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OPTIMAL SEED RATE FOR SOME PROMISING SUGARCANE VARIETIES

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Abstract

The present study was carried out at El-Mattana Agricultural Research Station, Qena Governorate, Upper Egypt in 2000/2001 and 2001/2002 growing seasons to evaluate four sugarcane varieties (three promising ones viz. F.160, Ph.8013 and G.85-37 and the commercial variety G.T.54-9) grown at two seed rates of 12600 and 16800 cuttings of 3-budded cane cuttings, i.e., 37800 and 50400 buds/fed, respectively, to obtain maximum cane and sugar yields. A split-plot experimental design with three replications was used in this work, where the main plots were assigned for sugarcane varieties while the seed rates were distributed in the sub-plots.

The results indicated that the tested sugarcane varieties significantly differed in stalk diameter and sucrose percentage (in both seasons) as well as stalk height and number of millable cane/m^2 (in the 2^{nd} season). However, no statistical variances were detected among varieties in juice purity percentage, cane and sugar yields/fed in both seasons.

Planting sugarcane using 16800 cane setts/fed two drills attained significantly higher number of millable stalks/m^2, cane and sugar yields compared with 12600 cuttings/fed in both seasons. Higher values of stalk height, number of millable cane/m^2 and purity percentage were significantly obtained by planting 2.0 drills in the 2^{nd} season. On the contrary, thicker stalks were produced in case of using 16800 cane setts/fed in both seasons.

The interaction between the studied factors had no marked effect on stalk diameter, number of millable cane/m^2 and sucrose percentage in both seasons. Meanwhile, stalk height and purity percentage were significantly affected by the interaction (in the 1^{st} season) as well as cane and sugar yields (in the 2^{nd} season).

INTRODUCTION

The commercial variety G.T.54-9 occupies most of the area planted with sugarcane in Egypt. Recently, Sugar Crops Research Institute has developed many promising varieties of sugarcane, among them F.160, Ph.8013 and G.85-37. It is well known that sugarcane varieties are completely different in their performance, quality and yields due to great variation in their gene structure. In addition, shoots emerged and mortality

percentages resulted from the competition among plants until they become millable canes are greatly influenced by seeding rate, affecting the subsequent crop cycle of sugarcane which occupies soil more than 4-5 growing seasons. Therefore, it is of great importance to investigate the optimal seed rate as well as the performance of such promising varieties of sugarcane to obtain the highest sugar yield. The results obtained by El-Shafai (1996) showed that planting cane with two rows of cane setts (50400 buds/fed) significantly increased stalk height compared with planting 1.5 rows (37800 buds/fed). On the contrary, he clarified that sugarcane plants grown by planting 1.5 rows markedly had thicker stalks than those planted by double rows. Planting density had no significant effect on sucrose and juice purity percentages. Moreover, he found that the increase in planting density (double rows) insignificantly increased the number of millable cane, cane yield and sugar yield/fed compared with those planted by 1.5 rows. Zahoor, *et al.* (1997) planted sugarcane cv. CP65/357 at a density of 30000, 40000 or 50000 sets/ha. They showed that sugar yield was highest with 40000 sets/ha, while juice quality (pol, purity and sugar content) was not affected by plant density. Cliandagave (1999) planted sugarcane at rates of 56250, 75000 or 112500 buds/ha. He found that cane and CCS [commercial cane sugar] yields were highest with the intermediate planting rate. Quality parameters did not differ significantly among treatments. Bull, *et al.* (2000) mentioned that the theory behind high density planting (HDP) is based on the fact that current crops intercept less than 60% of the light radiation available during the season. They added that HDP can significantly increase light interception in the period prior to canopy closure and can also make better use of available water and nutrient resources during this period suggesting that close rows have the potential to increase crop yield of cane per hectare. Avtar, *et al.* (2001) grew sugarcane cv. CoJ84 at seed rates of 50000 and 75000 three-budded seed sets/ha. They revealed that higher cane yield was obtained at a seed rate of 50000 three-budded setts/ha compared to 75000 three-budded setts/ha. Shahid, *et al.* (2001) studied the effect of different planting densities (100, 150, 200 and 250 thousand buds/ha) on yield of sugarcane cv. SPSG-394. Increasing planting rate gave higher cane yield.

Concerning varietal effect, Ahmed (1998) noticed significant differences in cane yield and its components, juice quality and sugar yield among the commercial variety G.T.54-9 and promising ones (G.85-37, G.84-47, G.75 368, G.87-55 and F.153). You-

sef, *et al.* (2000) observed that sugarcane varieties significantly differed in number of millable cane/m^2, millable cane length, millable cane diameter and cane yield. Mohamed and Ahmed (2002) obtained significant differences among the studied cane varieties in stalk height, diameter, number of millable cane, net cane and sugar yields.

MATERIALS AND METHODS

Two field experiments were conducted at El-Mattana Agricultural Research Station, Qena Governorate, Upper Egypt in 2000/2001 and 2001/2002 growing seasons to investigate the performance of four sugarcane varieties (three promising ones viz. F.160, Ph.8013 and G.85-37 in addition to the commercial variety G.T.54-9) grown at two seed rates of 1.5 and 2.0 rows of cane cuttings (12600 and 16800 of 3-budded cane cuttings, i.e., 37800 and 50400 buds/fed, respectively). Sugarcane varieties were planted on March 1st and harvested 12 months later in both seasons. A split-plot experimental design with three replications was used in this work, where the main plots were assigned for sugarcane varieties while seed rates were distributed in the sub-plots. Sub-plot area was 35 m^2 (comprised 5 ridges of 1 m apart and 7-m long). The other agricultural operations were practiced as recommended in the region.

Data recorded:

The following data were recorded at harvest:

1. Cane stalk height (cm), which was measured from land level up to the top visible dewlap.
2. Cane stalk diameter (cm), which was measured at the middle part of stalks.
3. Number of millable cane/m^2 was count.

A sample of 20 millable cane stalks from each treatment were collected immediately after harvest, cleaned and crushed to determine sucrose and purity percentages of cane juice as follows:

4. Sucrose percentage, which was determined using Saccharemeter according to A.O.A.C. (1995).
5. Purity percentage was calculated according to the following equation:

   Sucrose percentage/ Brix percentage x 100.

Where: Brix percentage (total soluble solids, TSS %) in juice, which was determined using Brix Hydrometer.

6. Cane yield (tons/fed). The millable cane of three guarded rows of all sub plots were harvested, topped, cleaned, weighed and cane yield (tons/fed) was determined.
7. Sugar yield (tons/fed) was estimated as follows:

   Sugar yield (tons/fed) = cane yield (tons/fed) x sugar recovery percentage.

   Where: sugar recovery percentage was determined according to the formula described by Yadav and Sharma (1980).

All the recorded data were statistically analyzed according to the method of Snedecor and Cochran (1981).

RESULTS AND DISCUSSION

1. Stalk height:

Results in Table (1) showed no significant differences in stalk length among the evaluated sugarcane varieties in the 1st season. However, an appreciable variation among cane varieties was detected in the 2nd season where the commercial sugarcane variety G.T.54-9 was superior to the three other varieties in stalk length while F.160 variety recorded the least value of this trait. The differences among cane could be due to the variation in their gene structure. This result is in agreement with those mentioned by Yousef, *et al.* (2000) and Mohamed and Ahmed (2002).

Table 1. Stalk height (cm) of the studied sugarcane varieties as affected by seed rate in 2000/2001 and 2001/2002 seasons.

Growing season	2000/2001					2001/2002				
Seed rate of	Sugarcane variety				Mean	Sugarcane variety				Mean
Cane cuttings/fed	G.T.54-9	F.160	Ph.8013	G.85-37		G.T.54-9	F.160	Ph.8013	G.85-37	
12600 (1.5 rows)	236.6	222.0	215.6	221.6	224.0	285.3	220.0	218.0	220.0	235.8
16800 (2.0 rows)	241.6	249.0	251.6	273.3	253.9	303.6	255.0	259.0	237.3	272.7
Mean	239.1	235.5	233.6	247.5	238.9	294.5	237.5	238.5	246.6	254.2
L.S.D. at 5% level for:										
Sugarcane varieties (A)					N.S			21.0		
Seed rate (B)					8.3			14.4		
(A) X (B)					16.7			N.S		

Results revealed that increasing seed rate from 12600 to 16800 cuttings/fed resulted in a significant increase in stalk height amounted to 29.9 and 36.9 cm in the 1st and 2nd season, respectively. The increase in plant height accompanying the increase in seed rate could be attributed to the fact that increasing planting material from 12600 to 16800 cuttings/fed (37800 to 50400 buds/fed, respectively) increased plant population density which led to an increase in competition among plants for solar radiation leading to the elongation of internodes and consequently taller plants. This result is in harmony with that reported by El-Shafai (1996) and El-Sogheir (1999) who found that higher planting density (double drills) resulted in longer cane stalks compared to 1.5 drills.

Stalk height was significantly affected by the interaction between cane variety and seed rate in the 1st season only. It was found that stalk height of G.T.54-9 variety was not affected by the used seed rates while the other three cane varieties showed taller stalks in case of the dense planting using 16800 cutting/fed.

2. Stalk diameter:

Data recorded in Table (2) pointed out that the tested sugarcane varieties were differed significantly in stalk diameter in the two growing seasons. Sugarcane variety F.160 was superior, while G.85-37 was inferior to the other three varieties in stalk diameter in both seasons. The variation among sugarcane varieties in stalk diameter may be controlled by their genetic structures. Similar results were reported by Mohamed and Ahmed (2002).

Table 2. Stalk diameter (cm) of the studied sugarcane varieties as affected by seed rate in 2000/2001 and 2001/2002 seasons.

Growing season	2000/2001					2001/2002				
Seed rate of Cane cuttings	Sugarcane variety				Mean	Sugarcane variety				Mean
	G.T.54-9	F.160	Ph.8013	G.85-37		G.T.54-9	F.160	Ph.8013	G.85-37	
12600 (1.5 rows)	2.83	3.03	2.90	2.86	2.90	2.83	3.06	2.96	2.93	2.95
16800 (2.0 rows)	2.83	2.96	2.86	2.76	2.85	2.86	2.93	2.83	2.70	2.83
Mean	2.83	3.00	2.88	2.81	2.88	2.85	3.00	2.90	281.00	2.89
L.S.D. at 5% level for:										
Sugarcane varieties (A)					0.10			0.05		
Seed rate (B)					0.03			0.05		
(A) X (B)					N.S			N.S		

Results in Table (2) revealed that planting cane with 12600 cane setts (37800 buds/fed) appreciably and positively influenced stalk diameter compared with planting 16800 cuttings/fed in both seasons. Thinner stalks observed in case of planting double drills is mainly due to the increase in plant population density leading in turn to increase competition among grown cane plants for light, water and nutrients. This result coincides with that mentioned by El-Shafai (1996).

No marked effect on stalk diameter was noticed due to the interaction among sugarcane varieties and seed rates in both seasons.

3. Number of millable cane/m^2:

Data illustrated in Table (3) showed that the studied varieties did not significantly differ in number of millable cane/m^2 in the 1st season. However, the differences in this trait reached the level of significance in the 2nd season where the highest number of millable cane/m^2 was equally produced by both of G.T.54-9 and G.85-37 varieties while the least value of this trait was recorded by F.160 variety.

Growing sugarcane using two rows (16800 cane cuttings/fed) attained markedly higher number of millable cane/m^2 compared with 1.5 rows (12600 setts/fed) in both seasons. This result is probably due to higher planting bud density (50400 buds/fed) in case of 2.0 rows as compared with 1.5 rows (37800 buds/fed).

No statistical difference was detected among all possible combinations studied in number of millable cane/m^2 in both seasons.

Table 3. number of millable cane/m^2 of the studied sugarcane varieties as affected by seed rate in 2000/2001 and 2001/2002 seasons.

Growing season	2000/2001					2001/2002				
Seed rate of Cane cuttings	Sugarcane variety				Mean	Sugarcane variety				Mean
	G.T.54-9	F.160	Ph.8013	G.85-37		G.T.54-9	F.160	Ph.8013	G.85-37	
12600 (1.5 rows)	13.2	12.9	14.3	13.7	13.5	13.6	10.0	12.4	13.9	12.4
16800 (2.0 rows)	14.6	14.6	14.9	16.3	15.1	15.9	15.1	15.0	15.8	15.4
Mean	13.9	13.7	14.6	15.0	14.3	14.8	12.5	13.7	14.8	13.9
L.S.D. at 5% level for:										
Sugarcane varieties (A)					N.S			0.4		
Seed rate (B)					0.45			0.7		
(A) X (B)					N.S			N.S		

4. Sucrose percentage:

Results in Table (4) revealed that the evaluated sugarcane varieties differed significantly in sucrose percentage in both seasons. Sugarcane variety G.85-37 surpassed the three other varieties and markedly recorded the highest sucrose percentage (18.00%) in the 1st season, while the commercial variety G.T.54-9 had the highest value of this trait (18.75%) in the 2nd one. Differences among sugarcane varieties in sucrose percentage could be attributed to their variable genetic structures. This result is in line with that obtained by Mohamed and Ahmed (2002).

The results clarified that planting sugarcane using 12600 or 16800 of cane cuttings had no significant influence on sucrose percentage in the 1st season. This result is in agreement with those found by Zahoor, *et al.* (1997) and Cliandagave (1999). However, higher sucrose percentage was significantly obtained in case of planting sugarcane using 2.0 rows compared with 1.5 rows of cane cuttings in the 2nd season.

The variety x seed rate interaction had no significant effect on sucrose percentage in the two seasons.

Table 4. sucrose percentage of the studied sugarcane varieties as affected by seed rate in 2000/2001 and 2001/2002 seasons.

Growing season	2000/2001					2001/2002				
Seed rate of	Sugarcane variety				Mean	Sugarcane variety				Mean
Cane cuttings	G.T.54-9	F.160	Ph.8013	G.85-37		G.T.54-9	F.160	Ph.8013	G.85-37	
12600 (1.5 rows)	16.52	16.32	17.53	17.81	17.05	18.23	17.06	15.80	16.77	16.96
16800 (2.0 rows)	16.02	16.67	18.14	18.19	17.25	19.27	17.49	16.32	17.10	17.54
Mean	16.27	16.49	17.84	18.00	17.15	18.75	17.27	16.06	16.94	17.25
L.S.D. at 5% level for:										
Sugarcane varieties (A)					0.60			1.08		
Seed rate (B)					N.S			0.45		
(A) X (B)					N.S			N.S		

5. Purity percentage:

Data illustrated in Table (5) revealed that differences in juice purity percentages among the tested sugarcane varieties were not significant in both seasons.

Results indicated that planting sugarcane using 12600 (1.5 rows) or 16800 (2.0 rows) of cane setts had no significant effect on purity percentage in the 1st season.

This result is in accordance with those reported by Zahoor, *et al.* (1997) and Cliandagave (1999). However, planting sugarcane using 2.0 drills recorded significantly higher purity percentage compared with 1.5 drills of cane cuttings in the 2nd season.

Purity percentage was appreciably affected by the interaction between the studied cane varieties and seed rates in the 1st season. Planting sugarcane variety G.T.54-9 using 12600 cane cuttings attained the maximum purity percentage (94.35%) while F.153 variety recorded the highest purity (92.43%) when it was planted with 16800 setts/fed. In the 2nd season, purity percentage was insignificantly affected by seeding rates.

Table 5. Purity percentage of the studied sugarcane varieties as affected by seed rate in 2000/2001 and 2001/2002 seasons.

Growing season	2000/2001					2001/2002				
Seed rate of Cane cuttings	Sugarcane variety				Mean	Sugarcane variety				Mean
	G.T.54-9	F.160	Ph.8013	G.85-37		G.T.54-9	F.160	Ph.8013	G.85-37	
12600 (1.5 rows)	94.35	89.77	85.56	87.06	89.18	83.31	90.00	89.00	88.50	87.70
16800 (2.0 rows)	90.75	92.43	85.72	82.37	87.81	87.50	93.00	90.00	91.00	90.37
Mean	92.55	91.10	85.64	84.72	88.50	85.40	91.50	89.50	89.75	89.03
L.S.D. at 5% level for:										
Sugarcane varieties (A)					N.S			N.S		
Seed rate (B)					N.S			0.78		
(A) X (B)					2.67			N.S		

6. Cane yield:

Data presented in Table (6) showed that sugarcane varieties did not differ significantly in cane yield in both seasons. This indicates that the new promising varieties are as good yielding as the cultivated one.

Planting sugarcane using 16800 cuttings/fed resulted in a significant increase in cane yield amounted to 2.334 tons/fed (5.27%) over 12600 in the 1st season, corresponding to 4.770 tons/fed in the 2nd one. These results are probably due to higher number of millable canes/m^2 harvested in case of two rows compared with 1.5 rows (Table 3) which could be attributed to higher planting bud density (50400 buds/fed) in the 1st case compared with the latter one (37800 buds/fed). This finding was explained by Bull, *et al.* (2000) who mentioned that dense population would increase light interception in the period prior to canopy closure and can also make better use of avail-

able water and nutrients during this period, suggesting that narrow rows have the potential to increase crop yield of cane per unit area. This result is also in agreement with that reported by Shahid, *et al.* (2001).

Table 6. Cane yield (tons/fed) of the studied sugarcane varieties as affected by seed rate in 2000/2001 and 2001/2002 seasons.

Growing season	2000/2001					2001/2002				
Seed rate of	Sugarcane variety				Mean	Sugarcane variety				Mean
Cane cuttings	G.T.54-9	F.160	Ph.8013	G.85-37		G.T.54-9	F.160	Ph.8013	G.85-37	
12600 (1.5 rows)	43.333	45.400	44.533	43.667	44.233	43.360	38.930	43.530	42.200	42.000
16800 (2.0 rows)	45.400	46.933	46.533	47.400	46.567	47.400	48.030	45.800	45.860	46.770
Mean	44.367	46.167	45.533	45.533	45.400	45.380	43.480	44.660	44.030	44.390
L.S.D. at 5% level for:										
Sugarcane varieties (A)					N.S					N.S
Seed rate (B)					1.046					1.234
(A) X (B)					N.S					2.469

Results showed a significant interaction effect of the studied factors on cane yield in the 2nd season only. It was noticed that cane yield of Ph.8013 variety did not significantly responded to the used seed rates while the other three varieties significantly recorded higher cane yield corresponding to 16800 cane cuttings/fed. The maximum cane yield (48.030 tons/fed) was obtained from F.160 variety planted with 16800 setts/fed.

7. Sugar yield:

Results in Table (7) indicated no significant differences among the evaluated sugarcane varieties in sugar yield in the two seasons.

The difference between the two seed rates in sugar yield was significant in both seasons. Planting sugarcane using 16800 cuttings/fed resulted in the production of 0.444 ton/fed (8.2%) and 0.713 ton/fed (14.6%) higher than that produced in case of planting sugarcane by 12600 setts/fed, in the 1st and 2nd season, respectively. This result is probably due to higher number of millable canes/m^2 (Table 3) and higher cane yield (Table 6) in case of two rows compared with 1.5 rows of cane cuttings. This result is in line with that reported by Zahoor, *et al.* (1997) who showed that sugar yield was highest with 40000 sets/ha when they increased planted seed setts of sugarcane from 30000 to 40000 and 50000/ha.

Sugar yield was significantly influenced by the interaction between the studied factors in the 2nd season only. It could be noticed that sugar yield produced by G.T.54-9 variety did not significantly differ in case of planting it by 1.5 or 2.0 rows of cane cuttings. Meantime, the other three varieties markedly gave higher sugar yield as they were planted with 2.0 rows of cane setts. The highest sugar yield (6.201 tons/fed) was achieved by F.153 variety planted with two rows of cane cuttings (16800 setts/fed).

Table 7. Sugar yield (tons/fed) of the studied sugarcane varieties as affected by seed rate in 2000/2001 and 2001/2002 seasons.

Growing season	2000/2001					2001/2002				
Seed rate of	Sugarcane variety				Mean	Sugarcane variety				Mean
Cane cuttings	G.T.54-9	F.160	Ph.8013	G.85-37		G.T.54-9	F.160	Ph.8013	G.85-37	
12600 (1.5 rows)	5.394	5.712	5.364	5.186	5.414	5.107	4.689	4.703	4.920	4.855
16800 (2.0 rows)	6.100	5.386	6.085	5.859	5.858	5.317	6.201	5.265	5.489	5.568
Mean	5.747	5.549	5.724	5.523	5.636	5.212	5.445	4.984	5.205	5.211
L.S.D. at 5% level for:										
Sugarcane varieties (A)					N.S					N.S
Seed rate (B)					0.323					0.200
(A) X (B)					N.S					0.400

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معدل التقاوى الأمثل لبعض أصناف قصب السكر المبشرة

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معهد بحوث المحاصيل السكرية - مركز البحوث الزراعية - الجيزة - مصر.

اجرى هذا البحث بمحطة المطاعنة للبحوث الزراعية بمحافظة قنا بمصر العليا خلال موسمى النمو ٢٠٠٠/٢٠٠١ و ٢٠٠١/٢٠٠٢ لدراسة أداء أربعة أصناف من قصب السكر (ثلاثة أصناف مبشرة هى: اف ١٦٠ ، بى اتش ٨٠١٣ ، جيزة ٨٥-٣٧ مقارنة بالصنف التجارى جيزة-تايوان ٥٤-٩) منزرعة بمعدلين من عقل التقاوى (١٢٦٠٠ و ١٦٨٠٠ عقلة بكل منها ثلاثة براعم -أى ٣٧٨٠٠ و ٥٠٤٠٠ برعم/فدان). استخدم التصميم التجريبى قطع منشقة مرة واحدة فى ثلاثة مكررات حيث وزعت الأصناف فى القطع الرئيسية ومعدلى التقاوى فى القطع الشقية.

أوضحت النتائج أن أصناف قصب السكر المختبرة تباينت معنويا فى قطر العيدان والنسبة المئوية للسكروز - فى حين لم تختلف الأصناف معنويا فى النسبة المئوية لنقاوة العصير ومحصولى العيدان والسكر/فدان فى الموسمين- وكان هناك اختلاف معنوى بين الأصناف فى ارتفاع العيدان وعدد العيدان القابلة للعصير/م٢ فى الموسم الثانى فقط.

أشارت النتائج الى أن زراعة قصب السكر بصفين من عقل التقاوى (١٦٨٠٠ عقلة/فدان) قد حقق زيادة معنوية فى عدد العيدان القابلة للعصير/م٢ ومحصولى العيدان والسكر/فدان مقارنة بالزراعة بصف ونصف (١٢٦٠٠ عقلة/فدان) فى حين ازداد قطر العيدان معنويا فى الحالة الأخيرة فى الموسمين- وأدت الزراعة بصفين من عقل التقاوى الى زيادة معنوية فى ارتفاع العيدان والنسبة المئوية للسكروز والنقاوة فى الموسم الثانى فقط.

أكدت النتائج أيضا أن التفاعل بين عاملى الدراسة لم يؤثر معنويا على قطر العيدان ، عدد العيدان القابلة للعصير/م٢ والنسبة المئوية للسكروز فى الموسمين - فى حين كان التفاعل معنويا على ارتفاع العيدان والنسبة المئوية للنقاوة (فى الموسم الأول) ومحصولى العيدان والسكر/فدان (فى الموسم الثانى).

تحت ظروف هذا البحث يمكن التوصية بزراعة أى من الأصناف المختبرة بصفين من عقل التقاوى للحصول على أعلى محصول عيدان قابلة للعصير وسكر.