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EFFECT OF NITROGEN FERTILIZATION ON FLOWERING, SEED SETTING, MORPHOLOGICAL AND TECHNOLOGICAL CHARACTERISTICS OF THREE SUGARCANE VARIETIES

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ABSTRACT: ***Plants of three micro propagated varieties of sugarcane Saccahrum officinarumL , namely F153 , G37-85 and GT 54-C9, and somaclones of GT 54-9 C9 of the same age were transplanted in mid-October 2001 into soil according to complete randomized block design (CRBD), as the following.***

Five levels of nitrogen fertilization (as ammonium nitrate) were used as follows: 0, 70,140,210and 280 Kg/feddan. Flowering, seed setting (open pollination), some morphological and technological characters for these materials were also recorded. The obtained results, regarding crop revealed that there was no effect of fertilization levels on flowering for the used different materials. Meanwhile seed setting responded to the genotypes of varieties and somaclones. In the first ratoon, fertilization and flowering behavior for a long period have been characterized by a decrease in flowering percentages and seed production. Moreover, the resulted seeds did not germinate. All varieties have shown different response to nitrogen fertilizer levels for all studied characteristics, except for the stem diameter. The effect of growing season has been significantly higher in the first ratoon compared to the plant crop season. The interaction between varieties and nitrogen levels showed significant values for all the studied characteristics.

Key words: ***N2 fertilizer, characters, sugarcane varaities.***

INTRODUCTION

In Egyt, the need for sugar has been greatly increased because of the gap between production and consumption. Therefore, enthusiastic efforts have been directed toward the improvement of sugar crops either by using conventional breeding methods (Gaber *et al*., 1990 and Abu El Fath *et al.*, 1994) or via tissue culture techniques and their applications (Sharaf and Ouf. 1995 a & b; Ouf *et al*., 1996; Sharaf and Ouf, 1998 & 1999; Sharaf et *al*., 2000 and Ouf *et al.,* 2003).

The present work was conducted to study the effect of nitrogen fertilization levels on three varieties of sugarcane (*Saccharum officinarum* L.) and some somaclones regenerated from one of them to induce flowering and seed setting, growth under the Sabahia Researsh Station conditions. Some of agronomical characteristics for all used material were evaluated.

MATERIALS AND METHODS

Plantlests grown in clay pots of the three varieties of sugarcane namely: F153, G 37-85 and GT 54-C9 were produced using micropropagating techniques (in vitro plants) according to Sharaf and Ouf (2000). Somaclones (as regenerates) using tissue culture techniques according to Sharaf and Ouf 1995), were used as plant material in this work. All materials,of the same age, were transplanted into soil under the field conditions of Sabahia Research Station , the physical and chemical properties of soil are listed in Table (1) October 2001.A complete randomized block design (CRBD) with three replications for the two seasons of 2001 / 2002 and 2002 / 2003 were used. . Plot area was 18.75 m2 (3.75 ×5 cm), each variety was planted on three ridges of 5 meters in length and 1.25 meters in width. The rate of nitrogen fertilization (as ammonium nitrate) was: 0, 70, 140, 210 and 280 kg / feddan. Irrigation was applied as normal except in October and November, where it was at ten-days intervals. All other culture practices were carried out according to the recommendations of the Egyptian Ministry of Agriculture. Flowering date of each variety, seed setting through open pollination was recorded. Ten stalks were taken randomly from each plot and chopped after topping at the end of the flowering season , to evaluation the following characteristics : plant weight of leaves, plant length, number of internodes, stalk diameter , weight of fresh leaves, weight of dry leaves, leaf area, total chlorophyll , juice weight , total soluble solids (TSS%) and sucrose % .The data were analyzed statistically according to Steel and Torrie (1981) .

RESULTS AND DISCUSSION

Effect of nitrogen levels on flowering and tested:

Table (2) summarized the response of varieties to different levels of nitrogen with respect to flowering and seed setting.

All cultured varieties and somaclones bloomed at varying periods (from mid February to mid March for two growing seasons) under the different levels of nitrogen fertilization. These periods were much less when compared with those results reported by Abu El Fath *et al*.,(1999) , who found that flowering duration ranged from November to July (sown in Spring) and from November to April (sown in Autumn). In fact our results come in agreement

with what Abu El Fath *et al.,* 1999 reported on that flowering duration was variety dependent.

Data presented in table (2) showed that there was no effect of nitrogen level on varieties. On the contrary, other studies have reported a major effect of nitrogen fertilization level (Coleman, 1959 and Clements and Aedow, 1964).But there was significant effect of nitrogen on seed setting that varied from variety to another.

In the second growing season, the flowering behavior occurred for a relatively longer duration from December2002, to July 2003, under all nitrogen fertilization levels for the assigned varieties. This result could be explained as tube effect due to micropropagation and tissue culture techniques during the first 1^{st} season then, produced tillers (at the 2 ed season) return back to their flowering behavior. Seed setting did not occurred.

Evaluation of morphological and technological characteristics:

Data recorded in table (3&4) indicated that the effect of varieties , nitrogen fertilization levels and their interaction for studied characters along the two growing seasons have been as follows: Stem weight: Significant effect due to varieties and nitrogen fertilization levels were indicated where the highest mean (6.00 gm) was encountered for somaclolnes G37-85 and the lowest one (1.4 gm) for F153. The nitrogen level (N_4) showed the heighest mean, but (N_1) showed the lowest one, the season effect was significant, where the mean at second season was higher than that of the plant crop season: (LSD: Var. 0. 126). Number of Internodes: The effect of varieties, nitrogen fertilizer levels and growing season showed significant values, where somaclones GT54- C9 and N_4 at the first ratoon season (18.8) showed highest values, the variety F153 and level N_1 at first ratoon season recorded (12.2) the lowest value..LSD 0.05 (Var 0.0566. N 0.551 and 40.807). Stem diameter: No significant effect was obtained for the three studied factors. (LSD: Var. 0. 126). Weight of fresh leaves: Significant effect of varieties, nitrogen fertilization levels, and growing seasons was observed for this character as the mean of somaclones of GT54- C9 showed the highest mean (108.25) while that of variety F153 showed the lowest mean (36.19) value. Concerning the nitrogen fertilizers, N_3, N_4 and N_5 have the same effect as the highest levels N_1 has shown the lowest value. The 2^{nd} growing season was highly significant than 1^{st} season. LSD 005(Var: 2.76, N: 2.24 and Y 13.8). Nitrogen fertilization: variation of tsted genotypes are cleared prominence as their response to N2 highest mean value. There is gradual increase of all tested characters for all testes varieties by increasing the nitrogen fertilization level except in GT 54-9 and somaclones regarding plant crop.

Table (4): Effect of nitrogen fertilizer levels on the means of sugarcane technological characters:

Varieties	Tech. character	TSS %		Sucrose %		Juice weight (gm)		Chlorophyll	
	Nitrogen levels	plant crop	first ratoon	plant crop	first ratoon	plant crop	first ratoon	plant crop	first ratoon
F153	N1	17.30	20.60	14.70	13.90	700.00	1266.60	37.10	38.83
	N2	20.30	21.00	15.30	16.00	1100.00	1266.60	33.50	40.70
	N3	20.60	20.00	16.00	15.80	657.00	1300.00	32.30	42.00
	N4	22.00	21.00	15.80	18.20	966.60	1600.00	30.33	35.90
	N5	21.30	21.30	16.50	17.50	566.60	1400.00	32.90	34.90
G37-85	N1	19.00	20.60	17.30	12.90	566.96	1300.00	31.17	35.30
	N2	20.00	19.60	14.10	15.20	516.60	1333.30	29.70	30.60
	N3	19.60	20.00	15.70	15.60	6000.00	1533.30	27.20	31.40
	N4	20.30	20.60	17.90	17.60	766.60	1500.00	25.07	31.40
	N5	21.00	18.30	15.20	16.70	1000.00	1233.30	24.27	31.40
GT54-9	N1	18.60	20.60	12.90	13.40	1066.60	1166.60	28.47	34.20
	N2	21.00	20.30	13.80	16.60	1200.00	1166.60	25.23	37.07
	N3	21.00	20.00	15.20	19.20	933.30	1766.60	26.80	33.90
	N4	20.00	20.60	15.20	17.90	850.00	1733.30	34.50	33.10
	N5	20.30	21.00	14.80	17.50	1183.30	1400.00	29.40	36.50
SGT54-9	N1	20.60	20.00	12.20	10.80	833.30	1233.30	29.10	37.80
	N2	19.60	20.20	14.90	16.30	750.00	1933.30	27.90	35.40
	N3	19.60	21.00	14.60	15.60	833.30	2200.00	26.90	35.20
	N4	21.30	21.00	16.00	18.20	616.60	2133.30	32.40	36.80
	N5	21.30	21.30	15.40	16.90	883.30	1533.30	31.80	34.70

Plant height: No significant effect due to varieties, more nitrogen fertilization level was occurred; only the effect growing season indicated that the effect of plant crop was more significant than the first ratoon season. LSD.0.05 (y: 0.28).

Weight of fresh leaves: The varieties, nitrogen fertilization level and growing season have show significant effects where somaclone GT54-C9, (N_3; N_4 and N_5) and the second season recorded the highest values, where as the lowest values have been shown for the Var. F153, level N_1 and the plant crop season . LSD. 0.05 (var 2.76, N_2 74, Y.13.8).

Weight of dry leaves: Significant effect was obtained for varieties , nitrogen fertilization levels and growing seasons where the highest values were the G 37- 85, GT-C9 and somaclones of C9 , (N_3 ,N_4, N_5) and first ratoon season of growing while the lowest values were Var: 1.546, Y: 3.97.

Juice weight: Signification effect for nitrogen fertilizer levels and growing season was reported for this characters : where the highest values were recorded for somaclones GT54- C9 , N_3,N_4 nitrogen levels and the first ratoon season , while no significant effect between varieties LSD.0.05 was observed.

Total soluble solids (TSS): The somaclones GT54-C9 showed, significantly, the highest mean (1806.64) for this character and the variety F153 showed the lowest mean (798.04).Significant effect for nitrogen fertilizer levels was shown, where the levels N_4 and N_5 resulted in the level N_1 level results the lowest mean. The mean of TSS at first ratoon season was significant higher than that of the plant crop season. (LSD.0.05 Var: 0.33; N: 0.124).

Sucrose %: The effect of varieties, nitrogen fertilizer levels and growing season were found to be significant as following: the highest mean in sucrose (16.38%) was for variety F153 and lowest mean (14.80%) was recorded for somaclones GT54 – C9. The N_5 presented the highest effect while the N_1 was the lowest. The plant crop season was significantly higher than the first ratoon season. LSD. 0.05 Var: 0.245, N: 0.311, Year.

Chlorophyll: Significant effect for varieties, and growing seasons was reported and no effect has been noticed for chlorophyll (38.47) content of nitrogen fertilizer levels. The variety F153 indicated the highest mean of chlorophyll content and G37- 85 was the lowest one (33.28). In the first ratoon season, the mean of chlorophyll was higher than that of plant crop season.

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تأثير التسميد الأزوتى وتقنيات زراعة الأنسجة على الأزهار وعقد البذور والصفات المورفولوجية والتكنولوجية في ثلاثة أصناف من قصب السكر

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الملخص العربى

يهدف البحث الى تحديد انسب مستوى للتسميد الآزوتي اللازم للأزهار وعقد الثمار من جهة والصفات المورفولوجية والتكنولوجية لثلاثة أصناف من قصب السكر من جهه أخرى- حيث أجريت هذه الدراسة على ثلاث أصناف كشتلات منتجة بطريقة الإكثار السريع Micropropagation وهى GT_{54}- C_9, G_{37}- 85, F_{153} الإضافة إلى السلالات الناتجة عن زراعة الأنسجة للصنف GT_{54}- C_9 (و كانت جميع الشتلات فى نفس العمر).وقد تمت الزراعة فى قطع عشوائية تحت نظام التسميد الآزوتي على خمس مستويات صفر ، ٧٠ كجم ، ١٤٠ كجم، ٢١٠ كجم و ٢٨٠ كجم فى صورة نترات الأمونيوم.

وقد أظهرت النتائج انه لا يوجد تأثير للمستوى الآزوتي على الأزهار وعقد الثمار فى جميع الأصناف تحت الدراسة و ذلك فى موسم الزراعة الأول غرس(٢٠٠٢/٢٠٠٣) كما أن عمليتي الأزهار وعقد الثمارقدتمت فى فترة زمنية قصيرة.

ويعزى ذلك إلى طريقة الزراعة بالشتلات بطريقتي زراعة الأنسجة والإكثار السريع ويطلق على هذه النباتات بصفة عامة Vitroplant و فى هذة الطريقة نجد تأثير ما يعرف بظاهرة tube effect و ذلك فى فصل النمو الأول أما فى فصل النمو الثاني خلفة أولى (٢٠٠٣/٢٠٠٤) فلا تأثير لهذة الظاهرة.

كما أظهرت النتائج تأثر كل الصفات المورفولوجية والتكنولوجية فى جميع الأصناف والسلالات المنزرعة بمستوى التسميد الآزوتي فيما عدا سمك الساق ،كما أن موسم النمو (غرس او خلفة أولى)كان ذا تأثير معنوي على هذه الصفات مع جميع مستويات التسميد والأصناف والسلالات المنزرعة بينما لوحظ اختلافات معنوية عند التفاعل بين الأصناف ومستويات التسميد وموسم النمو.

Table (1): Physical and properties of the experimental soil. (Surface layer of 6-30 cm).

Soil PH	E.C. mmhos	Physical raje distribution					Chemical properties								Total N %	Organic matter %
		Clay %	Salt %	Sand %	CaCo3	Texture grade	Soluble cations me/L Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Anions CO_3^{-2}	HCO_3^{-}	Cl^{-1}	SO_4^{-2}		
7.9	4.60	42.3	39.9	12.8	6.7	Clay loam	17.19	11.61	13.81	1.47	--	2.13	27.39	13.19	0.08	1.53

Table (2): Effect of nitrogen fertilization level (s) on flowering seed setting for *In vitro* plant varieties and soma clones in the plant crop (2001&2002).

Varieties	Flowering dates and stages					Nitrogen fertilizer level(s) producing seed setting
	Initiation M-W	Develop M-W	Tip M-W	Flag M-W	Full M-W	
F153	J-1	J-4	F-3	F-4	Mar- 2	N5
G37-85	D-3	J-2	J-3	J-4	F-2	N1,N2,N4,N5
GT54-C9	J-1	J-4	F-1	F-2	Mar-1	N1,N5
Somaclones of GT 54-C9	D-4	J-3	J-4	F-1	F-3	N1,N5

M:Month W:week J:January D:December
F:February Mar:March N:Nitrogen fertilization levels.

Table (3): Effect of different nitrogen fertilization levels on the means of varied tested characters of four tested genotypes.

Varieties	Nitrogen levels	Plant wt. Kg		Stem wt. Kg		No. of Nodes		Stem diameter cm		Wt. of fresh leaves		Wt. of dry leaves		Leaves area		Length in cm	
		plant crop	first ratoon	plant crop	first ratoon	plant crop	first ratoon	plant crop	first ratoon	plant crop	first ratoon	plant crop	first ratoon	plant crop	first ratoon	plant crop	first ratoon
f153	N1	2.50	4.20	1.40	3.10	15.00	12.20	2.30	2.10	28.93	36.88	10.53	14.39	0.39	0.39	152.00	218.40
	N2	3.30	6.30	1.80	4.70	15.30	20.00	1.80	2.10	36.45	42.28	13.13	23.87	0.97	0.97	157.90	201.60
	N3	3.30	6.30	1.90	4.90	16.30	20.20	2.20	2.10	37.14	46.88	9.96	31.40	0.72	0.72	147.80	128.50
	N4	3.30	7.07	1.90	5.90	16.30	19.40	2.30	2.20	39.60	52.67	13.45	39.57	0.65	0.65	151.00	205.20
	N5	2.10	6.60	1.80	4.50	15.60	16.50	2.00	2.20	38.82	63.96	6.53	36.23	0.72	0.73	148.70	175.60
G37-85	N1	2.30	4.60	1.40	3.00	16.60	13.60	2.00	2.20	24.69	35.76	8.46	16.87	0.62	0.63	147.00	177.30
	N2	3.60	5.40	1.80	4.30	13.30	16.00	2.00	2.20	38.14	79.90	8.02	38.07	0.65	0.65	152.30	179.70
	N3	2.90	6.90	1.80	4.90	14.00	16.50	2.20	2.20	44.72	113.85	9.22	53.67	0.61	0.61	151.30	156.00
	N4	3.20	6.80	1.90	5.80	16.60	17.50	2.00	2.10	44.95	99.23	11.21	45.80	0.57	0.56	157.20	156.00
	N5	3.10	5.40	1.90	4.00	12.60	18.80	2.00	2.00	48.01	86.39	10.51	53.33	0.65	0.63	153.20	147.47
GT54-9	N1	2.70	4.80	1.40	4.00	13.60	14.10	2.20	2.40	26.89	58.67	14.04	39.40	0.60	0.54	152.10	199.90
	N2	3.40	7.20	1.70	4.90	12.60	17.20	2.30	2.20	35.86	100.92	10.16	24.37	0.64	0.61	146.70	188.90
	N3	3.80	7.30	2.00	5.60	13.60	19.50	2.20	2.40	41.57	121.83	8.49	46.37	0.87	0.86	150.20	211.00
	N4	2.50	6.40	2.00	5.40	15.00	18.50	2.40	2.20	45.93	122.60	7.69	48.07	0.70	0.70	156.80	143.60
	N5	2.70	4.50	2.00	3.30	19.00	20.80	2.30	2.30	43.33	136.24	10.42	52.53	0.88	0.88	149.50	197.20
SGT54-9	N1	3.00	5.03	1.40	4.03	13.60	15.00	2.30	2.50	26.36	61.80	11.03	18.67	0.65	0.65	160.90	202.10
	N2	2.60	5.50	1.80	4.40	15.00	18.50	2.30	2.20	34.48	112.13	11.70	45.00	0.81	0.81	158.40	183.20
	N3	2.70	6.90	1.90	6.00	16.00	19.60	2.30	2.30	46.02	115.63	12.89	45.77	0.87	0.87	161.90	181.20
	N4	2.10	6.50	2.00	5.50	18.00	21.20	2.50	2.30	42.57	123.75	9.03	53.10	0.80	0.77	158.10	208.40
	N5	3.20	6.50	2.20	5.07	14.60	21.40	2.20	2.50	48.15	127.93	9.92	48.45	0.84	0.68	157.20	204.10