in brix and sucrose percentage in both seasons. Data also showed that increasing nitrogen fertilization levels caused a relative decreases in purity and sugar recovery pecentage in the first season only. The inverse response in the values of juice purity due to the increase in nitrogen levels led to reducing sugars which consequently lowered purity percentage. These results are in agreement with those obtained by Quintero-Duran (1993)

Table 5: Effect of nitrogen sources, nitrogen levels, number of N applications and their interaction on birx% and sucrose% in 2006/2007 and 2007/2008 seasons.

Nitrogen source (A)	N level, kg N/fed (B)	Birx%								Sucrose%							
		2006/2007 season				2007/2008 season				2006/2007 season				2007/2008 season			
		Number of N applications (C)			Mean	Number of N applications (C)			Mean	Number of N applications (C)			Mean	Number of N applications (C)			Mean
		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses	
Urea 46%	180	20.08	20.41	20.32	**20.27**	20.26	20.87	20.64	**20.59**	17.90	18.60	18.46	**18.32**	17.48	17.62	17.55	**17.55**
	210	21.09	21.61	21.53	**21.41**	20.33	21.52	21.06	**20.97**	18.09	18.67	18.50	**18.42**	17.67	17.92	17.55	**17.72**
	240	21.70	22.00	21.52	**21.74**	20.12	21.04	19.78	**20.32**	18.08	18.21	18.18	**18.16**	17.37	17.92	17.66	**17.65**
Mean		**20.96**	**21.34**	**21.12**	**21.14**	**20.24**	**21.15**	**20.49**	**20.63**	**18.02**	**18.49**	**18.38**	**18.30**	**17.51**	**17.82**	**17.59**	**17.64**
Ammoniu m nitrate	180	20.89	21.29	20.85	**21.01**	20.54	21.59	21.03	**21.05**	18.22	19.03	18.97	**18.73**	18.38	19.37	18.53	**18.76**
	210	21.01	21.88	21.62	**21.50**	22.30	22.99	22.11	**22.47**	18.38	19.12	18.94	**18.81**	19.26	19.40	19.20	**19.29**
	240	20.86	21.92	21.40	**21.39**	22.01	22.45	21.91	**22.12**	18.27	18.58	18.38	**18.41**	18.87	19.18	18.58	**18.88**
Mean		**20.92**	**21.70**	**21.29**	**21.30**	**21.62**	**22.34**	**21.68**	**21.88**	**18.29**	**18.91**	**18.76**	**18.66**	**18.84**	**19.32**	**18.77**	**18.98**
Ammoniu m sulphate	180	21.57	21.96	21.81	**21.78**	21.37	22.37	22.18	**21.98**	18.65	18.90	18.80	**18.78**	18.97	19.22	19.07	**19.08**
	210	21.72	22.13	22.01	**21.95**	22.20	22.83	22.12	**22.38**	18.88	19.34	19.14	**19.12**	19.52	19.64	19.42	**19.53**
	240	20.35	21.82	21.22	**21.13**	21.88	22.26	22.19	**22.11**	18.84	19.09	18.90	**18.94**	19.25	19.39	19.22	**19.29**
Mean		**21.21**	**21.97**	**21.68**	**21.62**	**21.82**	**22.49**	**22.16**	**22.16**	**18.79**	**19.11**	**18.95**	**18.95**	**19.25**	**19.41**	**19.24**	**19.30**
Average of N-level	180	20.85	21.22	20.99	**21.02**	20.72	21.61	21.28	**21.21**	18.26	18.84	18.74	**18.61**	18.28	18.73	18.39	**18.47**
	210	21.27	21.87	21.72	**21.62**	21.61	22.45	21.76	**21.94**	18.45	19.04	18.86	**18.78**	18.82	18.99	18.72	**18.84**
	240	20.97	21.91	21.38	**21.42**	21.34	21.92	21.29	**21.52**	18.40	18.63	18.49	**18.50**	18.50	18.83	18.49	**18.60**
Mean of N. applications		**21.03**	**21.67**	**21.36**		**21.23**	**21.99**	**21.45**		**18.37**	**18.84**	**18.70**		**18.53**	**18.85**	**18.53**	
LSD at 0.5 level for:																	
Nitrogen sources	**(A)**				**0.26**				**0.19**				**0.11**				**0.22**
Nitrogen levels	**(B)**				**0.23**				**0.32**				**0.06**				**0.18**
Number of N application	**(C)**				**0.14**				**0.17**				**0.07**				**0.14**
A x B					**0.40**				**0.56**				**0.10**				**NS**
A x C					**NS**				**NS**				**0.12**				**NS**
B x C					**0.24**				**NS**				**0.12**				**NS**
A x B x C					**0.41**				**0.51**				**NS**				**NS**

Table 6: Effect of nitrogen sources, nitrogen levels, number of N applications and their interaction on purity% and sugar recovery% in 2006/2007 and 2007/2008 seasons.

Nitrogen source (A)	N level, kg N/fed (B)	Purity%								Sugar recovery%							
		2006/2007 season				2007/2008 season				2006/2007 season				2007/2008 season			
		Number of N applications (C)			Mean	Number of N applications (C)			Mean	Number of N applications (C)			Mean	Number of N applications (C)			Mean
		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses		2 doses	3 doses	4 doses	
Urea 46%	180	89.13	91.14	90.83	**90.37**	86.28	84.42	85.14	**85.28**	12.00	12.73	12.59	**12.44**	11.33	11.15	11.21	11.23
	210	85.78	86.42	85.98	**86.06**	86.92	83.29	83.37	**84.52**	11.62	12.07	11.90	**11.86**	11.54	11.16	10.96	11.22
	240	83.37	82.79	84.54	**83.57**	86.33	85.14	89.27	**86.91**	11.00	11.26	11.50	**11.25**	11.27	11.43	11.87	11.52
Mean		**86.09**	**86.79**	**87.11**	**86.66**	**86.51**	**84.28**	**85.92**	**85.57**	**11.54**	**12.01**	**12.00**	**11.85**	**11.38**	**11.25**	**11.35**	11.33
Ammonium nitrate	180	87.19	89.43	90.97	**89.20**	89.51	89.71	88.14	**89.12**	11.91	12.74	12.94	**12.53**	12.35	13.02	12.24	12.54
	210	87.50	87.38	87.66	**87.52**	86.36	84.40	86.84	**85.87**	12.05	12.48	12.42	**12.32**	12.41	12.18	12.45	12.35
	240	87.58	84.82	85.92	**86.11**	85.70	85.46	84.84	**85.34**	11.99	11.77	11.82	**11.86**	12.07	12.22	11.78	12.02
Mean		**87.42**	**87.21**	**88.19**	**87.61**	**87.19**	**86.52**	**86.61**	**86.77**	**11.99**	**12.33**	**12.39**	**12.24**	**12.28**	**12.47**	**12.16**	12.30
Ammonium sulphate	180	86.47	86.08	86.20	**86.25**	88.77	85.91	85.97	**86.88**	12.06	12.15	12.11	**12.11**	12.60	12.31	12.23	12.38
	210	86.93	87.37	86.95	**87.08**	87.94	86.01	87.81	**87.25**	12.27	12.61	12.43	**12.43**	12.81	12.57	12.73	12.70
	240	92.55	87.46	89.08	**89.70**	87.99	87.09	86.66	**87.24**	13.10	12.47	12.61	**12.74**	12.65	12.59	12.27	12.51
Mean		**88.65**	**86.97**	**87.41**	**87.68**	**88.23**	**86.34**	**86.81**	**87.13**	**12.48**	**12.41**	**12.38**	**12.42**	**12.69**	**12.49**	**12.41**	12.53
Average of N-level	180	87.60	88.88	89.33	**88.60**	88.19	86.68	86.42	**87.09**	11.99	12.54	12.55	**12.36**	12.10	12.16	11.89	12.05
	210	86.74	87.06	86.86	**86.89**	87.07	84.57	86.01	**85.88**	11.98	12.39	12.25	**12.20**	12.25	11.97	12.05	12.09
	240	87.84	85.02	86.51	**86.46**	86.67	85.90	86.92	**86.50**	12.03	11.84	11.98	**11.95**	12.00	12.08	11.97	12.02
Mean of N. applications		**87.39**	**86.99**	**87.57**		**87.31**	**85.71**	**86.45**		**12.00**	**12.25**	**12.26**		**12.12**	**12.07**	**11.97**	
LSD at 0.5 level for:																	
Nitrogen sources	(A)				NS				0.78				0.19				0.24
Nitrogen levels	(B)				1.06				NS				0.20				NS
Number of N application	(C)				NS				0.78				0.14				NS
A x B					1.80				1.84				0.34				0.38
A x C					1.09				NS				0.25				NS
B x C					1.09				NS				0.25				NS
A x B x C					NS				2.33				NS				NS

Yield and quality of sugarcane

Number of nitrogen applications significantly affected both brix and sucrose percentages in both seasons; increasing the number of nitrogen applications from 2 to 3 increased the values of brix and sucrose percentages in both seasons, thereafter additional number of applications nitrogen increment was not accompanied by a marked increase in brix and sucrose percentage in both seasons. Purity percentage was significantly affected by the number of nitrogen applications in the 2nd season. Increasing the number of nitrogen applications from 2 to 3 resulted in an decrease in purity percentage in the second season. Sugar recovery percentage was significantly affected by number of nitrogen applications in the 1st season only. Increasing the number of nitrogen applications from 2 to 4 applications resulted in an increase in sugar recovery percentage. Similar results were reported by Pannerselvam and Durai (2004) and Nigade *et al.* (2006).

The interaction effect between nitrogen sources x nitrogen levels significantly affected brix, purity and sugar recovery percentages in both seasons, However, sucrose pecentage was significantly affected in the first season only.

Brix percentage was insignificantly affected by the interaction between nitrogen sources x number of nitrogen applications at harvest in both seasons. While, sucrose, purity and sugar recovery percentages were significant in the first season only.

With regard to the effect of the interaction between nitrogen fertilization levels x number of nitrogen application on brix, sucrose, purity and sugar recovery percentages were significant in the first season.

The second order interactions among the three studied factors had a significant effect on brix percentage in the 1st and 2nd seasons, while purity percentage was affected in the 2nd season only.

The present results revealed that using urea fertilizer at the rate of 240 kg N/fed in 4-equal doses gave the highest yield under the condition of Sohag Governorate when cane tonnage was considered, while ammonium nitrate at 180 kg N and 4 doses and 210 kg N and 4 doses in the first and second seasons proved to be the best in terms of sugar yield/fed.

REFERENCES

A. O. A. C. (1995). Official methods of analysis published by the A.O.A.C., Box 540, Washington.

Abd El-Latif, F.A.; Laila. M. Saif; Nour El-Hoda. M. Taha and I.H. El-Geddawy (1993): Response of some sugarcane varieties to different levels of nitrogen. Egypt. J. Appl. Sci., **8** (11): 780-786.

Chaudhury, D.C.; S.N. Singh and S.B. Singh (1992). Studies on the effect of time and fractional doses of nitrogen application on yield, yield attributes, juice quality and economic return of sugarcane ratoon. India, Cooperative-Sugar. **24**(2-3): 99-102.

El-Geddawy, I.H.; M.S. Rady; H.A. Dawwam; F.A. Hendaw and R.A.M. Abo El-Ghait (2005). Response of some sugar cane varieties to nitrogen and potassium application. Egypt. J. Agric. Res., **83**(2): 693-707.

Faria, C.M.B.; L.B. Morgado; J.R. Pereiea and O.P. Aragao (1983). Effect of sources and levels of nitrogen on irrigated sugarcane. Pesquisa Agrofecuaria Barasieira. **18**(7): 849-853.

Ismail, A.M.A.; M.A. Bekheet and A.S. Abo El-Hamd (2008). Yield and quality of four sugarcane varieties as influenced by seed rate and nitrogen fertilization. Egypt. J. Appl. Sci., 23(1): 107-123.

Ismail, A.M.A.; T.S. El-Amary and N.B. Azzazy (2000). Response of yield and quality of sugar cane to nitrogen and zinc fertilization. Egypt. J. Agric. Res., **78**(3): 1161-1169.

Kadam, R.H.; M.D. Patil and J.D. Patil (1991). Effect of forms and levels of urea on yield and nitrogen uptake by sugarcane. J. Maharashtra-Agric., Univ. **16**(2): 242-244.

Mohamed, B.D. and A.Z. Ahmed (2005). Response of three sugar cane varieties to varing nitrogen fertilizer rates. The 11th Conference of Agronomy, Agron. Dept., Fac. Agric., Assiut. Univ., Nov. 15-16, 2005.

Mokadem, Sh.A. (1998). Response of the promising sugarcane variety G.85/37 grown under Middle Egypt region to different sources and rates of nitrogen. Pakistan Sugar J., **12** (1): 10-15.

Mokadem, Sh.A.; I.H. El-Geddawy and M.E. El-Amir (2008). Effect of planting dates, nitrogen fertilizer sources and rates on yield and quality of the new sugarcane variety PH 8013. Minia J. Agric. Res & Develop **28**(1): 83-104.

Nigade, R.D.; U.A. Kadam and B.S. Jadhav (2006). Response of sugarcane varieties to the time of fertilizer application and earthing up. India. Cooperative. Sugar. 38(3): 31-34.

Pannerselvam, R. and R. Durai (2004). Studies on planting techniques and intercrops in sugarcane under levels and times of nitrogen application. India. Cooperative-Sugar. **35**(11): 857-860.

Quintero-Duran, R. (1993). Nitrogen application according to soil type and cane variety. Serie-Tecnica-CENICANA,-Centro-de-Investigacion-de-la-Cana-de-Azucar-de-Colombia. (12): 37.

Singh, A.K.; T.K. Srivastava and Menhi-Lal (2001). Effect of nitrogen and potassium nutrition on yield and quality of seed cane under sub-tropical conditions. Indian, J. Sugarcane., Technology. **16**(1): 9-13.

Snedecor, G.W. and W.G. Cochran (1981). Statistical Methods. Seventh Ed. Iowa State Univ. Press, Ames, Iowa, USA.

Taha, E.M.; Sh.A. Mokadem; A.Z. Ahmed and M.O. Galal (2008). Assessment of the optimum seeding rate and nitrogen level for five sugarcane varieties. Minia J. Agric. Res & Develop **28**(3): 469-494.

Tishchenko, N.N.; D.B. Nikitin; I.M. Magomedov and E. Moran (1991). Effect of nitrate and ammonium forms of nitrogen fertilizers on sugarcane photosynthesis and growth parameters. Fiziologiya -i- Biokhimiya - Kul'turnykh - Rastenii. **23**(5): 446-456.

تأثير مصادر ومستويات وعدد مرات إضافة السماد النيتروجيني على محصول وجودة قصب السكر

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**معهد بحوث المحاصيل السكرية – مركز البحوث الزراعية- الجيزة.

أقيمت تجربتان حقليتان بمحطة البحوث الزراعية بشندويل بمحافظة سوهاج فى الموسمين المتتاليين ٢٠٠٦/٢٠٠٧ ، ٢٠٠٧/٢٠٠٨ لدراسة تأثير مصادر ومستويات وعدد مرات إضافة السماد الاوزتى على حاصل وجودة قصب السكر على الصنف PH 8013. تضمنت كل تجربة سبعة وعشرون معاملة تمثل التوافيق المختلفة بين ثلاثة مصادر من السماد النيتروجيني (يوريا ٤٦,٥% نينروجين و نترات أمونيوم ٣٣,٥% نيتروجين و سلفات أمونيوم ٢٠,٦% نيتروجين) وثلاثة مستويات لنفس المصادر هى (١٨٠ كجم ن/ف و ٢١٠ كجم ن/ف و ٢٤٠ كجم ن/ف) وثلاثة معاملات لتوزيع السماد النيتروجيني (دفعتين – ثلاث دفعات – أربع دفعات). أستخدم تصميم القطع المنشقة مرتين في أربعة مكررات في كلا الموسمين حيث تم وضع مصادر النيتروجين فى القطع الرئيسية ووزعت مستويات التسميد النيتروجيني في القطع الشقية الأولى بينما عدد مرات الإضافة وزعت فى القطع الشقية الثانية ووزعت المعاملات توزيعا عشوائيا.

أوضحت النتائج المتحصل عليها أن طول الساق وعدد العيدان القابلة للعصير/فدان وحاصل السكر طن/فدان والنسبة المئوية للنقاوة تأثرت معنويا بمصادر النيتروجين المستخدمة فى الموسم الثاني فقط بينما صفات: عدد السلاميات/الساق و وحاصل العيدان بالطن/فدان والنسبة المئوية للبركس والسكروز وناتج السكر تأثرت معنويا

بمصادر النيتروجين المستخدمة فى كلا الموسمين وأعطى استخدام سماد اليوريا أعلى القيم لصفات الحاصل بينما سلفات الامونيوم أعطى أعلى القيم لصفات الجودة.

أظهرت النتائج أن مستويات التسميد النيتروجيني حققت زيادة ايجابية ومعنوية لصفات طول الساق وعدد السلاميات/الساق وعدد العيدان القابلة للعصير/فدان وحاصل العيدان والسكر طن/فدان والنسبة المئوية لناتج السكر وسجل مستوى ٢٤٠ كجم ن/ف أعلى القيم لهذه الصفات.

أدت زيادة عدد مرات إضافة السماد الأزوتي من ٢ إلى ٤ جرعات إلى زيادة ايجابية ومعنوية لصفات طول وقطر الساق وعدد السلاميات/الساق وعدد العيدان القابلة للعصير/فدان وحاصل العيدان والسكر طن/فدان وأدى توزيع السماد على أربع جرعات إلى الحصول على أعلى القيم لهذه الصفات.

أوضحت هذه الدراسة أن استخدام اليوريا كمصدر للازوت بمعدل ٢٤٠ كجم نيتروجين للفدان تضاف على أربع دفعات متساوية أعلى حاصل من قصب السكر على اساس الوزن وذلك تحت ظروف محافظة سوهاج بينما أعطى استخدام نترات الامونيوم بمعدل ١٨٠ كجم نيتروجين تضاف على اربع جرعات و ٢١٠ كجم نيتروجين تضاف ايضا على اربع جرعات فى الموسم الاول والثانى أعلى محصول سكر (طن/فدان).