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EFFECT OF VARIETIES PLANTING DENSTIES AND NITROGEN FERTILIZATION LEVELS ON YIELD AND YIELD COMPONENTS OF SUGAR CANE

BY

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ABSTRACT

Two field trials were conducted at Shandaweel Research Station, Souhag Governorate for two successive seasons 1993/94 and 1994/95, to investigate the influence of planting system [one and half drills of three budded sugar cane cuttings (37800 buds/fed), double drills (50400 buds/fed)] and nitrogen fertilization levels (150, 190 and 230 kg N/fed) on yield and quality of the two sugar cane varieties (F 153, Giza 74-961).

A split plot design with 4 replications was used in this study where varieties were allocated in the main plots and six treatments of the combination between planting densities and N fertilization levels were random distributed at in the sub plot.

The obtained results showed that F-153 sugar cane variety tend to produced higher number of millable cane than G. 74-96 variety in the two growing seasons, without significant differences. Also, results indicated that F-153 sugar cane variety outyielded G. 74-96 variety in cane yield as well as sugar yield tons/fed with significant differences in the second season.

Planting density slightly and insignificantly affected the number of millable cane, cane yield and sugar yield per feddan in the two seasons. However, slight increase was produced by growing double drills compared with 1-5 drill.

Concerning the effect of N fertilization levels on number of millable cane, cane yield and sugar yield (tons/fed) were not significantly affected in the two seasons respectively. The increase in N levels from 150 to 190 and up to 230 kg /fed increased cane yield by 10.66 % and 5.25 %, in the first seasons, corresponding to 1.57 and 0.66 % in the second season. However, the highest sugar yield (7.238 tons/fed), was obtained by the application of 190 kg N/fed in the first season. Whereas the application of 230 kg N/fed recorded the highest sugar yield (7.077 tons/fed)in the second season.

INTRODUCTION

Sugar cane is considered the *main sugar crop* in Egypt where the amount of sugar extracted from it reached 1.050 million tons, contributing for 93 % of the

total sugar production (1.125 million tons). Planting the superior new sugar cane varieties will increase the output of land area and in turn increase the national income. Planting density plays an important role in the amount of intercepted solar radiation and transpiration of crop canopies which in turn effect the photosynthesis processes. This well enhance the dry matter producing and the extracted sugar by sugar cane plant. Although nitrogen contents is only a fraction of one percent of to total dry weight of mature sugar cane plants, it plays a role as important as that of carbon, hydrogen and oxygen which together from more than 90 percent of dry matter content. Many investigations provided an evidence of close relationship between the applied doses of nitrogen fertilization and growth, as well as yield and quality characters of sugar cane. The main target of the presented study is to find out the optimal planting density and N fertilization levels for tow new promising varieties, of sugar cane namely (F-153 and G. 74-96) for producing the highest yield and the best quality. Sainni and Singh (1982) found that the highest cane yield (84.5 t/ha) was obtained with 150 kg N/ha. However, Patel and Joshi (1987) showed that with adding nitrogen at 100, 200, 300 and 400 kg/ha, the highest cane yield was recorded at 100 and 200 kg/ha. Bharad *et al.* (1991) revealed that application of nitrogen (100, 200 and 300 kg N/ha) gave average cane yields of 72.9, 74.9 and 76.1 t/ha, respectively. Abd EL-Gawad *et al.* (1992 c) showed that the application of nitrogen at 240 kg/fed gave the highest net cane yield and sugar yield. Abd EL-Hadi *et al.* (1994) found that application of nitrogen fertilization at rates of 150, 175 and 200 kg N/fed gave significant increase in sugar yield.

Usman (1989) reported that sugar yield increased by increasing plant density when he grew sugar cane at 24-34 cuttings 17.5. Muragama *et al.* (1990) observed that sugar yield was not significantly affected by planting sugar cane at 100 cm row spacing instead of 75 cm. Ahmed (1995) found that both cane and sugar yields were not significantly affected by planting system (double or 1.5 drills).

MATERIALS AND METHODS

Two field experiments were conducted in Shandaweel Research Station (Souhag Governorate) in two successive seasons 1993/94 and 1994/95, in order to investigate the influence of planting system [one and half drills of three budded sugar cane cuttings (37800 buds/fed), double drills (50400 buds/fed)] and nitrogen fertilization levels (150, 190 and 230 kg N/fed) on cane and sugar yields of two sugar cane varieties (F 153 and Giza 74-961).

Nitrogen fertilization was given in from of urea (46 % N) at two equal doses, the first at full germination stage and the second one was applied a month later. Normal agronomic practices for sugar cane plants were applied properly.

Split plot design was used in this study with four replications. The tested varieties were allocated randomly in the main plots and the six treatments of the combinations between the two planting densities and the three levels N fertilization levels were distributed at random in the sub plot. The experimental

unit area was 35 m^2 (1/120 fed), with five ridges of 7 meters length and one meter a part. Planting date was in the first week of April in the two growing seasons and harvesting date was after a year in the first week of April.

At harvest, yield of three guarded rows were taken to determine cane yield and the actual sugar yield per feddan was calculated according to the following equation:

Row sugar production = Cane yield in tons/fed X Recovery %.

The collected data were subjected to proper statistical analysis of split-plot design according to the procedure outlined by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1- Number of millable cane:

Number of millable cane at harvest is the corne stone in respect of cane yield. Results in Table (1) show the effect of variety, planting density, nitrogen fertilization levels and their interaction on number of millable cane per feddan in the two growing seasons.

Results showed that F-153 sugar cane variety produced higher number of millable cane/fed in both seasons compared with G. 74-96 variety. The increase in number of millable cane produced by F-153 variety over that of G. 74-96 was 4.35 and 2.38 % in the first and second seasons, respectively. Such obtained increases were, however, below the level of significance. The superiority of F-153 variety over G. 74-96 variety due to its unique genetical make up and its higher tillerage capacity. The present results are in agreement with those reported by Ahmed (1995) who found that G. 74-96 was superior in this studied trait compared with G. 85-37 and G. T. 54-9 cultivars.

Results also showed that using double drill surpassed 1.5 drill in number of millable cane/fed in both seasons (Table 1). Growing 2 drills increased number of millable cane by 3.57 and 6.43 % compared with growing 1.5 drill in the first and second seasons, respectively. However, the analysis of variance of the present data showed that such differences were below the level of significance. Present results are in accordance with those obtained by Ahmed (1995) who mentioned that planting double drills increased number of millable cane. The increase in number of millable cane by growing double drill is more likely due to ensuring more number of buds to grow and producing more plants and consequently more millable cane at harvest. Similar results were also reported by Usman (1989) who grew sugar cane at 24-34 cuttings/7.5 m row.

Concerning the effect of N fertilization levels, results in Table (1) indicated that no significant effect was obtained on number of millable cane in both seasons in spit of the observed differences among the applied N levels. It was noticed that in both seasons, the highest number of millable cane was at the medium N level of 190 kg N/fed. Results cleared that increasing N levels from 150 to 190 kg /fed insignificantly increased number of millable cane / fed at

harvest by 8 .58 and 12.26 % in the first and second seasons, respectively. Also, increasing N level from 150 to 230 kg N/fed induced an increase of 7.62 and 6.31 % in number of millable cane/fed in the first and second seasons, respectively. The analysis of variance of the data showed that those increases were, however, below the level of significance these results are in agreement with those reported by Ahmed (1995) who found that applying N at 150, 180, 210 and 240 kg N/fed had no significant effect on number of millable cane.

Table (1): Effect of plant density and nitrogen fertilization levels on number of millable cane per feddan of two sugar cane varieties at harvest during 1993/94 and 1994/95 seasons.

Character		Number of millable cane/fed at harvest			
Seasons		1993/94			
Varieties	N-levels kg/fed Plant density	150	190	230	Mean
G. 74-96	1.5 drill	50280	55940	55940	53530
	2.0 drill	56280	49580	61880	55910
Mean		53280	51980	58910	54720
F-153	1.5 drill	51420	60400	57180	56330
	2.0 drill	54220	66040	53360	57870
Mean		52820	63220	55270	57100
P X N	1.5 drill	50820	57390	56560	54930
	2.0 drill	55250	57810	57620	56890
G. Mean		53050	57600	57090	55910
		1994/95			
G. 74-96	2.0 drill	53140	49980	56560	53220
	1.5 drill	58560	67700	62560	62940
Mean		53280	58840	59560	58050
F-153	1.5 drill	55120	66560	60280	60650
	2.0 drill	54560	64280	55980	58270
Mean		52820	65420	58130	59460
P X N	1.5 drill	54130	58270	58420	56940
	2.0 drill	56560	65990	59270	60600
G. Mean		53050	62130	58840	58770

L.S.D. at 5 % level: Differences did not reach the level of significance for the other factors or their interaction

Results in Table (1) showed that the interaction effect between all of the studied factors on number of millable cane/fed at harvest were not significant in the two growing seasons. These results indicated that each experimental factors acted independently on its effect on this studied trait.

In general, the highest number of millable cane in the first season was 66040 which was produced by growing F-153 sugar cane variety using double drills and applying 190 kg N/fed. However, it was observed in second season that

G. 74-96 variety recorded the maximum number of millable cane/fed of 67700 when it was grown by double drills and supplied with 190 kg N/fed.

2- Cane yield (tons/fed):

Yield of sugar cane stalks is considered the most economical part of sugar cane plants since it is the final expression for the interaction effect of the genetical make up of the cultivated sugar cane varieties and the environmental factors.

Data presented in Table (2) indicated that the effects of variety, planting density, nitrogen fertilizer level and their interactions on cane yield in the two seasons. Results showed that F-153 variety outyielded G. 74-96 with a significant differences in the second season. The increase in sugar cane yield recorded for F-153 over G. 74-96 was slightly higher by 0.14 % in the first season which was insignificant. Whereas, a marked significant increase of 16.03 % was recorded in the second season. The superiority of F-153 variety was mainly due to its better performance in many characters as number of stalks/m after 105 and 195 days, stalk height, purity %, recovery % and number of millable cane/fed consequently, a higher cane yield of F-153 is expected. Results indicated clearly the important role of growing a variety having a high yielding capacity. The results here are in agreement with those obtained by Ahmed (1995) who found that cane yield of G. 83-37 variety was superior as compared with G.T. 54-9 and G. 74-96.

Concerning the effect of plant density, results in Table (2) showed that growing double drills outyielded 1.5 drill in both seasons, but the differences were not enough to reach the level of significance. Data showed that double drills increased cane yield by 2.96 and 5.99 % in the first and second seasons, respectively over 1.5 drills planting. The increase in cane yield due to growing double drills is mainly due to the increase in number of stalks/m, TSS % after 210 days, N content in leaves after 150 days as well as number of millable cane/fed compared with growing 1.5 drills. The present results agree with those obtained by Yadav (1993) who found that planting sugar cane by double rows produced higher cane yield.

The effect of N fertilizer levels on cane yield was not significant in spit of the marked differences that recorded in both seasons (Table 2). The increase in N levels from 150 to 190 and 230 kg N/fed insignificantly increased cane yield by 10.60 and 5.25 %, respectively in the first season, corresponding to 1.57 and 0.66 % in the second season. The increase in cane yield due to increasing N levels were not that great to reach the level of significance. It is clear that the highest cane yield was recorded at the medium N level of 190 kg N/fed. This level produced the great increase in cane yield particularly in the first season (10.60 %). The effect of N on cane yield is expected as a result of its encouraging effect on number of stalks/m, stalk height, N % content in leaves, fiber % and number of millable cane/fed. The obtained results in the present study are in agreement with those recorded by Abd EL-Latif *et al.* (1993) and Abd EL-Hadi *et al.* (1994).

Results in Table (2) indicated that all interaction effects among all of the studied experimental factors on sugar cane yield were not significant in the two seasons.

Table (2): Effect of plant density and nitrogen fertilization levels on cane yield (tons/fed) of two sugar cane varieties at harvest during 1993/94 and 1994/95 seasons.

Character		Cane yield (tons/fed)			
Seasons		1993/94			
Varieties	N-levels kg/fed Plant density	150	190	230	Mean
G. 74-96	1.5 drill	52.320	57.140	48.855	52.765
	2.0 drill	49.910	53.855	57.405	53.723
Mean		51.115	55.487	53.130	53.244
F-153	1.5 drill	46.020	56.250	54.465	52.245
	2.0 drill	54.182	56.655	52.335	54.391
Mean		50.101	54.452	53.400	53.318
P X N	1.5 drill	49.170	56.685	51.660	52.505
	2.0 drill	52.046	55.255	54.870	54.057
G. Mean		50.608	55.970	53.265	53.281
L.S.D. at 5 %		NS			
		1994/95			
G. 74-96	1.5 drill	52.201	56.002	48.500	52.241
	2.0 drill	51.201	51.200	60.700	54.420
Mean		51.730	53.630	54.630	53.330
F-153	1.5 drill	59.600	60.900	57.300	59.620
	2.0 drill	65.601	63.101	63.600	64.151
Mean		62.630	60.530	60.500	61.880
P X N	1.5 drill	55.901	56.960	52.931	55.930
	2.0 drill	58.461	57.200	62.200	59.281
G. Mean		57.180	58.080	57.560	57.610
L.S.D. at 5 %		4.723			

L.S.D. at 5 % level: Varieties (V): Differences did not reach the level of significance for the other factors or their interaction accepted varieties in the second season.

3- Sugar yield (tons/fed):

The effect of variety, plant density, nitrogen fertilizer and their interactions on sugar yield (tons/fed) in the two seasons are presented In Table (3). Data indicated that F-153 variety significantly outyielded G. 74-96 variety in the second season. In such season significant increase of 28.19 % in sugar yield was recorded by F-153 over G. 74-96 varieties. However, no significant difference was detected between those varieties in the first season with even a very slight reduction of 2.08 % was observed in sugar yield by F-153 variety. The superiority of cane yield produced by F-153 in the second season led to its

superiority in sugar yield. Similar results were obtained by Ahmed (1995) who indicated that G. 85-37 variety produced higher sugar yield than G.T. 54-9 and G. 74-96, but without significant differences.

Planting density slightly affected sugar yield in the two seasons with no significant difference. A slight increase was produced by growing double drills compared with 1.5 drill. Double drills produced an increase of 3.19 and 3.34 % in sugar yield in the first and second seasons, respectively compared with growing 1.5 drill. Similar results were also obtained by Murayama *et al.* (1990) and Ahmed (1995).

Table (3): Effect of plant density and nitrogen fertilization levels on sugar yield (tons/fed) of two sugar cane varieties at harvest during 1993/94 and 1994/95 seasons.

Character		Sugar yield (tons/fed)			
Seasons		1993/94			
Varieties	N-levels kg/fed Plant density	150	190	230	Mean
G. 74-96	1.5 drill	6.065	7.690	6.430	6.728
	2.0 drill	5.640	6.980	7.540	6.722
Mean		5.855	7.335	6.850	6.725
F-153	1.5 drill	5.810	6.840	6.480	6.376
	2.0 drill	6.125	7.445	6.830	6.800
Mean		5.967	7.142	6.655	6.588
P X N	1.5 drill	5.937	7.265	6.455	6.552
	2.0 drill	5.885	7.212	7.185	6.761
G. Mean		5.911	7.238	6.820	6.656
L.S.D. at 5 %		NS			
		1993/94			
G. 74-96	1.5 drill	6.460	5.356	5.605	5.803
	2.0 drill	6.170	5.060	7.100	6.110
Mean		6.315	5.202	6.352	5.956
F-153	1.5 drill	6.780	7.805	8.110	7.565
	2.0 drill	8.060	7.560	7.495	7.705
Mean		7.420	7.682	7.802	7.635
P X N	1.5 drill	6.620	6.575	6.857	6.684
	2.0 drill	7.115	6.310	7.297	6.907
G. Mean		6.867	6.442	7.077	6.795
L.S.D. at 5 %		0.685			

L.S.D. at 5 % level: Varieties (V) Differences did not reach the level of significance for the other factors or their interaction accepted varieties in the second season.

The effect of N fertilization levels on sugar yield was not significant in the two seasons. Results in Table (3) showed some slight variations in the second

season than that of the first one. The higher sugar yield was obtained by the application of 190 kg N/fed in the first season (7.238 t/fed), but the 230 kg N/fed recorded the highest sugar yield in the second season (7.077 t/fed). Results reported by Abd EL-Gawad *et al.* (1992 c), Abd EL-Latif *et al.* (1993) and Abd EL-Hadi *et al.* (1994) indicated pronounced effect of N levels on sugar yield.

The results in Table (3) clearly showed that each of the applied experimental factor acted independently in influencing sugar yield where no significant effects for all of the studied interactions were detected.

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الكثافة النباتية والتسميد النيتروجيني وأثرهما على المحصول في بعض أصناف قصب السكر

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أقيمت تجربتان حقليتان بمحطة بحوث شندويل بمحافظة سوهاج بمصر العليا في موسمي ١٩٩٣/٩٤ ، ١٩٩٤/٩٥ لدراسة تأثير الكثافة النباتية ومستوى السماد النيتروجيني على محصول صنفين من قصب السكر هما ف – ١٥٣ و جيزة ٧٤-٩٦. وإشتملت الكثافة النباتية على معاملتين هما (زراعة صف ونصف من عقل قصب السكر تحتوى على ٣ براعم (٣٧٨٠٠ برعم/فدان) ، زراعة صفين من عقل قصب السكر تحتوى على ٣ براعم (٥٠٤٠٠ برعم/فدان)). وأضيفت ٣ مستويات للسماد النيتروجيني هى (١٥٠ ، ١٩٠ ، ٢٣٠ كجم نيتروجين/فدان). وقد أستخدم تصميم القطع المنشقة مرة واحدة في ٤ مكررات حيث وزعت الأصناف على القطع الرئيسية ووزعت الـ ٦ معاملات الخاصة بالتوافقات بين الكثافة النباتية ومستويات السماد النيتروجيني عشوائيا على القطع الشقية. كانت مساحة القطعة الشقية ٣٥ م^2. كان تاريخ الزراعة والحصاد الأسبوع الأول من أبريل في كلا الموسمين. وتتلخص أهم النتائج المتحصل عليها فيما يلي:

١-أعطى الصنف ف-١٥٣ زيادة غير معنوية في عدد الميدان القابلة للعصير/فدان مقارنة بالصنف جيزة ٧٤-٩٦ في كلا الموسمين.

٢-تفوق الصنف ف -١٥٣ معنويا على الصنف جيزة ٧٤-٩٦ في محصول القصب بنسبة ١٦,٠٣ % في الموسم الأول وكانت الزيادة غير معنوية في الموسم الثانى حيث بلغت ٠,١٤ %. وأيضا تفوق الصنف ف -١٥٣ معنويا على الصنف جيزة ٧٤-٩٦ في محصول السكر/فدان بنسبة زيادة قدرها ٢٨,١٩ % في الموسم الثانى بينما كانت الفروق غير معنوية في الموسم الأول.

٣-أدت زراعة صفين من العقل إلى زيادة غير معنوية في عدد السيقان القابلة للعصير بنسبة ٣,٥٧ ، ٦,٤٣ % مقارنة بزراعة صف ونصف من العقل في الموسم الأول والثانى على التوالى. كما أدت زراعة صفين من العقل إلى زيادة غير معنوية في محصول الميدان والسكر حيث بلغت نسبة الزيادة في محصول السكر ٣,١٩ ، ٣,٣٤ % في الموسم الأول والثانى على التوالى.

٤-أدت زيادة مستويات السماد النيتروجيني إلى زيادة غير معنوية في عدد السيقان القابلة للعصير للفدان في كلا الموسمين. وتم الحصول على أكبر عدد للسيقان القابلة للعصير للفدان باضافة ١٩٠ كجم نيتروجين/فدان.

٥-أدى زيادة مستوى السماد النيتروجيني من ١٥٠ إلى ١٩٠ كجم نيتروجين/فدان إلى زيادة غير معنوية في محصول الميدان بلغت ١٠,٦ ، ١,٥٧ % في الموسم الأول والثانى على التوالى. وبزيادة مستوى السماد النيتروجيني من ١٥٠ إلى ٢٣٠ كجم نيتروجين/فدان تسبب في زيادة محصول الميدان بنسبة ٥,٢٥ ، ٠,٦٦ % في الموسم الأول والثانى على التوالى.

٦-أوضحت النتائج عدم وجود تأثير معنوى لمستويات التسميد النيتروجينى على محصول السكر فى كلا الموسمين. وتم الحصول على أعلى محصول سكر بإضافة ١٩٠ كجم نيتروجين/فدان فى الموسم الأول (٧,٢٣٨ طن/فدان) وبإضافة ٢٣٠ كجم نيتروجين/فدان فىالموسم الثانى (٧,٠٧٧ طن/فدان).