Journal

J. Biol. Chem. Environ. Sci., 2019, Vol. 14(1): 215-233
http://biochemv.sci.eg

EFFECT OF ROW SPACING AND NITROGEN FFERTILIZATION ON YIELD AND QUALITY OF SOME SUUGARCANE VARIETIES

Gadallah,A.F.I. and Rania M. Abd El-Aziz

Agron. Dept .Sugar Crops Res. Inst., Agric. Res. Center, Giza, Egypt

ABSTRACT

The present investigation was carried out at Shandaweel Agricultural Research Station, Sohag Governorate [26.5013° N, 31.7651° E] during 2016/2017 and 2017/2018 to investigate the effect of three row spacing (80, 100 and 120 cm),and three nitrogen levels (180, 210 and 240 kg N/fed) on yield and quality of three sugarcane varieties i.e. [G.3 (2003-47), G.4 (2004-27), in addition to (commercial variety) G.T.54-9 (Each experiment was carried out in a randomized complete block design using a split-split plot arrangement with three replications.

The results showed that planting sugarcane in rows spaced at 80 cm apart attained a significant increase in cane stalk height, number of millable canes and cane yield/fed. Significant increase in stalk diameter, brix, sucrose and sugar recovery percentages as well as sugar yield/fed were recorded surpassed the other varieties recorded at 120 cm row spacing in both seasons.

The results showed that sugarcane varieties differed significantly in all studied traits. G.T.54-9 variety in stalk height and cane yield/fed, while G.3 (2003-47) variety was superior in stalk diameter, brix, sucrose sugar recovery and sugar yields/fed in both seasons. G.4 (2004-27) variety attained the highest values of number of millable canes/fed in both seasons. ,

Raising N fertilization level up to 240 kg N/fed resulted a significant increase in stalk height, diameter, number of millable cane/fed, cane and sugar yields/fed, while the application of 210 kg

N/fed led to a significant increase in brix, sucrose and sugar recovery percentages, in both seasons.
Key word: brix, cane yield, commercial variety, stalk height, sucrose.

INTRODUCTION

Row spacing has a direct effect on plant population. It plays a distinct role in the amount of solar radiation and hence, crop canopy development, which in turn affects photosynthesis and ultimately the dry matter produced by plant. **Avtar (2000)** planted sugarcane in single rows (75 or 90 cm) or double rows (120:60, 60:30 or 120:30 cm). He found that single row spacing of 75 cm produced the highest mean yield of 55.5 tons, which was insignificantly different from double row spacing of 60:30 (52.0 tons) and 120:60 (51.0 tons). **El-Geddawy *et al.* (2002)** found that the widest row spacing gave the highest sucrose, and sugar recovery percentage. Otherwise, They found that varieties differed significantly in juice quality traits. **Raskar and Bhoi (2003)** found that cane girth and number of millable canes were significantly higher with a 90-cm intra-row spacing compared with 30 or 60-cm intra-row spacing. However, Millable cane height was insignificantly affected by row spacing. **Rizk *et al.* (2004-a)** found that sucrose was insignificantly affected by the studied row distances (100, 120 and 140 cm). Likewise, **Rizk *et al.* (2004-b)** showed that number of internodes/stalk was insignificantly influenced by the same row distances. However, the widest row distance significantly gave the thickest stalks. **El-Shafai and Ismail (2006)** indicated that planting sugarcane in rows spaced at 80-cm apart attained a significant increase in cane stalk height, number of millable canes, cane and sugar yields/fed compared with 100 and 120 cm, while sucrose and sugar recovery percentages were insignificantly affected by row spacing. **Bekheet *et al.* (2011)** showed that planting sugarcane varieties in rows spaced at 80-cm apart attained significant increase in cane stalk height, number of millable canes, cane yield/fed, brix, sucrose, sugar recovery percentages and sugar yield/fed compared with those planted at 100 and 120 cm. However, they detected a significant increase in stalk diameter at 120 cm row spacing. **Abd El-Lattief (2016)** found that narrow inter-row spacing 100 cm produced higher number of millable canes, cane and sugar yields compared to the other inter-row spacing 120 and 140 cm. **Galal *et al.* (2018)**

indicated that planting sugarcane in rows spaced at 100 cm attained significant increases in the number of millable canes/ha, stalk length, stalk weight, sucrose %, sugar recovery % and cane and sugar yield/ha in the plant and 1st ratoon cane crops.

It is known that the differences among genotypes and varieties are attributed to the variation in foliage size (leaf area), number of stomata on both sides of leaves, thickness of cuticle (wax layer), soil and meteorological factors prevailed. In Egypt, many studies were carried out to evaluate sugarcane varieties for productivity and quality traits. Significant variations among varieties were reported by **El-Shafai and Ismail (2006)** showed that sugarcane commercial cv. G.T.54-9 was superior in stalk height, number of millable cane, cane and sugar yields/fed compared with Phil.8013, G.95-19, G.95-21 varieties, while thicker stalks, higher sucrose and sugar recovery percentages were given by Phil.8013. **Ahmed *et al.* (2008**) cleared that sugarcane variety G.84-47 surpassed the other two varieties (Phil.8013 and G.98-28) in millable cane number/m^2, stalk height, sugar recovery% and cane yield, meanwhile sugarcane variety Phli.8013 attained the highest value of stalk diameter, brix%, sucrose% and sugar yield. **Ismail *et al*. (2008)** found that sugarcane varieties differed significantly in all the studied traits in plant and first ratoon crops except purity%, cane and sugar yields in the plant cane. The commercial cv. G.T.54-9 showed superiority in stalk length, purity%, sugar recovery% and sugar yields/fed. Highest number of millable canes and cane yield were given by G.95-21 variety, whereas thicker stalks were recorded by phil.8013 variety. **El-Bakry (2018)** revealed that the promising sugarcane variety 'G.2003-47'showed the significant superiority in juice quality traits. **Galal *et al*. (2018)** found that sugarcane variety 'G.2003-47' had a significant superiority in the number of millable canes/ha and quality traits. The promising sugarcane 'G.2004-27' variety surpassed the other ones in stalk length, stalk weight as well as cane and sugar yields/ha in the plant and 1st ratoon cane.

In Egypt, several investigators reported that cane yield was increased with increasing nitrogen rate. They added that increasing N application from 100 up to 200 kg decreased quality parameters **El-,Geddawy *et al*. (2005); Mohamed and Ahmed (2005); Ismail *et al*. (2008**);**El- Mokadem *et al*. (2008); Taha *et al*. (2008) and Bekheet *et al*. (2011)** stated that raising N fertilization level from 170 to 200 kg

N/fed for the plant cane and from 185 to 215 kg N/fed for the 1st ratoon crop resulted in a significant increase in cane stalk height, stalk diameter, number of millable canes, cane and sugar yield/fed. **Abd El-Aal *et al*. (2015)** reported that increasing N fertilization level from 180 to 210 and 240 kg N/fed resulted in a significant increase in stalk diameter and cane yield of plant cane. On the contrary, sucrose and sugar recovery percentage significantly decreased as the applied N-dose was increased. **Bekheet *et al*. (2018)** were showed that increasing nitrogen levels from 150 up to 210 kg N/fad resulted in a significant increase in plant length, diameter, stalk weight, number of millable canes, cane and sugar yields, as well as brix, sucrose, quality and sugar recovery percentages in both seasons.

The objective of this work was to find out the best combination of the studied factors to attain the maximum cane and sugar yields under conditions of Sohag Governorate.

MATERIALS AND METHODS

The present investigation was carried out at Shandaweel Agricultural Research Station, Sohag Governorate [26.5013° N, 31.7651° E] during 2016/2017 and 2017/2018 seasons to investigate the effect of three row spacing (80, 100 and 120 cm) and three nitrogen levels (180, 210 and 240 kg N/fed) on yield and quality of three sugarcane varieties (Giza 2003-47) [G3], G.iza 2004-27) [G4], in addition to G.T.54-9 (commercial variety). A split-split plot design with three replications was used, where row spacing were allocated in the main plots, the sub plots were assigned for the three sugarcane varieties, while the three N levels were distributed in the sub-sub plots. Sugarcane was grown as a plant cane in the first week of March and harvested at age of 12 months in both seasons. Nitrogen fertilizer (Urea, 46.5% N) was added in two equal doses. The first one was applied 50 days after planting, preceded with hoeing. The second N-dose was added one month after the 1st one. Recommended P fertilizer was added during seed bed preparation at the rates of 30 kg P_2O_5 (as super phosphate, 15.5%). Recommended K fertilizer was added with the second dose of nitrogen at the rate 48 kg K_2O (as potassium sulphate 48% K_2O/fed. Plot area was 60 m^2, including 15, 12 and 10 rows in the case of spacing 80, 100 and 120 cm spacing, respectively and 5 m in length). The other agricultural practices were done as recommended /by Sugar

Crops Research Institute. The soil mechanical and chemical properties of the experimental sites were determined according to **Jackson (1973)** and are shown in **Table (1)**

At harvest, 20 plants were randomly taken from each plot and cleaned to determine:-

1-stalk height (cm)

2- Stalk diameter (cm)

3- number of millable canes/fed

4- cane yield (ton/fed)

5-Brix percentage (total soluble solids, TSS %) in juice was determined using Brix Hydrometer standardized at 20 C^{o}.

6-Sucrose/100 cm^{3} juice was determined using Sacharemeter according to **A.O.A.C. (2005)**.

7- Sugar recovery percentage was calculated as follows:
Sugar recovery % = richness % x purity %, where richness = (sucrose in 100 x factor) /100. Factor = 100- [fiber% + physical impurities% + percent water free from sugar].

8-sugar yield (ton/fed) which was estimated according to the following equation: Raw sugar production = cane yield (tons/fed) x sugar recovery %.

The collected data were statistically analyzed according to **Snedecor and Cochran (1981)**. Treatment means were compared using LSD at 5% level.

Table (1): Physical and chemical properties of the upper 40 cm of the experimental soil.

Season		2016/2017	2017/2018
Physical analysis	Sand	53.20	51.70
	Silt	28.40	27.75
	Clay	18.40	20.60
	Soil texture	Sandy loam	Sandy loam
	$Ca\ co_3$	1.38 %	1.28 %
	O.M.	0.81%	0.80 %
Chemical analysis	E.C ds/cm^3	1.12	1. 19
	pH	7.2	7.4
	N Available (ppm)	25.0	26.31
	P Available (ppm)	18.25	18.40
	K Available (ppm)	554	552
	$Co_{3\ Meq/100g}$	Absent	Absent
	$H\ Co_{3\ Meq/100g}$	0.318	0.225
	$Cl_{Meq/100g}$	0.437	0.253
	$So_4^{=}{}_{Meq/100g}$	0.704	0.604
	$Ca^{++}{}_{Meq/100g}$	0.609	0.503
	$Mg^{++}{}_{Meq/100g}$	0.415	0.312
	$Na^{+}{}_{Meq/100g}$	0.313	0.165
	$K^{+}{}_{Meq/100g}$	0.122	0.102

RESULTS AND DISCUSSION

1. Stalk height:

Data in **Table (2)** showed that increasing row spacing from 80 to 100 and to 120 cm led to a significant decrease in cane stalk height in both seasons. The results manifested that increasing row spacing to 100 and to 120 cm decreased stalk height by (7.67 and 18.15 cm) and (7.70 and 15.26 cm) in the first and second season, respectively, compared to sugarcane grown at 80 cm. The results are in consistence with those obtained by **El-Shafai and Ismail (2006).** This result could

be due to the intra specific competition among cane plants for light in the dense planting, *i.e.* narrower row spacing.

The tested sugarcane varieties varied significantly in stalk height in both seasons. The commercial G.T.54-9 variety had the highest stalks among the two varieties, followed by G.3 and G.4 which recorded the lowest values in this trait. The variance among cane varieties in this trait may be due to their gene make-up. These finding coincide with those reported by **El-Shafai and Ismail (2006); Ismail *et al.* (2008)** and **Ahmed *et al.* (2008**) who recorded differences among the tested cane varieties in stalk height.

Data in **Table (2)** clear that increasing the applied N levels from 180, 210 to 240 kg N/fed led to a significant increase in stalk height. The increase in stalk height may be attributed to the role of nitrogen as an essential element in building-up plant organs and enhancing their growth. These results are in agreement with those reported by **El-Mokadem *et al*. (2008)** and **Bekheet *et al*. (2018)**.

Regarding to the 1st order interaction it could be noticed that ,the interaction effect between row spacing x sugarcane varieties was significant on stalk height in both seasons. Using 80 cm row spacing with sugarcane G.T.54-9 variety recorded the highest stalk height in both seasons. Row spacing x nitrogen levels interaction had a significant effect on stalk height in both season. Using 80 cm row spacing with 240 kg N/fed recorded the highest stalk height in both seasons. Sugarcane varieties x nitrogen fertilization levels interaction had significant effect on stalk height in both seasons. Using G.T.54-9 variety with 240 kg N/fed recorded the highest stalk height in both seasons.

The second order interaction among the three studied factors had a significant effect on stalk height in both seasons. Using 80 cm row spacing with sugarcane G.T.54-9 variety at a rate of 240 kg N/fed recorded the highest stalk height in both seasons compared with the other interactions.

2. Stalk diameter:

Data in **Table (2)** showed a significant and gradual increase in cane stalk diameter associated with widening spacing between rows from 80 to 100 and 120 cm in both seasons. This result may be attributed to lower intraspecific competition for nutrients, water and solar radiation among cane plants grown in wider rows, which

reflected in better growth conditions, compared with those grown in narrower ones. This result is in accordance with those reported by **El-Geddawy *et al*. (2002)** and **Rizk (2004-b)**.

The tested sugarcane varieties varied significantly in stalk diameter in both seasons. The G.3 variety had the thickest stalks, while G. 4 variety recorded the lowest value of this growth character. Meantime, G.T.54-9 had moderate stalk diameter. The variance among cane varieties in these traits may be due to their gene make-up. These findings coincide with those obtained by **El-Shafai and Ismail (2006); Ismail *et al.* (2008)** and **Ahmed *et al.* (2008**) who recorded differences among the tested cane varieties in stalk diameter.

The results clear that increasing the applied N levels up to 210 and 240 kg N/fed a significantly increased in stalk diameter in both seasons. This result may be attributed to the role of N element in building-up plant organs and enhancing plant growth. These results are in agreement with those reported by **El- Mokadem *et al*. (2008) and Bekheet *et al*. (2018)**.

The interaction effect between row spacing x sugarcane varieties was significant on stalk diameter in both seasons. Using 120 cm row spacing with sugarcane G.3 variety recorded the highest stalk diameter in both seasons.

Row spacing x nitrogen levels interaction had a significant effect on stalk diameter in both season. Using 120 cm row spacing with 240 kg N/fed recorded the highest stalk diameter in both seasons.

Sugarcane varieties x nitrogen fertilization levels interaction had significant effect on stalk diameter in both seasons. Using G.3 variety with 240 kg N/fed recorded the highest stalk diameter in both seasons.

The second order interaction among the three studied factors had a significant effect on stalk diameter in both seasons. Using 120 cm row spacing with sugarcane G.3 variety at a rate of 240 kg N/fed in recorded the highest stalk diameter in both seasons.

Table (2): Effect of row spacings, sugar cane variety, nitrogen levels and their interactions on stalk height and diameter (cm) in 2016/2017 and 2017/2018 seasons

Row spacings (cm) (A)	Varieties	Stalk height (cm)								Stalk diameter (cm)							
		2016/2017				2017/2018				2016/2017				2017/2018			
		Nitrogen kg/fed (C)			Mean	Nitrogen kg/fed (C)			Mean	Nitrogen kg/fed (C)			Mean	Nitrogen kg/fed (C)			Mean
		180	210	240		180	210	240		180	210	240		180	210	240	
80	Giza 54-9	322.33	328.33	333.33	328.00	316.33	324.00	329.67	323.33	2.48	2.51	2.53	2.51	2.50	2.52	2.54	2.52
	Giza-3	317.67	322.33	327.67	322.65	310.67	315.67	321.67	316.00	2.49	2.52	2.54	2.52	2.51	2.53	2.55	2.53
	Giza-4	313.00	318.00	323.67	318.22	299.33	309.67	316.67	308.56	2.44	2.49	2.50	2.48	2.46	2.50	2.52	2.49
Mean		317.67	322.89	328.22	322.93	308.78	316.44	322.67	315.96	2.47	2.50	2.53	2.50	2.49	2.52	2.54	2.51
100	Giza 54-9	318.33	323.00	327.67	323.00	309.67	317.33	322.00	316.33	2.52	2.54	2.59	2.55	2.53	2.55	2.61	2.57
	Giza-3	307.00	315.00	320.67	314.22	300.67	308.33	313.33	307.44	2.53	2.56	2.61	2.57	2.55	2.57	2.62	2.58
	Giza-4	299.33	310.67	315.67	308.56	294.33	301.67	307.00	301.00	2.47	2.51	2.53	2.50	2.48	2.53	2.55	2.52
Mean		308.22	316.22	321.33	315.26	301.56	309.11	314.11	308.26	2.51	2.54	2.58	2.54	2.52	2.55	2.59	2.55
120	Giza 54-9	302.67	310.67	318.00	310.44	300.00	307.00	313.33	306.78	2.55	2.58	2.61	2.58	2.57	2.60	2.63	2.60
	Giza-3	297.33	305.33	315.00	305.89	293.67	300.33	307.00	300.33	2.58	2.61	2.63	2.61	2.60	2.62	2.64	2.62
	Giza-4	292.33	297.33	304.33	298.00	286.67	297.00	301.33	295.00	2.51	2.54	2.56	2.53	2.52	2.55	2.58	2.55
Mean		297.44	304.44	312.44	304.78	293.44	301.44	307.22	300.70	2.55	2.57	2.60	2.57	2.56	2.59	2.62	2.59
Mean varieties	Giza 54-9	314.44	320.67	326.33	320.48	308.67	316.11	321.67	315.48	2.62	2.54	2.58	2.55	2.53	2.56	2.59	2.56
	Giza-3	307.33	314.22	321.11	314.22	301.67	308.11	314.00	307.93	2.54	2.56	2.59	2.56	2.56	2.58	2.61	2.58
	Giza-4	301.56	308.67	314.56	308.26	293.44	302.78	308.33	301.52	2.47	2.51	2.53	2.50	2.49	2.52	2.55	2.52
Nitrogen average		307.78	314.52	320.67		301.26	309.00	314.67		2.51	2.54	2.57		2.52	2.55	2.58	
LSD at 0.5 level for:																	
Row spacings (A)					3.01				1.43				0.004				0.005
Varieties (B)					0.87				1.17				0.009				0.006
Nitrogen levels (C)					0.84				0.82				0.004				0.004
(A) x (B)					1.50				2.02				0.015				0.010
(A) x (C)					1.46				1.42				0.007				0.007
(B) x (C)					1.46				1.42				0.007				0.007
(A) x (B) x (C)					2.52				2.46				0.012				0.011

3. Number of millable canes/fed and canes yield/fed:

Data in **Table (3)** cleared that increasing distance between rows from 80 up to 120 cm resulted in a significant reduction in the number of millable cane/fed and cane yield (ton/fed) in both seasons. These results could be due that widening distance between rows to 120 cm decreased the planting density material. These results are in agreement with those mentioned by **El-Geddawy *et al.* (2002)** and **Raskar and Bhoi (2003), El-Shafai and Ismail (2006)** and **Abd El-Lattief (2016).**

Sugarcane G.4 variety significantly surpassed the other two varieties in number of millable cane in both seasons, while G.T.54-9 variety had significantly surpassed the other two varieties in cane yield/fed in both seasons. The difference among cane varieties in these traits could be due to their gene make-up. These findings coincide with those obtained by **El-Shafai and Ismail (2006); Ismail *et al.* (2008)** and **Ahmed *et al.* (2008**) who recorded differences among the tested cane varieties in these characters.

Significant increases in number (0.63 and 1.40) and (0.27 and 0.82) thousand millable cane/fed and (1.50 and 2.68) and (1.42 and 2.75) ton/fed were obtained by supplying sugarcane with 210 kg N/fed and 240 kg N/fed compared with that recorded by applying 180 kg N/fed in the first and second season, successively. These results are probably due to the increase of both stalk height and diameter as N-level was raised (Table 2) which may be referred to the role of nitrogen as an essential element in building up plant organs. These results coincided with those given by **Ismail *et al.* (2008);El-Mokadem *et al.* (2008)** and **Bekheet *et al.* (2018)**.

Number of millable cane/fed and cane yield (ton/fed) was significantly affected by the interaction between row spacing x sugarcane varieties in both seasones, planting sugarcane G.T.54-9 variety at 80 cm between rows given the highest cane yield/fed in both seasons while, G.4 variety gave highest number of millable cane in both seasons at the same row spacing.

The interaction between row spacing x N levels was significantly in both seasons. Using 80 cm row spacing with 240 kg N/fed recorded the highest number of millable and cane yields/fed in both seasons, without significant difference from that obtained with using 100 cm at the same rate 240 kg N/ in the second seasons.

The interaction between sugarcane varieties x N levels was significantly in both seasons G.4 variety with 240 kg N/fed gave highest number of millable cane while G.T.54-9 variety gave the highest yield/fed in both seasons

The 2nd order interaction among the three studied factors had a significant influence on number of millable cane and cane yield/fed in both seasons. Planting G.T.54-9 variety at 80 cm between rows fertilizing with 240 kg N/fed given the highest can yield/fed in both seasons while, G.4 variety gave highest number of millable and the lowest cane yield in both seasons at the same row spacing .

Table (3): Effect of row spacings, sugar cane variety, nitrogen levels and their interactions on number of millable cane (thousand/fed) and cane yield (ton/fed) in 2016/2017 and 2017/2018 seasons

Row spacings (cm) (A)	Varieties	Number of millable cane (thousand/fed)								Cane yield (ton/fed)							
		2016/2017				2017/2018				2016/2017				2017/2018			
		Nitrogen kg/fed (C)			Mean	Nitrogen kg/fed (C)			Mean	Nitrogen kg/fed (C)			Mean	Nitrogen kg/fed (C)			Mean
		180	210	240		180	210	240		180	210	240		180	210	240	
80	Giza 54-9	45.37	45.94	46.83	46.05	44.64	45.27	45.77	45.23	53.42	56.26	56.71	55.46	52.64	53.89	55.11	53.88
	Giza-3	45.13	45.65	46.69	45.82	44.08	44.74	45.22	44.68	59.62	51.18	52.26	51.02	49.49	50.93	52.24	50.89
	Giza-4	46.36	47.15	48.45	47.32	48.92	46.55	47.23	47.57	52.14	53.27	54.35	53.25	50.92	52.37	52.64	52.31
Mean		45.62	46.25	47.32	46.40	45.88	45.52	46.07	45.83	51.73	53.57	54.44	53.24	51.02	52.40	53.66	52.36
100	Giza 54-9	44.09	44.83	45.06	44.66	43.15	43.80	44.35	43.77	52.34	53.44	54.97	53.58	51.96	53.86	55.31	53.71
	Giza-3	43.31	43.95	44.68	43.98	42.70	43.05	43.86	43.20	49.47	51.13	52.21	50.94	49.74	51.06	52.27	51.02
	Giza-4	44.84	45.38	46.06	45.42	43.90	44.49	44.99	44.46	50.92	52.25	53.60	52.26	50.88	52.19	53.46	52.18
Mean		44.08	44.72	45.27	44.69	43.25	43.78	44.40	43.81	50.91	52.27	53.60	52.26	50.86	52.37	53.68	52.30
120	Giza 54-9	42.10	42.78	43.33	42.74	41.53	42.00	42.51	42.01	50.83	52.06	53.19	52.03	50.36	51.98	53.39	51.91
	Giza-3	41.67	42.41	43.10	42.39	40.91	41.60	42.23	41.58	48.31	49.57	51.07	49.65	48.14	49.40	50.84	49.46
	Giza-4	42.65	43.17	43.98	43.26	42.00	42.74	43.08	42.61	49.64	51.00	52.39	51.01	49.76	51.00	52.37	51.04
Mean		42.14	42.79	43.47	42.80	41.48	42.11	42.61	42.07	49.59	50.88	52.21	50.90	49.42	50.79	52.20	50.80
Mean varieties	Giza 54-9	43.85	44.52	45.07	44.48	43.11	43.69	44.21	43.67	52.20	53.92	54.96	53.69	51.65	53.24	54.60	53.17
	Giza-3	43.37	44.00	44.83	44.07	42.56	43.13	43.77	43.16	49.13	50.63	51.85	50.54	49.12	50.46	51.79	50.46
	Giza-4	44.62	45.23	46.16	45.34	44.94	44.59	45.10	44.88	50.90	52.17	53.45	52.17	50.52	51.85	53.16	51.84
Nitrogen average		43.95	44.58	45.35		43.54	43.81	44.36		50.74	52.24	53.42		50.43	51.85	53.18	
LSD at 0.5 level for:																	
Row spacings (A)					0.19				0.66				0.17				0.74
Varieties (B)					0.10				0.62				0.20				0.79
Nitrogen levels (C)					0.08				0.57				0.23				0.06
(A) x (B)					0.17				1.08				0.35				0.14
(A) x (C)					0.13				0.98				0.40				0.11
(B) x (C)					0.13				0.98				0.40				0.11
(A) x (B) x (C)					0.23				1.70				0.70				0.19

4. Juice quality percentages and sugar yield /fed:

Data in **Tables 4 and 5** showed that increasing distances between rows from 80 to 100 up to 120 cm caused a significantly increased in the brix, sucrose, sugar recovery percentages and sugar yield tons/fed. These results are in agreement with those mentioned by **Ismail *et al*. (2008)** and **El- Mokadem *et al*. (2008)**.

Sugarcane G.3 variety surpassed significantly G.T.54-9 and G.4 varieties in brix, sucrose, sugar recovery percentages and sugar yield/fed in both seasons. Meanwhile, G.4 variety recorded the lowest ones. Sugarcane G.3 variety produced 0.12 and 0.24 ton of sugar/fed, in the 1st season and 0.09 and 0.26 ton of sugar/fed, in the 2nd one higher than those given by G.T.54-9 and G.4 varieties, successively. Moreover, The difference among cane varieties in these traits could be due to their genetic structure. These findings are in agreement with those reported by **El-Shafai and Ismail (2006); Ismail *et al.* (2008); Ahmed *et al.* (2008); El-Bakry (2018**) and **Galal *et al.* (2018)** recorded differences among the tested cane varieties in these characters.

Nitrogen rates showed significantly effected on brix, sucrose, sugar recovery percentages and sugar yield/fed, in both seasons. Gradual increases in brix, sucrose, sugar recovery percentages and sugar yield ton/fed values were noticed as nitrogen rate increased from 180 up to 210 kg N/fed. Thereafter, the additional nitrogen increment was not accompanied by an increase in brix, sucrose, sugar recovery percentages in both seasons, while sugar yield increased by increasing nitrogen up to 240 kg/fed in both seasons. Similar results were observed by **El- Mokadem *et al*. (2008)** and **Bekheet *et al*. (2018)**.

Brix, sucrose, sugar recovery percentages and sugar yield/fed were significantly affected by the interaction between row spacing x sugarcane varieties in both seasons. Planting sugarcane G.3 at row spacing 120 cm gave the highest values of brix, sucrose, sugar recovery percentages and sugar yield/fed in both seasons.

Brix, sucrose, sugar recovery percentages and sugar yield ton/fed were significantly affected by the interaction between row spacing x N levels in both seasons. Using row spacing at 120 cm with 210 kg N/fed gave the highest values of brix, sucrose and sugar recovery percentages in both seasons, while, highest values of sugar yield/fed, recorded at 120 cm with 240 kg N/fed in both seasons.

Brix, sucrose, sugar recovery percentages and sugar yield ton/fed were significantly affected by the interaction between sugarcane varieties x N levels in both seasons. Planting sugarcane G.3 fertilized at rate 210 kg N/fed gave the highest values of brix, sucrose and sugar recovery percentages in both seasons.

The 2nd order interaction among the three studied factors had a significant influence on brix, sucrose, sugar recovery percentages and sugar yield/fed in both seasons. Planting sugarcane G.3 variety at row spacing 120 cm fertilized with 210 kg N/fed gave the highest values of brix, sucrose, sugar recovery percentages and sugar yield/fed in both seasons.

Under conditions of the present work, growing commercial sugarcane variety G.T.54-9 and promising G.3 (2003-47) variety in rows of 100 cm apart and fertilized with 240 kg N/fed can be recommended to get the maximum cane and sugar yields/fed.

Table (4): Effect of row spacings, sugar cane variety, nitrogen levels and their interactions on birx and sucrose percentages in 2016/2017 and 2017/2018 seasons

Row spacings (cm) (A)	Varieties	Birx %								Sucrose percentage %							
		2016/2017				2017/2018				2016/2017				2017/2018			
		Nitrogen kg/fed (C)			Mean	Nitrogen kg/fed (C)			Mean	Nitrogen kg/fed (C)			Mean	Nitrogen kg/fed (C)			Mean
		180	210	240		180	210	240		180	210	240		180	210	240	
80	Giza 54-9	18.33	18.92	18.67	18..64	18.89	19.39	19.19	19.15	16.41	16.83	16.62	16.62	16.82	17.45	17.25	17.17
	Giza-3	19.54	20.79	19.91	20.08	20.11	20.68	20.39	20.39	17.59	18.91	17.90	18.14	18.21	18.74	18.48	18.48
	Giza-4	18.05	18.47	18.28	18.27	18.70	19.23	18.99	18.98	16.30	16.64	16.55	16.50	16.67	17.30	17.03	17.00
Mean		18.64	19.39	18.95	19.00	19.23	19.77	19.52	19.51	16.77	17.46	17.06	17.09	17.23	17.83	17.58	17.55
100	Giza 54-9	19.85	20.39	20.06	20.10	20.09	20.73	20.37	20.39	18.00	18.53	18.25	18.26	18.18	18.79	18.44	18.47
	Giza-3	21.00	21.81	21.45	21.42	21.47	21.95	21.73	21.72	18.98	19.88	19.46	19.44	19.55	19.94	19.82	19.77
	Giza-4	19.63	20.03	19.91	19.85	19.98	20.55	20.18	20.24	17.75	18.08	17.97	17.93	18.03	18.65	18.27	18.32
Mean		20.16	20. 74	20.47	20.46	20.51	21.08	20.76	20.78	18.24	18.83	18.56	18.54	18.59	19.13	18.84	18.85
120	Giza 54-9	20.59	20.87	20.89	20.75	20.84	21.09	20.99	20.98	18.62	18.95	19.80	18.79	18.90	19.08	19.02	19.00
	Giza-3	21.77	21.98	21.84	21.86	21.99	22.79	22.09	22.29	19.83	20.10	20.02	19.98	20.06	20.89	20.13	20.36
	Giza-4	20.36	20.79	20.47	20.54	20.67	21.18	20.88	20.91	18.46	18.82	18.63	18.64	18.76	19.27	18.87	18.97
Mean		20.91	21.21	21.03	21.05	21.17	21.69	21.32	21.39	18.97	19.29	19.15	19.14	19.24	19.75	19.34	19.44
Mean varieties	Giza 54-9	19.59	20.06	19.84	19.83	19.94	20.40	20.18	20.17	17.68	18.11	17.89	17.89	17.97	18.44	18.23	18.21
	Giza-3	20.77	21.53	21.07	21.12	21.19	21.81	21.40	21.47	18.80	19.63	19.13	19.19	19.27	19.86	19.47	19.53
	Giza-4	19.35	19.76	19.55	19.55	19.78	20.32	20.02	20.04	17.50	17.85	17.72	17.69	17.82	18.40	18.06	18.09
Nitrogen average		19.90	20.45	20.15		20.30	20.84	20.54		18.00	18.53	18.24		18.35	18.90	18.59	
LSD at 0.5 level for:																	
Row spacings (A)					0.11				0.04				0.11				0.06
Varieties (B)					0.07				0.06				0.06				0.07
Nitrogen levels (C)					0.05				0.05				0.04				0.04
(A) x (B)					0.12				0.10				0.11				0.11
(A) x (C)					0.09				0.08				0.07				0.07
(B) x (C)					0.09				0.08				0.07				0.07
(A) x (B) x (C)					0.16				0.14				0.13				0.13

Table (5): Effect of row spacings, sugar cane variety, nitrogen levels and their interactions on sugar recovery% and sugar yield (ton/fed) in 2016/2017 and 2017/2018 seasons

Row spacings (cm) (A)	Varieties	Sugar recovery								Sugar yield (ton/fed)							
		2016/2017				2017/2018				2016/2017				2017/2018			
		Nitrogen kg/fed (C)			Mean	Nitrogen kg/fed (C)			Mean	Nitrogen kg/fed (C)			Mean	Nitrogen kg/fed (C)			Mean
		180	210	240		180	210	240		180	210	240		180	210	240	
80	Giza 54-9	10.60	10.42	10.32	10.45	10.43	10.88	10.78	10.70	5.58	5.87	5.85	5.76	5.49	5.87	5.94	5.77
	Giza-3	10.97	11.79	11.12	11.29	11.37	11.66	11.52	11.51	5.44	6.03	5.81	5.76	5.63	5.94	6.02	5.86
	Giza-4	10.32	10.48	10.49	10.43	10.36	10.80	10.62	10.59	5.38	5.58	5.70	5.56	5.28	5.66	5.70	5.54
Mean		10.63	10.90	10.64	10.72	10.72	11.11	10.97	10.94	5.47	5.83	5.79	5.69	5.47	5.82	5.88	5.72
100	Giza 54-9	11.28	11.58	11.45	11.43	11.35	11.69	11.48	11.50	5.90	6.19	6.29	6.13	5.90	6.29	6.35	6.18
	Giza-3	11.74	12.32	12.04	12.03	12.13	12.33	12.29	12.25	5.81	6.30	6.28	6.13	6.03	6.30	6.42	6.25
	Giza-4	11.11	11.25	11.20	11.19	11.23	11.63	11.39	11.42	5.66	5.88	6.00	5.85	5.72	6.07	6.09	5.96
Mean		11.37	11.72	11.56	11.55	11.57	11.88	11.72	11.72	5.79	6.12	6.19	6.04	5.88	6.22	6.29	6.13
120	Giza 54-9	11.57	11.79	11.65	11.67	11.74	11.80	11.79	11.78	5.88	6.14	6.20	6.07	5.91	6.14	6.29	6.11
	Giza-3	12.29	12.48	12.48	12.42	12.42	12.91	12.42	12.58	5.94	6.19	6.37	6.17	5.98	6.38	6.32	6.23
	Giza-4	11.52	11.67	11.65	11.61	11.68	11.97	11.85	11.83	5.72	5.96	6.11	5.93	5.81	6.11	6.21	6.04
Mean		11.79	11.98	11.93	11.90	11.95	12.23	12.02	12.07	5.84	6.09	6.23	6.05	5.90	6.21	6.27	6.13
Mean varieties	Giza 54-9	11.15	11.26	11.14	11.18	11.17	11.46	11.35	11.33	5.79	6.06	6.11	5.99	5.77	6.10	6.19	6.02
	Giza-3	11.66	12.20	11.88	11.91	11.97	12.30	12.08	12.12	5.83	6.17	6.16	6.02	5.88	6.20	6.25	6.11
	Giza-4	10.98	11.13	11.11	11.08	11.09	11.47	11.29	11.28	5.59	5.81	5.94	5.78	5.60	5.94	6.00	5.85
Nitrogen average		11.27	11.53	11.38		11.41	11.74	11.57		5.70	6.01	6.07		5.75	6.08	6.15	
LSD at 0.5 level for:																	
Row spacings (A)					0.11				0.03				0.06				0.03
Varieties (B)					0.04				0.05				0.04				0.03
Nitrogen levels (C)					0.05				0.04				0.02				0.02
(A) x (B)					0.08				0.09				0.08				0.06
(A) x (C)					0.08				0.06				0.04				0.04
(B) x (C)					0.08				0.06				0.04				0.04
(A) x (B) x (C)					0.14				0.11				0.07				0.07

REFERENCES

A.O.A.C. (2005). Association of Official Analytical Chemists. Official methods of analysis, 26th Ed. A.O.A.C., International, Washington, D.C; USA.

Abd El-Aal, A.M.; S.R.E. El Shiekh and M.A. Fergany (2015). Ratooning ability of some sugarcane promising varieties under different levels of nitrogen fertilization. Egypt. J. Appl. Sci., **30** (1): 23-34.

Abd El-Lattief, E.A.A. (2016). Yield and yield attributes of sugarcane as affected by some crop management treatments. I J Res Eng Appl. Sci 6(12): 11-19.

Ahmed, A.Z.; M.S.H. Osman and A. Mahmed (2008). Effect of excessive nitrogen application on yield and quality of three sugarcane varieties. Intern. Conf. "IS-2008" Meeting the Challenges of Sugar Crops & Integrated Industries in Developing Countries. Held at Sinai Univ., 11-14 Sep., 2008, Al-Arish, Egypt. pp. 34-39.

Avtar, S. (2000). Influence of seed rate and row spacing on the growth and yield of late planted sugarcane. Sugar Tech., 2(3): 49-50

Bekheet, M.A.; A.F.I. Gadallah and Y.A.M. Khalifa (2018). Enhancement of yield and quality of sugarcane by applied nitrogen, phosphorus and filter cake. Egypt. J. Agro. 40(3): 207 – 221.

Bekheet, M.A.; N.M.S. Shalaby and M.M. Ibrahim (2011): Effect of row spacing and nitrogen fertilization on yield and quality of two sugarcane varieties,Fayoum J. Agric. Res. & Dev., 25(2):112-127

El-Bakry, A. (2018). Effect of row spacing on some sugarcane varieties yield and juice quality. J Biol Chem Environ Sci 13(2): 105-120.

El-Geddawy, I.H.; D.G. Darweish; A.A. El-Sherbiny and E.E.A. El-Hady (2002). Effect of row spacing and number of buds/seed setts on 1- growth characters of first ratoon crops for some sugar cane varieties. Pakistan Sugar J., **17** (3): 7-14.

El-Geddawy, I.H.; M.S. Rady; H.A. Dawwam; F.A. Hendaw and R.A.M. Abo El-Ghait (2005). Response of some sugar cane varieties to nitrogen and potassium application. Egypt. J. Agric. Res., **83**(2): 693-707.

El-Shafai, A.M.A. and A.M.A. Ismail (2006). Effect of row spacing on yield and quality of some promising sugarcane varieties. Egypt. Appl. Sci., **21** (11): 32-46.

Galal, M.O.A.; M.A.M. Osman and A.M.K. Ali (2018). Evaluation of some promising sugarcane varieties for yield, quality and natural infection with Pokkah Boeng disease under different row spacing. J Agri Res 3(9): 1-13.

Jackson M.l.(1973). Soil Chemical Analysis Prentice-Hall of India private, New Delhi.

Ismail, A.M.A.; M.A. Bekheet and A.S. Abo El-Hamd. (2008). Yield and quality of four sugarcane varieties as influenced by seed rate and nitrogen fertilization. Egypt. J. Appl. Sci., **23** (1): 107-123.

Mohamed, B.D. and A.Z. Ahmed (2005). Response of three sugar cane varieties to varing nitrogen fertilizer rates. The 11th Conference of Agronomy, Agron. Dept., Fac. Agric., Assiut. Univ., Nov. 15-16..

Mokadem, Sh.A.; S.A.A. AtaAllah; M.A Bekheet and A.F.I. Gadalla (2008). Effect of sources, levels and number of applications of nitrogen fertilizer on yield and quality of sugar cane.Minia J. Agric. Res., Develop., **28** (4): 767-783.

Raskar, B.S. and P.G. Bhoi (2003). Yield attributes of sugarcane as influenced by intra-row spacings, fertilizer levels and planting materials. Indian Sugar, 53(5): 327-331.

Rizk, T.Y.; M.H. El-Agroudy; I.H. El-Geddawy and M.A. Fergany (2004-a). Effect of row spacing and cutting size on cane juice quality attributes. Egypt. J. Agric. Res., **82** (1): 251-262.

Rizk, T.Y.; M.H. El-Agroudy; I.H. El-Geddawy and M.A. Fergany (2004-b). Effect of row distance and cutting size on growth criteria of two promising sugar cane varieties and the commercial variety. Egypt. J. Agric. Res., **82** (1): 263-276.

Snedecor, G.W. and W.G. Cochran (1981). Statistical Methods. Seventh Ed. Iowa State Univ. Press, Ames, Iowa, USA.

Taha, E.M.; Sh.A. Mokadem; A.Z. Ahmed and M.O. Galal (2008). Assessment of the optimum seeding rate and nitrogen level for five sugarcane varieties. Minia J. Agric. Res & Develop **28**(3): 469-494.

تأثير مسافة التخطيط والتسميد النيتروجينى على حاصل وجودة بعض اصناف قصب السكر

احمد فتحى ابراهيم جادالله * رانيا محمد عبدالعزيز

معهد بحوث المحاصيل السكرية- مركز البحوث الزراعية - جيزة- مصر

أُقيمت تجربه حقليه فى محطة البحوث الزراعية بشندويل (دائرة عرض 26.5013 شمالاً وخط الطول 31.7651 شرقاً) بمحافظة سوهاج خلال موسمى الزراعة 2017/2016 و 2018/2017 وذلك لدراسة تأثير المسافة بين الخطوط (80 و 100 و120سم) ومستويات التسميد النيتروجينى (180 و 210 و 240 كجم نيتروجين للفدان) على حاصل وجودة بعض أصناف قصب السكر (جيزة تايوان 54-9 (س9 كونترول) و الصنف جيزة 3 و الصنف جيزه 4) فىتصميم القطاعات كاملة العشوائيه بترتيب القطع المنشقة مرتين فى ثلاث مكررات .

أوضحت النتائج أن زراعة قصب السكر فى خطوط على مسافة 80 سم حققت زيادة معنوية فى طول العود وعدد العيدان القابلة للعصر، وحاصل العيدان/فدان. بينما أعطت مسافة التخطيط 120 سم اعلى القيم فى قطر العود ومحصول السكر/فدان والنسبة المئوية لكلٍ من البركس والسكروز وناتج السكر فى كلا الموسمين.

أظهرت النتائج أن زراعة الصنف التجارى س9 أعطى أعلى طول للساق وأعلى ناتج من محصول العيدان/فدان فى الموسمين. بينما حقق الصنف جيزة3 أفضل القيم فى سمك الساق ومحصول السكر/فدان وكذلك النسبة المئوية لكلا من البركس والسكروز وناتج السكر فى كلا الموسمين.

اظهرت النتائج أن زيادة معدل السماد النيتروجينى حتى 240 كيلو جرام ن/ فدان حققت زيادة معنوية فى طول وقطر العود وعدد العيدان القابلة للعصر ومحصولى العيدان والسكر/فدان، بينما حقق معدل التسميد لقصب السكر 210 كجم ن/فدان افضل القيم لكل من البركس والسكروز وناتج السكر فى كلا الموسمين.

أظهرت النتائج معنويه التفاعل الثنائى و الثلاثى بين عوامل الدراسه على الصفات المدروسه لقصب السكر فى منطقه البحث. تحت ظروف هذه الدراسة يمكن التوصيه بزراعة اى من أصناف قصب السكر س9 او الصنف جيزة3 فى خطوط على مسافة 100 سم والتسميد بمعدل 240 كيلو جرام نيتروجين للفدان للحصول على أعلى حاصل من العيدان والسكر/فدان.