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Evaluation of sugarcane genotypes under different row spacing

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Abstract

The present study was carried out at El-Mattana Agricultural Research Station (Latitude of 25.17º N and longitude of 32.33º E), Luxor Governorate, Egypt during the 2014/2015 and 2015/2016 growing seasons to find out the suitable row spacing (80, 100 and 120 cm) on yield and quality of two promising sugarcane varieties viz. G.2003-47 and G.2003- 49 compared with the commercial variety (G.T. 54-9). The results indicated significant differences among tested genotypes in stalk height, cane yield in the plant cane and first ratoon crops, while stalk diameter and sugar yield exhibited significant differences only in the first ratoon. Row spacing had a significant effect on the number of millable cane / m^2, cane and sugar yields /fed in the plant cane and first ratoon crops, while it had a significant effect on stalk height only in plant cane crop. The row spacing of 120 cm exerted the highest number of millable cane / m^2, stalk height, and sugar yield in plant cane and first ratoon crops, as well as stalk diameter, cane yield, Brix, richness and reducing sugars in plant cane only. Moreover, the check cultivar recorded the highest mean value of sugar yield in the first ratoon crop, when planted at 120 cm row spacing. On the other hand, the 80 cm inter row-spacing gave the highest mean values of purity and sugar recovery% in both plant cane and first ratoon crops and Brix, sucrose and richness in first ratoon only. The significant linear effects were found for the number of millable cane / m^2, stalk height, cane yield, sugar yield and reducing sugar with the rate of row spacing.

Keywords: Sugarcane; Row spacing; Cane yield; Sugar yield.

Introduction

Sugarcane is the main commercial sugar crop cultivated in Upper Egypt. It plays an important role in the local and global development. The row spacing played major role in the number of millable cane per unit. Also, it has effect in stalk characters *i.e.* height, diameter and weight. These traits build the direct effect in net cane yield. The productivity of sugarcane

depends on two components i.e., number of millable cane and stalk weight .This conclusion has been noted by many investigators *i.e.* **Kesref (2001)** ; **Ahmed *et al* . (2005)** ; **Chitkala** ; **Devi *et al.* (2005)** ; **El-Shafai *et al.* (2010)**; **Omoto *et al*.(2013)**; **Abd El-Latif (2015)** and **Abiy *et al.* (2016).** Moreover, **Ahmed *et al*. (2011)** found that the closest enter-row spacing (80 cm) gave the highest values of all studied traits. The main challenge for sugar cane cultivation in Egypt, it is depended on one commercial variety. Breeding or introduction and adaptation for new sugar cane varieties is considered the main goal in sugar cane for production process.

Many studies were carried out to evaluate sugarcane varieties for production and quality parameters under different agricultural treatments (**Yadav** and **Sharma**, **1980**, **Gowda *et al*. 2001**, **El-Geddawy *et al.* 2002 (a**) and (**b)**, **Sundara**, **2003** and **Taha *et al.* 2008, Mehareb et al. 2015.**

The present work was conducted to find out the relative effect of row spacing on the production of two new promising sugarcane varieties grown in Upper Egypt.

Material and Methods

The present study was carried out at El-Mattana Agricultural Research Station (Latitude of 25.17^{o} N and longitude of 32.33^{o} E), Luxor Governorate, Upper Egypt during 2014/2015 and 2015/2016 seasons to find out the suitable row spacing (80 , 100 and 120 cm) on yield and quality of two promising sugarcane varieties viz. G.2003-47 and G2003- 49 compared with the commercial variety (G.T. 54-9). The experiment was conducted in Randomized Complete Block Design using Split-block arrangement with three replications .The row spacing arranged vertically while the genotypes was horizontally. The planting date was at March, 2014. The plot area was 60 m^2 (including 15, 12 and 10 rows in case of spacing 80, 100 and 120 cm spacing, respectively, and 5 m in length) and the recommended cultural

practices of sugarcane production were adopted through the growing season. Soil mechanical and chemical analyses of the experimental site showed that soil was clay loam, containing 55, 21 and 115 ppm of the available N, P and K, respectively and a pH of 7.5 .

At harvest time, the experimental plots were individually harvested and 30 stalk samples from each plot were chosen at random and the following data were recorded:

1- Number of millable cane / m^2, was calculated on plot basis .

2- Stalk height in cm , as the average length of thirty stalk measured from soil surface up to the top visible dewlap.

3- Stalk diameter in cm, as the average of diameter of thirty stalks measured at the middle stalk internode.

4- Cane yield (t /fed) was calculated on plot basis.

5- Sugar yield (t /fed.) = cane yield (t/fed) x Recovery sugar % (**Yadav and Sharma 1980**). It was calculated on plot basis.

A sample of 30 stalks from each plot, stripped, cleaned and squeezed by an electric pilot mill according to the method described by **Meade and Chen**, **(1977)** and the following quality traits were estimated:

1- Brix % (percentage of total soluble solids in juice which was determined using Brix hydrometer).

2- Sucrose % was determined using Saccharometer.

3- Purity % was determined using the formula described by **Meade** and **Chen (1977)** *i.e.*, Sucrose / Brix x100.

4- Richness percentage was calculated according to the formula:

Richness percentage = [Brix % - 0.4 (Brix % - sucrose %) × 0.73] according the method of **Satisha et. al. (1996).**

5- Reducing sugar (cm).

6- Sugar recovery % was calculated according to the formula described by **Yadav** and **Sharma (1980) , *i.e.,*** Recovery Sugar % = [Sucrose - 0.4 (Brix - sucrose)] x 0.73.

Collected data were subjected to normal statistical analysis as shown by **Snedecor** and **Cochran (1989).** Comparisons between treatment means were performed using revised LSD at 5% level of probability. Moreover, the response curve analyses, *i.e.*, linear and quadratic trends were carried out for the row spacing in all studied traits.

Result and discussion

1- Effect of genotypes :

Data in Tables 1 and 2 revealed that significant differences among genotypes in stalk height, cane yield in plant cane and first ratoon crops , and on stalk diameter and sugar yield in first ratoon only. The check cultivar G.T. 54 /9 recorded the highest mean values of stalk height, cane and sugar yields in both of the plant cane and first ratoon crops. Furthermore, the genotype G. 2003/47 showed the lowest mean values of cane and sugar yields in the plant cane and first ratoon crops. These differences among studied genotypes due to the genetic make-up and diversity in genetic performance. Superiority of the check cultivar G.T 54 / 9 in cane yield could be ascribed to the superiority of its yield components, i.e., the number of millable cane / m^2. While, superiority of the check cultivar G.T 54 / 9 in sugar yield due to the superiority of cane yield and sugar recovery. This result in agreement with **Mohamed** and **Ismail (2002); El-Sogheir** and **Ferweez (2009); Allabody *et al.* (2010) ; El-Zeny; Maha *et al.* (2010); Osman *et al.* (2010) and El-Labbody *et al.* (2011).**

The cane yield is directly proportionate to stalk population and has been noted by numerous authors, *i.e.,* **Kesref (2001); Ahmed *et al.* (2005);**

Chitkala, Devi *et al.* (2005); El-Shafai *et al.* (2010); Omoto *et al*. (2013); Abd El-Latif (2015) and **Abiy *et al.* (2016).**

2- Effect of inter-row spacing:

The results in Tables 1 and 2 revealed that row spacing had a significant effect on number of millable cane / $m^{2,}$ cane and sugar yields / fed in the plant cane and first ratoon crops and on stalk height in plant cane only. Using 120 cm row spacing in planting of sugar cane recorded the highest mean values of cane and sugar yields in plant cane and first ratoon crops.

In the highest mean values of number of millable cane / m^2, stalk height and sugar yield/fed in the plant cane and first ratoon crops and of stalk diameter, cane yield, brix , reducing sugars and richness were obtained when used 120 cm row spacing in the plant cane crop only. On the other hand, 80 cm row spacing recorded the lowest mean values for number of millable cane / m^2 and sugar yields both in the plant cane and the first ratoon crops. The number of millable cane / m^2 played also a role in the expected cane yields /fed. Number of millable cane / m^2, was increased by planting sugarcane at 120 cm row spacing. These results might indicate that the wide spacing decrease shading and competition among plants and result in low mortality %. These results are in agreement with those reported by **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); El-Shafai** and **Ismail (2006)** and **El-Labbody *et al.*(2011).**

On the other hand, using of 80 cm inter row-spacing gave the highest mean value of the quality traits such as purity and sugar recovery in both of plant cane and first ratoon crops and brix, sucrose and richness only in the first ratoon (Table 2). In this respect, **Ahmed *et al*. (2011)** found that the closest enter-row spacing (80 cm) gave the highest mean values of all studied traits.

3- Effect of Interaction between genotypes and inter row spacing:

The results in Tables 1 and 2 revealed that the interaction between varieties and inter-row spacing was not significant for all studied traits in the plant cane and first ratoon crops. The check cultivar recorded the highest mean value of sugar yield (6.730 ton /fed.) in plant cane under 120 cm of inter row spacing and in first ratoon crop (6.414 ton /fed.) under 100 cm of inter row spacing.

4- The response curves analysis (linear and quadratic trends).

The response curves analysis, *i.e.*, linear and quadratic trends were subjected for the row spacing in all studied traits to determine the effects of these trends on yield and quality (Tables 1 and 2). The results revealed that the significant linear effects were found for number of millable cane / m^2, stalk height, cane yield, sugar yield and reducing sugar in plant cane and first ratoon crops and stalk diameter in plant cane crop only. Moreover, the significant quadratic effect was found only for cane yield. These significant effects may be led to the current rate of row spacing for the genotypes under study should take care and announcement for more and further studies to get the optimum rate of sowing spacing.

Table 1: Mean performance of three sugarcane genotypes under three rate of row spacing for some agronomic traits, cane and sugar yields in plant cane and first ratoon crops.

Traits		Number of millable cane/ m^2		Stalk height (cm)		Stalk diameter (cm)		Cane yield (ton/fed)		Sugar yield (ton/fed)	
Genotypes	**Row s.**	**Plant cane**	**First ratoon**	**Plant cane**	**First ratoon**	**Plant cane**	**First ratoon**	**Plant cane**	**First ratoon**	**Plant cane**	**First ratoon**
G.T 54/9	80cm	10.67	11.00	257.67	253.33	2.77	2.53	44.17	43.92	5.687	5.419
	100cm	11.33	12.33	264.00	248.00	2.67	2.63	52.25	53.17	6.640	6.414
	120cm	12.33	13.00	274.33	246.67	2.77	2.70	52.25	52.50	6.730	6.178
mean		11.44	12.11	265.33	249.33	2.74	2.62	49.56	49.86	6.352	6.004
G.2003/47	80cm	10.00	10.33	222.33	215.00	2.70	2.17	42.81	43.13	5.705	5.047
	100cm	10.67	11.33	231.67	205.33	2.63	2.33	47.80	48.25	6.491	5.529
	120cm	12.33	12.33	254.67	246.00	2.77	2.27	48.03	48.28	6.321	5.757
mean		11.00	11.33	236.22	222.11	2.70	2.26	46.21	46.55	6.172	5.444
G.2003/49	80cm	10.33	10.33	222.33	220.67	2.77	2.47	38.43	38.85	5.220	4.641
	100cm	12.00	12.00	234.67	231.33	2.63	2.30	43.20	43.92	5.782	5.271
	120cm	12.33	13.33	248.00	246.00	2.70	2.20	43.17	43.72	5.924	5.367
mean		11.55	11.89	235.00	232.66	2.70	2.32	41.60	42.16	5.642	5.093
General mean		11.33	11.78	245.52	234.26	2.71	2.40	45.79	46.19	6.055	5.514
Average row s. at :	80cm	10.33	10.55	234.11	229.67	2.74	2.39	41.80	41.97	5.531	5.036
	100cm	11.33	11.89	243.45	228.22	2.64	2.42	47.75	48.45	6.304	5.738
	120cm	12.33	12.89	259.00	246.22	2.75	2.39	47.82	48.17	6.325	5.767
Rev.L.S.D $_{0.05}$ for Gen.		Ns	Ns	4.96	12.97	Ns	0.24	1.16	0.62	Ns	0.38
Rev.L.S.D $_{0.05}$ for row s.		0.90	0.90	5.32	Ns	Ns	Ns	1.64	1.72	0.38	0.54
Rev.L.S.D $_{0.05}$ for Gen. x row s.		Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Linear effect of row spacing		**	**	**	*	**	Ns	**	**	**	*
Qadratic effect of row spacing		Ns	Ns	Ns	Ns	Ns	Ns	**	**	Ns	Ns

Ns ,* , ** : mean non-significant and significant at 5 % and 1 % level of probability , respectively .

Table 2: Mean performance of three sugarcane genotypes under three rate of row spacing for quality traits in plant cane and first ratoon crops.

Traits		Brix %		Sucrose %		Purity %		Richness %		Reducing sugar %		Sugar recovery%	
Genotypes	Row s.	Plant cane	First ratoon	Plant cane	First ratoon	Plant cane	First ratoon	Plant cane	First ratoon	Plant cane	First ratoon	Plant cane	First ratoon
G.T 54/9	80cm	21.75	21.83	18.82	18.32	86.61	89.93	15.02	14.91	0.45	0.42	12.88	12.35
	100cm	21.68	21.71	18.64	18.01	86.02	82.96	14.94	14.77	0.54	0.47	12.71	12.07
	120cm	22.01	21.8	18.88	17.73	85.80	81.33	15.15	14.73	0.57	0.50	12.87	11.76
mean		21.81	21.78	18.78	18.02	86.15	84.74	15.04	14.80	0.52	0.46	12.82	12.06
G.2003/47	80cm	22.32	22.2	19.41	17.79	87.01	80.20	15.44	14.92	0.48	0.50	13.32	11.70
	100cm	23.08	21.23	19.87	17.32	86.11	81.11	15.91	14.39	0.54	0.62	13.57	11.47
	120cm	22.69	21.95	19.36	17.93	85.28	81.66	15.59	14.85	0.58	0.47	13.15	11.91
mean		22.69	21.79	19.55	17.68	86.13	80 .99	15.65	14.72	0.53	0.53	13.35	11.69
G.2003/49	80cm	23.33	22.18	19.95	18.02	85.51	81.25	16.04	14.97	0.42	0.50	13.58	11.94
	100cm	22.56	21.92	19.95	18.00	86.64	82.10	15.59	14.86	0.52	0.46	13.39	12.00
	120cm	22.92	22.36	19.97	18.40	86.99	82.28	15.87	15.17	0.55	0.58	13.73	12.27
mean		22.92	22.15	19.96	18.14	86.38	81.88	15.83	15.00	0.50	0.51	13.57	12.07
General mean		22.47	21.91	19.43	17.95	86.22	82.54	15.51	14.84	0.52	0.50	13.25	11.94
Average row s. at :	80cm	22.47	22.07	19.39	18.04	86.38	83.80	15.50	14.93	0.45	0.47	13.26	12.00
	100cm	22.44	21.62	19.48	17.78	86.26	82.06	15.48	14.67	0.53	0.52	13.22	11.85
	120cm	22.54	22.04	19.40	18.02	86.02	81.76	15.54	14.92	0.57	0.52	13.25	11.98
Rev.L.S.D $_{0.05}$ for Gen.		Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Rev.L.S.D $_{0.05}$ for row s.		Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Rev.L.S.D $_{0.05}$ for Gen. x row s.		Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Linear effect of row spacing		Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	**	*	Ns	Ns
Qadratic effect of row spacing		Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns

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الملخص العربي

تقييم بعض التركيب لقصب السكر تحت معدلات مختلفة للمسافة بين الخطوط

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[1]عهد بحوث المحاصيل السكرية ، مركز البحوث الزراعية ، الجيزة – مصر
[2]قسم المحاصيل ، كلية الزراعة والموارد الطبيعية ، جامعة أسوان – مصر

أجريت هذه الدراسة بمحطة البحوث الزراعية بالمطاعنة (خط العرض 25.17° شمالا وخط طول 32.33درجة جنوبا)، محافظة الأقصر بصعيد مصرخلال الموسمين الزراعيين 2015/2014 و 2016/2015 لتقدير المسافة المثلى بين الخطوط (80، 100و120سم) على صفات المحصول والجودة لصنفيين مبشرين من القصب جيزة47/2003 و جيزة49/2003 مقارنة بالصنف التجارى جيزة – تايوان 9/54. أشارت النتائج إلى وجود إختلافات معنوية بين الأصناف في إرتفاع الساق، ومحصول القصب في محصول الغرس والخلفة الأولى، بينما كانت معنوية في سمك الساق ومحصول السكرفى محصول الخلفة الأولى فقط. كان تأثيرالمسافة بين الخطوط معنويا على صفات عدد العيدان القابلة للعصير/م^2 ومحصول القصب والسكر فى الغرس والخلفة الأولى. بينما لصفة إرتفاع الساق فى محصول الغرس فقط. أدى استخدام المسافة120سم بين الخطوط إلى أكبر قيمة لصفات عدد العيدان القابلة للعصير/م^2،ارتفاع الساق ومحصول السكر في محصول الغرس والخلفة الأولى، بينما لصفة سمك الساق،حصول القصب، البركس، الحلاوة والسكريات المختزلة فى محصول الغرس فقط. علاوة على ذلك،سجل الصنف التجارى أعلى قيمة لمحصول السكر في محصول الخلفة الأولى عند استخدام المسافة120سم بين الخطوط.من ناحية أخرى،دى إستخدام المسافة80سم بين الخطوط إلى أعلى قيمة للنقاوه وناتج السكر النظرى في كل محصول الغرس والخلفة الأولى ولصفة البركس، السكروز والحلاوة فى محصول الخلفة الأولى فقط.تم الحصول على تأثير خطي معنوى لمعدلات المسافة بين الخطوط لصفات عدد النباتات القابلة للعصير/ م^2، وارتفاع الساق،ومحصول القصب والسكريات المختزلة.