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PERFORMANCE OF TWO PROMISING SUGAR CANE VARIETIES UNDER DIFFERENT INTERROW SPACING.

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ABSTRACT

The present investigation was carried out at Shandaweel Agricultural Research Station, Sohag Governorate to study the performance of the two promising sugar cane varieties grown as plant cane in 2008/2009 and 2009/2010 seasons and the 1st ratoon crops in 2009/2010 under three row spacing of (80, 100 (the recommended) and 120 cm) and two promising sugar cane varieties, G.98-28, G.99-160 beside G.T.54-9 the commercial variety. A split plot design with four replications was used in the plant cane and 1st ratoon crops. Row spacing treatments were allocated in the main plots, while, sugar cane varieties were randomely distributed in the sub-plots.

The results showed that: Increasing row spacing up to 120 cm recorded the highest values of stalk height, diameter, brix%, sucrose%, purity%, no. of millable canes/fed, sugar recovery%, cane and sugar yields/fed in the plant cane and 1st ratoon crops compared with the other two spacing.

Sugarcane varieties differed significantly, where G.98-28 variety recorded the highest stalk height, sucrose%, purity%, no. of millable canes/fed, sugar recovery%, cane and sugar yields/fed in the plant cane and 1st ratoon crops over the other two varieties. G.T.54-9 variety surpassed G.98-28 and G.99-160 varieties in stalk diameter, brix% in the plant cane and 1st ratoon crops.

The interaction between G.98-28 variety and 120 cm interrow spacing in 1st season plant cane and 1st ratoon crops obtained the highest cane and sugar yields/fed.

Under this conditions, 120 cm row spacing for the plant cane and the 1st ratoon crop of G.98-28 variety grown at Shandaweel, can be recommended to obtain the higher cane and sugar yields/fed.

INTRODUCTION

Egyptian Government imports about 1.10 million ton of sugar, every year to face the rapid increase of population. Recently, more attention has been given to increase the area planted with sugar crops to minimize the gab between sugar consumption and production (CCSC, 2010). Row spacing has a direct effect on plant population. It plays a distinct role in the amount of solar radiation intercepted and hence, crop canopy development which in turn affects photosynthesis and ultimately the dry matter produced by plant. Also, it may affect cane diameter, length and weight which contribute to cane yield. Productivity of sugarcane is represented by cane yield trait, while stalk weight and number of millable stalk at harvest are the two primary components of cane yield. Gascho and Shih (1981) and Prasad *et al.* (1983) studied the effect of 0.45, 0.70, 0.90, 1.35 and 1.50 m on yield and quality. They found that maximum population were reached in the narrow rows (50 cm) than that in the wide rows (150 cm). Shah Nawaz *et al.* (2000), Avtar *et al.* (2001), Rasker and Bhoi (2003) and Sundara (2003) studied the effect of intra-row

spacing (30, 60, 90, 120 and 150 cm). they showed that cane girth and number of millable canes were significantly higher with a 90 cm intrarow spacing compared with the other intrarow spacing. Yousef *et al.* (2000) and Gowda *et al.* (2001) mentioned that higher stalk length, diameter, number of millable canes, cane and sugar yields/fed were obtained with a row spacing of 75 cm than for a row spacing of 90 cm. El-Geddawy *et al.* (2002 a and b) found that narrow row spacing (100 cm) produced higher number of millable canes, sucrose, sugar recovery%, cane and sugar yields/fed compared to 120 and/or 140 cm row spacing. The wider row spacing (140 cm) significantly recorded higher values for stalk height, diameter, weight compared with those of narrower spacing of 100 cm. Ahmed *et al.* (2002), Mohamed and Ismail (2002), Osman *et al.* (2004), Rizk *et al.* (2004 a and b) and El-Shafai and Ismail (2006) found that interrow spacing increased stalk height, sucrose%, brix%, purity%, number of millable canes/fed, cane and sugar yields/fed in plant cane and 1st ratoon crops. Planting cane at 90 cm inter- row spacing recorded the highest values of stalk height and number of millable canes/fed, while it gave the highest net cane yield in plant cane only, however, Planting cane at 120 cm gave the highest sugar yield in in plant cane and 1st ratoon crops compared with the other 100 and 140 cm row spacing.

The new sugar cane varieties is considered one of the essential wings for production. Productivity of sugarcane depends upon cane yield and its components traits, while sugar yield as a final product is greatly affected by cane yield and quality traits at harvest. El-Sogheir *et al.* (2003), Osman *et al.* (2004) and Ahmed *et al.* (2005) found that Phil.8013, G.74-96, G.95-21 and G.T.54-9 varieties differed significantly in number of plants/m^2, sugar recovery%, cane and sugar yields/fed in plant cane and 1st ratoon crops. While, G.74-96 recorded significant increased in stalk diameter and sugar recovery%. The commercial cv. G.T.54-9 showed that superiority in stalk length, sugar recovery% and sugar yields, while higher number of millable canes/fed and cane yields/fed were given by G.95-21 variety. Thicker stalks was recorded by Phil.8013 variety. Mohamed and Ismail (2002) and El-Sogheir and Ferweez (2009) found that Phil.8013, G. 84-47 and G. 98-28 in descending order could be cultivated and/or replaced with the main variety G.T.54-9 which yielded the best quality, cane and sugar yields/unit area. Allabody *et al.* (2010), El-Zeny, Maha *et al.* (2010) and Osman *et al.* (2010) found that varieties, i.e. G.T.54-9, Phil.8013 and G.98-28 and G.84-47 of sugar cane, had significant effect on stalk length and diameter, as well as, sucrose%, sugar recovery%, cane and sugar yields/fed in the plant cane and 1st ratoon crops. G.84-47 and/or G.98-28 surpassed the others varieties.

The purposes of this study were to determine the optimum distance between sugar cane ridges and sugar cane varieties giving the highest sugar and cane yields/fed under Shandaweel representing the Upper Egypt conditions.

MATERIALS AND METHODS

The present investigation was carried out at Shandaweel Agricultural Research Station, Sohag Governorate to study the performance of the two promising sugar cane varieties grown as plant cane in 2008/2009 and 2009/2010 seasons and the 1st ratoon crops in 2009/2010 under three row spacing of (80, 100 (the recommended) and 120 cm) and two promising sugar cane varieties G.99-160 and G.98-28, beside G.T.54-9 the commercial variety. A split plot design with four replications was used in the plant cane and 1st ratoon crops. Row spacing treatments were allocated in the main plots, while, sugar cane varieties were randomely distributed in the sub-plots. The sub-plot area was 60 m2 (including 15 and 12 and 10 rows in case of spacing 80, 100 and 120 cm spacings, respectively and 5 m in length). Two rows of three-budded cane cuttings were used in planting. The previous crop was Faba Bean. Some physical and chemical properties of the experimental soil were determined according to Jakson (1967). The upper 20 cm of the soil was clay loam containing 21.0% sand, 29.3% silt and 49.2 clay, containing 27.0, 17.0, 395 ppm N, P and K respectively at pH of 6.85 (average means of two years). Plant cane was planted in the 1st week of March and 1st ratoon crop raised in the 1st week of March. Both plant cane and 1st ratoon crop were harvested at age of twelve months. Recommended NPK fertilizers were added at rates of 210 kg N (as urea 46.5% N/fed), 30 kg P_2O_5 (as calcium superphosphate 15.5% P_2O_5/fed) and 24 kg K_2O (as potassium sulfate 48% K_2O/fed). Nitrogen and potassium fertilizers were added in two equal doses. In the plant cane, the 1st N and potassium dose were applied two months after planting preceded with hoeing. In the 1st ratoon, the 1st N-dose and potassium were added one after month from harvesting the plant cane and after furrowing (ditching between rows of sugarcane) and earthing-up. The 2nd dose were added one month after the 1st one, for both cane crops. Phosphorus fertilizers was applied during seed bed preparation. The other agricultural practices were followed as recommended by Sugar Crops Research Institute.

Recorded data:

1. Vegetative chgaracters: at harvest, a sample of 10 millable canes from each sub plot was taken at random and the following data were recorded:

1. Millable cane stalk height (cm), which was measured from soil surface to the top point of visible dewlap.
2. Millable cane diameter, which was measured at the middle part of stalk.

II. Cane and sugar yields (ton/fed): Each sub plot was harvested, topped and cleaned from trash, weighed to estimate the following characters:

1. Cane yield (tons/fed) was calculated.
2. Sugar yield (tons/fed) was estimated according to the following equation: Raw sugar yield (ton/fed) = cane yield (ton/fed) x sugar recovery%.
3. Number of millable canes/fed were counted.

III. Juice quality traits: a sample of 20 millable cane stalks was collected immediately after harvest, stripped and squeezed then juice was extracted using 3- rool lab mill, filtrated and weighed to determine the following quality

traits as described by A.O.A.C. (2005): Juice extraction%, was calculated using the following equation: Juice extraction% = juice weight x 100/stalk weight. Juice extraction% about 58-60% from cane weight.

1. Brix% was determined in the laboratory using the Brix Hydrometer standardized at 20°C.
2. Sucrose%, was determined using "Saccharemeter" according to A.O.A.C. (2005).
3. Purity%, was calculated as follows:

Purity% = sucrose% / brix% x 100, where: brix%, was determined using brix Hydrometer standardized at 20 C^0.

4. Sugar recovery%, was calculated according to Yadav and Sharma (1980).

Sugar recovery% = {Sucrose - 0.4 (brix – sucrose) 0.73}.

Data were statistically analyzed according to Snedecor and Cochran (1981).

RESULTS AND DISCUSSION

1: Effect of row spacing.

Results illustrated in Table 1 revealed that row spacing had a significant influence on stalk height, diameter, brix%, sucrose%, purity%, No. of millable canes/fed, sugar recovery%, cane and sugar yields/fed in the plant cane and 1st ratoon crops. Planting sugar cane using 120 cm row spacing significantly recorded the highest mean values of stalk height, diameter, brix%, sucrose%, purity%, No. of millable canes/fed, sugar recovery%, cane and sugar yields/fed compared with 80 cm row spacing. On the contrary, 80 cm row spacing led to higher mean values of brix% in the plant cane and 1st ratoon crops over those given by 100 and 120 cm.

The number of millable cane/fed played also a role in the expected cane yields/fed. Number of millable cane/fed, was increased by planting sugarcane at 120 cm, these results may indicate that no shading and competition among plants at this wide spacing were very low and resulted in low mortality%.

Moreover, the increase in cane yields/fed can be attributed to higher values of stalk height, number of millable canes/fed at the widest row spacing (120 cm) which were gradually increased with increasing spacing to 80 and 100.

The increase in sugar yield, could be attributed to highest cane yields/fed, the expense of sucrose accumulation, sugar recovery% which is considered the main component of sugar yields/fed.

The increase of stalk height could be attributed to the proportion of invisible solar radiation is so much increased than the visible solar radiation due to dense sowing. The former has an elongation effect and hence accounts of the increase observed, herein; in stalk diameter when sugarcane was planted in close spaced rows.

The increase of stalk diameter may be attributed to the lower competition for nutrients, water and solar radiation among cane plants grown in rows of 120 cm apart, which reflected in better growth conditions,

compared with those grown in rows spaced at 100 or 120 cm (Chang, 1974). These results are in agreement with those reported by Gascho and Shih (1981), Shah Nawaz *et al.* (2000), Avtar *et al.* (2001), Ahmed *et al.* (2002), Mohamed and Ismail (2002), Rasker and Bhoi (2003), Sundara (2003), Osman *et al.* (2004), Rizk *et al.* (2004 a and b) and El-Shafai and Ismail (2006)

Table 1: Effect of row space on growth, quality traits and yields at harvest

Row spacing (cm)	Growth traits		Quality%			No. of millable cane/fed	SR%	Yields (tons/fed)	
	SH	SD	Brix%	Sucrose%	Purity%			Cane	Sugar
Plant cane (2008/2009 1st season)									
80	286.60	2.71	22.16	17.28	77.98	42.98	10.98	44.92	4.93
100	299.90	2.96	20.71	17.72	85.56	43.72	10.57	46.26	4.89
120	310.20	2.81	21.88	17.39	79.48	44.40	11.69	47.31	5.53
LSD at 5%	2.29	0.09	0.16	0.10	1.12	0.65	0.02	0.59	0.06
Plant cane (2009/2010 2nd season)									
80	280.00	2.59	20.91	15.65	74.84	41.10	10.10	43.70	4.41
100	293.10	2.85	20.10	17.19	85.52	42.50	11.71	44.27	5.18
120	303.45	2.65	20.55	16.15	78.59	47.12	10.60	49.75	5.27
LSD at 5%	1.34	0.03	0.11	0.05	0.66	0.23	0.01	0.33	0.01
1st ratoon cane (2009/2010 1st ratoon season)									
80	297.8	2.68	21.66	17.91	82.69	42.23	11.07	44.91	4.97
100	302.8	2.91	20.00	18.50	92.50	43.83	11.06	45.52	5.03
120	308.3	2.83	20.31	18.19	89.56	45.50	11.80	47.59	5.62
LSD at 5%	1.18	0.04	0.12	0.05	0.95	0.33	0.04	0.44	0.04

SH = Stalk height (cm), SD = stalk diameter (cm), SR% = Sugar recovery%

2. Varietal differences:

The obtained results in Table 2 revealed that the tested varieties significantly differed in stalk height, diameter, brix%, sucrose%, purity%, No. of millable canes/fed, sugar recovery%, cane and sugar yields/fed in the plant cane and 1st ratoon crops. Sugar cane G.98-28 variety recorded the highest mean values of stalk height, diameter, brix%, sucrose%, purity%, No. of millable canes/fed, sugar recovery%, cane and sugar yields/fed. G.99-160 variety surpassed G.98-28 and G.T.54-9 varieties in stalk diameter, brix% in the plant cane and 1st ratoon crops. These differences could be attributed to the genetic structure of the evaluated sugarcane varieties.

The increase in cane yield was strongly related to the higher number of millable canes/fed and stalk performance i.e. stalk height at harvest. The increase in sugar yield may be due to that G.98-28 variety was superior, also, in quality traits, i.e. sucrose and sugar recovery% as well as cane yield/fed. Similar results were reported by Mohamed and Ismail (2002), El-Sogheir and Ferweez (2009), Allabody *et al.* (2010), El-Zeny, Maha *et al.* (2010) and Osman *et al.* (2010).

Table 2: Effect of varietal differeces on growth, quality traits and yields at harvest.

Plant cane (2008/2009 1st season)									
Sugar cane varieties	Growth traits		Quality%			No. of millable cane/fed	SR%	Yields (ton/fed)	
	SH	SD	Brix%	Sucrose%	Purity%			Cane	Sugar
G.99-160	284.90	2.95	21.80	16.89	77.48	41.81	10.14	43.39	4.40
G.T.54-9	301.20	2.72	20.10	17.83	88.71	43.33	11.33	45.62	5.17
G.98-28	313.50	2.76	21.07	17.67	83.86	47.96	11.45	49.44	5.66
LSD at 5%	2.25	0.11	0.15	0.12	1.15	1.04	0.14	0.95	0.75
Plant cane (2009/2010 2nd season)									
G.99-160	279.10	2.89	20.79	15.12	72.73	40.12	10.45	42.23	4.41
G.T.54-9	297.00	2.65	19.79	17.00	85.90	41.10	11.71	43.10	5.05
G.98-28	307.60	2.70	20.00	16.24	81.20	45.20	10.85	47.10	5.11
LSD at 5%	1.18	0.05	0.07	0.02	0.37	0.33	0.09	0.41	0.19
1st ratoon cane (2009/2010 1st ratoon season)									
G.99-160	290.3	3.00	21.95	17.50	79.73	42.17	10.25	44.78	4.59
G.T.54-9	303.2	2.65	20.72	18.72	90.35	43.33	11.55	45.74	5.28
G.98-28	314.4	2.83	21.57	18.58	86.14	45.00	12.12	47.73	5.78
LSD at 5%	1.23	0.09	0.10	0.05	0.81	0.79	0.11	0.76	0.52

SH = Stalk height (cm), SD = stalk diameter (cm), SR% = Sugar recovery%

3. Interaction effects:

The tabulated results in Table 3 revealed that the interaction effect between G.98-28 variety and 120 cm row spacing significantly affected sugar recovery%, cane and sugar yields/fed in the 1st plant cane and 1st ratoon crops, which recorded the highest mean values of sugar recovery%, cane and sugar yields/fed.

Table 3: Interaction effect between row space x varieties on quality and yields at harvest.

Traits	Plant cane (2008/2009 1st season)								
Sugar	Row spacing								
Cane	Sugar recovery%			Cane yield (ton/fed)			Sugar yield (ton/fed)		
Varieties	80	100	120	80	100	120	80	100	120
G.99-160	10.12	10.17	10.13	42.00	43.33	44.83	4.25	4.41	4.54
G.T.54-9	11.83	10.20	11.95	44.75	45.50	46.60	5.29	5.64	5.57
G.98-28	11.00	11.35	13.00	48.00	49.83	50.50	5.28	5.65	6.57
LSD at 5%	0.17			1.12			0.19		
1st ratoon cane (2009/2010 1st ratoon season)									
G.99-160	10.13	10.38	10.25	43.77	44.12	46.45	4.43	4.58	4.76
G.T.54-9	11.82	10.88	11.95	44.85	45.20	47.16	5.30	5.13	5.64
G.98-28	11.25	11.92	13.20	46.10	47.23	49.16	5.19	5.63	6.49
LSD at 5%	0.26			1.14			1.10		

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اداء وسلوك صنفين مبشرين من قصب السكر تحت مسافات تخطيط مختلفة.

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أقيمت تجربتان حقليتان بمحطة بحوث شندويل بمحافظة سوهاج خلال ٢٠٠٨/٢٠٠٩ و٢٠٠٩/٢٠١٠ (كقصب غرس) و٢٠٠٩/٢٠١٠ (كخلفة اولى) لدراسة تأثير ثلاث مسافات زراعة (٨٠ ، ١٠٠ و١٢٠ سم) على محصول الغرس والخلفة الاولى لصنفى (جيزة ٩٨-٢٨ وجيزة ٩٩-١٦٠) المبشرين من قصب السكر بالاضافة الى الصنف التجارى جيزة تايوان ٥٤-٩ كمقارنة. إستخدم تصميم قطع منشقة مرة واحدة فى اربع مكررات حيث وضعت مسافات التخطيط فى القطع الرئيسية ووزرعت الاصناف فى القطع الشقية. اوضحت النتائج ما يلى:

- اختلفت مسافات التخطيط معنويا فى طول الساق وقطره والبركس والسكروز والنقاوة وعدد العيدان القابلة للعصيرللفدان وناتج السكر ومحصولى العيدان والسكر فى الغرس والخلفة. ادت زيادة مسافة الزراعة الى ١٢٠ سم الى زيادة طول الساق وقطره والبركس والسكروز والنقاوة وعدد العيدان القابلة للعصيرللفدان وناتج السكر ومحصولى العيدان والسكر فى القصب الغرس والخلفة بينما سجلت مسافة الزراعة ٨٠سم اقل القيم.

- اختلفت الاصناف معنويا فى طول الساق وقطره والبركس والسكروز والنقاوة وعدد العيدان القابلة للعصيرللفدان وناتج السكر ومحصولى العيدان والسكر. سجل الصنف جيزة ٩٨-٢٨ اعلى القيم لطول الساق والسكروز والنقاوة وعدد العيدان القابلة للعصيرللفدان وناتج السكر ومحصولى العيدان والسكر فى الغرس والخلفة. بينما سجل الصنف جيزة تايوان ٥٤-٩ اعلى قيم لقطر الساق وللبركس% فى الغرس والخلفة.

- كان للتفاعل بين الصنف جيزة ٩٨-٢٨ ومسافة الزراعة ١٢٠ سم تاثير معنويا على ناتج السكر ومحصول العيدان والسكر فى الغرس والخلفة.

- نوصى بزراعة الصنف جيزة ٩٨-٢٨ مع مسافة زراعة ١٢٠ سم للقصب الغرس والخلفة للحصول على أعلى محصول عيدان وسكر تحت ظروف شندويل بمحافظة سوهاج.

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