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EFFECT OF NITROGEN FERTILIZATION AND HIL SPACING ON YIELD AND JUICE QUALITY OF SWEET SORGHUM (*Sorghum bicolor*, L.)

Ramadan, B. S. H.
Agronomy Dept., Fac. Of Agric., Cairo Univ., Giza, Egypt.

ABSTRACT

Two field experiments were carried out at the Agricultural Experimental and Research Station, Faculty of Agriculture, Cairo University, Giza, Egypt, during 2003 and 2004 seasons to study the effect of some nitrogen rates (0, 40, 80, and 120 kg N/fed) and between hill spacing (20, 25, and 30 cm) on yield and juice quality of sweet sorghum . Variety " Roma" was used in the study.

Increasing nitrogen rates from zero to 120 kg N/fed markedly increased stalk diameter, stalk length and reducing sugars, while Brix and sucrose were decreased with increasing nitrogen rate. Stalk weight, juice extraction, and stripped stalk yield as well as syrup yield (gallon/fed) and total juice sugar yield were increased as nitrogen rate was increased up to 120 kg N/fed.

The results also revealed that the wider space (30 cm) between hills produced the highest stalk diameter, stalk length, Brix, and sucrose as well as reducing sugars and purity percentages. On the other hand stalk weight, stripped stalk yield, syrup yield gallon/fed and total juice sugar yield were increased with sweet sorghum grown at 25 cm between hills.

The interaction between nitrogen rate and hill spacing had a significant effect on some studied traits. Sweet sorghum grown at 25 cm between hills and given 120 kg N/fed gave the highest stripped stalk yield (ton/fed), syrup yield (gallon/fed) and total juice sugar yield (ton/fed).

INTRODUCTION

Sweet sorghum (*Sorghum bicolor*, L.) is a potential sugar and syrup crop which is adapted to a wide range of soil and climatic conditions. Soil fertility requirements for yield, syrup and sugar production for sweet sorghum are not well defined for most soil and cultural condition Nitrogen fertilization and plant density are among the most important factors that are responsible for achieving the production of high yield and quality of syrup

Singh (1974) Studied the effect of different levels of N application on sorghum juice quality . He found that the quality of juice deteriorated with the increasing of nitrogen application. Soileau and Bradford (1985) concluded that there was relationship betweet Brix reading of sweet sorghum juice and nitrogen fertilization. However, 90 and 180 Kg N/ha tended to yield more sugar than zero or 45 kg/ha Abbas and Al-Younis (1988) found that increasing nitrogen rate up to 120 kg N/ha. increased plant height, yield of stripped stems and sugar yield of sweet sorghum. Applying 120 kg N/ha increased sugar yield from 0.92 to 1.66 ton/ha. Atia, Nour El-Hoda, (1990) grew sweet sorghum under 0, 30, 45, 60, 75, 90 and 105 kg N/fed. She found that plant height, stalk diameter were significantly increased when nitrogen rate increased up to 105 kg N/fed. She added that juice extraction%, Brix, reducing sugars and purity % as well as yield of clean stalks and syrup yield were increased as N rate increased up to 105 kg N/fed. Almodares *et al.* (1996) applied 46, 92 and 138 kg N/ha. to sweet sorghum. They concluded that increasing nitrogen rate caused an increase in stalk yield but decreased sucrose and purity percentages. Besheit *et al.* (1996) grew sweet sorghum under different nitrogen rates; 60, 90, 120, 150 and 180 kg N/fed. They found that increasing nitrogen rate up to 150 kg N/fed significantly increased length, diameter of the stalk as well as juice extraction %, while syrup extraction was increased with the increase in nitrogen rate up to 180 kg N/fed They added that Brix and sucrose % were increased up to 120 kg N/fed While purity % decreased with the application of more than 120 kg N/fed. Balasubramanian and Ramamoorthy (1996) reported that juice yield, juice purity, and percentage of reducing sugars increased significantly with the increase in N application rate to 120 kg N/ha., but Brix value was lowest at the highest N application rate. Saheb *et al.* (1997) studied the effect of different levels of nitrogen (0, 50, 100, and 150 kg N/ha) on biomass and juice yields of sweet sorghum. They found that nitrogen application significantly increased juice crushing %, fresh stalk yield and juice yield, while Brix decreased with the increase in nitrogen rate up to 150 kg N/ha.

Mahmoud *et al.* (1999) and Azzazy *et al.* (2001) studied the effect of nitrogen rate, 50, 75 and 100 kg N/fed. on yiled and juice quality. They found that increasing nitrogen rate up to 100 kg N/fed markedly increased stalk diameter, length and mean stalk weight as well as reducing sugars% but decreased sucrose and purity percentages. They added that number of stripped stalks/fed., stalk weight, juice extraction %, stalk yield as well as syrup yield (ton/fed) were increased as N rate increased up to 100 kg N/fed. Ramadan (2003) grew sweet sorghum under different nitrogen rates *viz*, 50, 75 and 100 kg N/fed He found that application of 100 kg N/fed, significantly increased growth traits (diameter, length of the stalk and leaf area) juice extraction, stalk yield and syrup yield per ton of stalks and per fed and total juice sugar yield, while sucrose % was decreased as N rate increased. Brix and purity % were not significantly affected by nitrogen rates. El-Zeny, Maha (2004) using 0, 60, and 90 kg N/fed found that plant height, stalk diameter, number of internodes / plant, leaf area, number of leaves/plant, and stripped stalk yield were significantly increased as N rate increased. She added that juice yield and syrup yield as well as juice quality traits in terms of, Brix, sucrose %, reducing sugars % and purity % increased with 90 kg N/fed. El-Shafai *et al.* (2005) studied the effect of three mineral N levels (40, 60, and 80 kg N/fed) on yield and quality of sweet sorghum . They revealed that stalk height, stalk diameter, reducing sugars% and stripped stalk yield increased with increasing mineral N level from 40 to 80 kg N/fed However applying 60 kg N/fed was enough to obtain significantly the highest percentages of total soluble solids and sucrose.

Regarding the effect of plant spacing. Broadhead *et al.* (1963) studied the effect of different planting densities, resulting from spacing between hills (1, 4, 8, 12, 16 and 20 inch). They found that yields of stalk and syrup / acre usually decreased rapidly when the distance between plants was more than 6 to 8 inches. Juice extraction and stalk weight were decreased when plants were spaced closer than 6 to 8 inches in drill . Extraction and syrup per ton of stalks were increased as spacing increased up to 8 inches. Wider spacing resulted in higher Brix but sucrose and purity were unaffected.

Kalmbacher and Martin (1986) using distance of 2.5, 5, 10 or 20 cm between plants in rows 75 cm apart. They found that grain yield was decreased by about 310 Kg/ha with each cm increase in spacing, but solids content of juice was not affected by plant population. Caravetta *et al.* (1990) reported that the increase in within row spacing decreased dry matter yield due to a reduction in the number of plants / ha , reduction plant height, and the limited potential of the plant to compensate by increasing tillers production .Saheb *et al.* (1997) grew sweet sorghum at density of 80.000,100.000 or 120.000 plant/ha. They found that plant density of 120.000 plants/ha produced the highest dry biomass (12.2 ton / ha), fresh stalk yield (31.42 ton/ha.), crushing (33.4%) and juice yield (10,6 ton/ha).

Mallikarjun *et al.* (1997) grew sweet sorghum cv. Rio at densities of 220.000, 330.000, 440.000 or 660.000 plants/ha. Results indicated that the highest millable stalk yield was 40.0 t/ha., and the stalks had the best values for extractable juice, sugar content and Brix value. Millable stalk yield was higher at the density of 660.000 plants/ha. Mahmoud *et al.* (1999) studied the effect of row spacing (50 and 70 cm) and number of plants per hill (1, 2 and 3 plants), which resulted in six different plant densities ranged from 24.000 to 100.800 plants/ fed. They found that increasing plant density decreased stalk diameter, stalk weight, purity% and reducing sugars% as well as sucrose and Brix reading, while stalk and syrup yields were increased Amaducci *et al.* (2004) studied the effect of

two plant populations (10 and 20 plants/m^2). They found that higher plant density was associated with higher content of sucrose and lower content of glucose and fructose.

The objective of this paper was to determine the influence of nitrogen fertilization rates and plant density on yield of stalks and juice quality of sweet sorghum.

MATERIALS AND METHODS

Two experiments were conducted at the Agricultural Experiment and Research Station, Faculty of Agriculture, Cairo, University Giza, Egypt, during 2003 and 2004 seasons, to study the effect of nitrogen rates and between hill spacing on growth, juice quality and yield of sweet sorghum. Variety "Roma" which was obtained from Sugar Crop Research Institute, ARC, was used in this study, and was sown on the 7^{th} of May in both seasons A split-plot design with four replicates was used where four nitrogen rates (zero, 40 , 80 and 120 Kg N/fed) were arranged in the main plots, and applied in the form of urea (46% N) in two equal split doses, one half at thinning (two plants/hill) after 21 days from sowing and the other half after 36 days from sowing. Three spacing between hills 20 cm (60.000 plants/fed.), 25 cm (48.000 plants/fed) and 30 cm (40.000 plant/fed) were arranged in sub-plots. The sub-plot size was 17.5 m^2 (5 ridges, 5m long and 70 cm apart). At sowing 30 kg P_2O_5 and 24 kg k_2O/fed. were added. All cultural practices were carried out as usual. The soil type in the area is characterized as being clay, contained a Ec. of 1.21 and 1.10 mmohs /cm, pH of 7.9 and 7.6, total nitrogen of 0.34 and 0.32 %, organic matter content of 1.9 and 2.1%, $CaCO_3$ of 3.2 and 3 .6 %, K of 339 and 350 ppm and P of 9.4 and 10.1 ppm in the 1st and 2nd seasons, respectively.

At harvest time (dough stage), a random sample of ten stalks was taken from each sub-plot, the leaves and heads were removed to determine stalk length (measured from soil surface to the node at the base of the top mest-panicle), stalk diameter cm (measured at the middle of the fourth internode from stalk bottom), and mean stalk weight (g) (weight of sample / no. of clean stalks)x1000). Each sample was crushed in roller mill to obtain juice for analysis and percent juice extraction (weight of juice / weight of sample)x 100 was determined. Total soluble soilds (Brix) was estimated by using digital refractometer, Model PR1 (ATAGA), Japan. Sucrose % was determined by using direct polarization method as described by De-Whalley (1964). Purity percentage was calculated by dividing (sucrose % / Brix) x 100. Reducing sugars percentage in juice were determined by susing fehlin solution according to Plews (1970). Number of stalks/fed. and stalk yield ton/fed were determined on a plot basis. Syrup yield gallon/ton stalks was calculated by using the formula proposed by Broadhed *et al.* (1963) as follows: ST = EB (2000) (0.90) / (11.25) (0.75), where: ST gallons of syrup per ton of stalks, E = Percent juice Extraction; 2000 = pounds of stalks; 0.90 = factor for 10 % skmming loss; 11.25 = pounds per gallon of syrup, and 0.75 = % soluble solids in syrup (Brix). Syrup yield (gallon /fed.) was calculated by using the formula: ST x stalk yield (ton /fed). Total Juice sugar yield (ton / fed). was calculated by using the formula proposed by Soileau and Bradford (1985) as follows total juice sugar yield (ton/fed.) = fresh stalk yield x juice extraction % x Brix .

Data were subjected to statistical analysis according to statistical MSTATC package. The means were compared by using LSD test (Waller and Duncan, 1969) at 5 % level of significance.

RESULTS AND DISCUSSION

1- Effect of nitrogen rates:

Stalk diameter and length were significantly affected by the added nitrogen rates (Table1). Increasing nitrogen rates from zero to 120 kg N/fed markedly increased stalk diameter by 37.7 %, 28.6% and stalk length by 27.2, 26.7% in the first and second seasons compared to control, respectively. It is worthy to mention that the difference between 80 and 120 kg N was not significant for stalk diameter and length except for stalk diameter in the first season. The increase in stalk diameter and stalk length is mainly due to the role of nitrogen in stimulating the meristematic growth activity which contributes to the increase in number of cells in addition to cell enlargement. The result is in agreement with those obtained by, Besheit *et al.* (1996), Mahmoud *et al.* (1999) and El-Shafai *et al.* (2005).

Table 1 : Yield and yield components as affected by nitrogen rates in 2003 and 2004 seasons.

N rate kg /fed.	Stalk diameter cm		Stalk length cm		No. of stalks 10^3/fed		Mean stalk weight (g)		Stalk Yield (ton /fed)	
	Seasons									
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
0	1.60	1.74	192	215	49.67	50.17	350	367	20.6	21.7
40	1.91	2.10	222	226	49.65	49.11	492	514	28.7	30.0
80	2.11	2.23	243	255	49.22	49.61	537	565	31.2	33.2
120	2.41	2.44	248	255	50.56	50.78	576	585	34.2	35.4
a LSD at 0.05	0.11	0.22	15	12	ns	ns	62	47	2.8	3.1

Number of stripped stalks / fed was not significantly affected by nitrogen rates in both seasons. (Table 1), while Increasing nitrogen rate up to 120kg N/fed significantly increased mean stalk weight by 226 and 218 g and stalk yield by 13.6 and 13.7 ton/fed, over the control in both seasons, respectively . This increase in stalk weight and stalk yield may be attributed to longer and thicker stalks accompanying higher N rates as mentioned before. The increase in mean stalk weight and stalk yield accompanying higher nitrogen application was reported by Mahmoud *et al.* (1999) and El-Zeny, Maha (2004).

Juice quality traits in terms of Brix, sucrose, purity and reducing sugars percentages were significantly affected by nitrogen rates (Table 2). Increasing nitrogen rate up to 120 kg N/fed. markedly decreased Brix by 0.9 and 3.5% and sucrose by 11.6 and 8.3% and purity by 10.7 and 5.7% compared without nitrogen fertilization in both seasons, respectively. These results are in harmory with those of Balasubramanian and Ramamoorthy (1996), Saheb *et al.* (1997) and El- Shafai *et al.* (2005). On the contrary. Atia, Nour El Hoda (1990) reported that Brix and purity increased with increasing nitrogen rate up to 105 kg N/fed. On the other hand reducing sugars was increased as N rate was increased.

Nitrogen rates exhibited significant effects on juice extraction % (Table 2). A gradual increase in percent of extracted juice as N rate increased was recorded in both seasons. 120 kg N/fed gave the highest extraction % with an increase of 6.0 and 8.8 % over the unfertilized control in the 1st and 2nd seasons, respectively. This increase might have resulted from the stimulating effect of N on growth of sorghum plant in terms of length and diameter as mentioned before. The same findings were reported by Mahmoud *et al.* (1999) and Saheb *et al.* (1997).

Syrup yield (gallon/fed) and juice sugar yield (ton/fed) were significantly influenced by nitrogen rates (Table 2) The highest syrup yield (655 and 690 gallon/fed) and juice sugar yield (3.07 and 3.24 ton/fed) resulted from adding 120 kg N/fed in the first and second seasons, respectively. Such effect of higher nitrogen rate might have resulted from improving growth in terms of length, diameter and weight of individual stalk as mentioned before.

These findings are in agreement with those obtained by Abbas and Al-Younis (1988) and Ramadan (2003).

Table 2: Juice quality, syrup and juice sugar yields as affected by nitrogen rates and hill spacing in 2003 and 2004 seasons.

N rate kg /fed.	Brix %		Sucrose %		Purity %		Reducing sugars%		Juice extraction %		Syrup yield gallon*/fed		Total Juice sugar yield ton/fed	
	Seasons													
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
0	22.3	[illegible]	[illegible]	12.0	54.3	52.3	1.98	2.81	34.7	32.5	338	347	1.59	1.63
40	22.4	22.9	12.0	11.5	53.6	50.5	3.34	4.00	38.5	36.0	528	524	2.48	2.46
80	22.2	22.3	11.7	11.1	52.7	49.5	3.99	4.88	40.5	37.6	597	590	2.80	2.67
120	22.1	22.2	10.7	11.0	48.5	49.3	49.2	5.42	40.7	41.3	655	690	3.07	3.24
LSD at.05	0.2	0.3	0.4	0.3	2.3	1.1	0.28	0.30	2.0	0.2	38	58	0.18	0.27

* Gallon =3.78 liters

2- Effect of spacing between hills:

Results presented in table 3 revealed significant effect of hill spacing on stalk diameter and stalk length. These traits were gradually increased as hill spacing increased up to 30 cm between. The thickest (2.49 and 2.67) and tallest stalks (236 and 240 cm) in the first and second seasons, respectively resulted from 30 cm between hills reflecting the less plant competition for light and nutrients. Similar results were obtained by Mahmoud *et al.* (1999).

The 20 cm hill spacing gave the highest number of stalks at harvest (58.16 and 57.50 plants 10^3/fed) in the first and second seasons, respectively. Stalk weight and stalk yield/fed were significantly affected by hill spacing .The 30 cm hill spacing gave the highest mean stalk weight (562 and 557g), while 20 cm between hills gave the highest stalk yield (30.2 and 32 1 ton/fed) in the first and second seasons, respectively. The increase in stalk yield might have been due to the increase in number of stalks /fed. It is worthy to mention that the decrease in stalk length and diameter accompanying dense sowing was compensated by the increase in number of stalks per unit area. These results are similar to those of Broadhead *et al.* (1963) and. Saheb *et al.* (1997).

Data presented in Table (4) revealed that juice quality in terms of Brix, sucrose, purity and reducing sugar as well as, Juice extraction percentages were significantly affected by hill spacing. 30 cm hill spacing produced the best juice quality traits compared to 20 and 25 cm between hills, reflecting the higher inter-plant competition for light and nutrients under dense sowing. These results are in agreement with those of Broadhead *et al.*(1963), Abbas and Al-Younis (1988).

Syrup yield in gallon/fed and juice sugar yield ton/fed. were significantly affected by between hill spacing only in the second season. (Table 4).The highest syrup yield (559 gallon/fed) and juice sugar yield (2.62 ton/fed) resulted from planting sweet sorghum at 25 cm between hills. It is worth mentioning that 25and 30 cm plant spacing was significantly different in syrup and juice sugar yield in second seasons.

Table 3: Yield and yield components as affected by spacing between hills in 2003 and 2004 seasons.

Hill spacing cm	Stalk diameter cm		Stalk length		No. of stalks 10^3/fed.		Mean stalk weight (g)		Stalk yield ton/fed.	
	Season									
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
20	1.51	1.58	219	234	58.16	57.50	425	457	30.2	32.1
25	2.08	2.13	224	238	49.42	49.33	480	510	28.5	30.4
30	2.49	2.67	236	240	41.75	42.92	562	557	27.5	27.8
LSD at 0.05	0.16	0.20	5	3	2 32	1.36	37	20	1.2	1.1

Table 4: Juice quality traits, syrup and juice sugar yield as effected by spacing between hills in 2004 and 2005 seasons.

Hill spacing (cm	Brix		Sucrose%		Purity %		Reducing sugars%		Juice extraction %		Syrup yield gallon/fed		Juice sugar yield ton/fed	
	Seasons													
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
20	21.5	21.9	11.2	11.0	51.9	50.4	3.45	4.13	37.0	34 5	519	525	2.43	2.46
25	22.5	22.8	11.7	11.3	52.0	49.5	3.56	4.31	38.9	37.6	537	559	2.52	2.62
30	22.8	23.1	12.1	11.9	52.9	51.4	3.65	4.44	40.0	38.3	533	529	2.50	2.48
LSDat0.05	0.3	0.2	0.3	0.4	ns	1.6	0.18	0.17	1.5	1.1	ns	30	ns	0.14

3- Interaction Effects:

The interaction between nitrogen rate and hill spacing had a significant effect on Brix in the 1st season and juice extraction in both seasons (Table 5).

The highest Brix (23.4) resulted from sowing sweet sorghum at 30 cm between hills and with zero N. Applying 120 kg N/fed with 30 cm between hills gave the highest juice extraction (42.4 and 43.1%) in both seasons, respectively.

Table 5: Brix and juice extraction percentages as affected by nitrogen rates and hill spacing in 2003 and 2004 seasons.

N kg/fed.	Brix			Juice extraction%					
	2004 season			2003 saeson			2004 season		
	Hill spacing cm								
	20	25	30	20	25	30	20	25	30
0	22.3	23.3	23.4	32.0	35.1	37.0	29.9	33.8	33 9
40	22.0	23.2	23.3	37 1	38.4	40.2	32.6	37.5	37.7
80	21.5	22.6	22.9	40.3	41.0	41.4	35.7	38.6	38.5
120	21.8	22.1	22.8	38.6	41.1	42.4	39.9	40.8	43 1
LSD at 0.05		0.3			2.5			1.9	

The interaction between N rates and hill spacing had a significant effect on stalk diameter and stalk length in the second season (Table 6).

The highest stalk diameter (3.17cm) resulted from plants received 120 kg N/fed and sown at 30 cm between hills. While the highest stalk length 258 cm resulted from 80 kg N/fed and 30 cm between hills .

Mean stalk weight was affected by interaction between nitrogen rate and hill spacing in both seasons. The heaviest stalks (673 g) resulted from adding 120 kg N/fed and sown at 30 cm between hills in the first season while in the second season the highest stalk weight (639 g) resulted from adding 80 kg N/fed and 30 cm between hills.

Nitrogen rate x hill spacing interaction had a significant effect on stalk yield /fed. in both seasons, and syrup yield and juice sugar yield only in the second season (Table 6). Sweet sorghum grown at 20 cm between hills and given 120 kg N /fed. gave the highest stalk yield (36.4 and 39.0 ton/fed.) in both seasons,) and syrup yield (725 gallon /fed. in 2nd season), as well as juice sugar yield (3.40 ton/fed. in the 2nd season). The increase in syrup yield (gallon /fed) and juice sugar yield ton/fed. might have resulted from higher stalk yield in both seasons.

Table 6 : Yield and yield components as affected by nitrogen rate and hill spacing during 2003 and 2004 seasons.

N rate Kg/N/fed	Hill spacing Cm	Stalk diameter cm	Stalk length cm	Mean stalk weightg		Stalk yield ton/fed		Syrup yield gallon/fed	Juice sugar yield/ton/fed
		2004		2003	2004	2003	2004	2004	2004
0	20	1.19	216	305	322	21.6	23.3	332	1 56
	25	1.93	215	351	380	20.8	21 9	369	1.73
	30	2.09	214	395	400	19.3	20 1	341	1.60
40	20	1.64	219	424	459	30.0	31 9	489	2.29
	25	2 08	227	494	506	28.7	29.8	552	2 59
	30	2.58	231	557	576	27.5	28.3	531	2.49
80	20	1.72	252	462	488	32.8	34.2	555	2.64
	25	2.14	254	529	568	30.9	34.0	631	2.95
	30	2.84	258	530	639	29.9	31.3	585	2.74
120	20	1.78	249	510	556	36.4	39.0	725	3.40
	25	2.38	256	545	587	33.8	35.7	685	3.21
	30	3.17	255	673	611	32.3	31.4	659	3.09
LSD at 0.05		0.3	5	53	39	2.0	2.1	60	2.80

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"تأثير التسميد النتروجينى والمسافة بين الجور علـــى محـــصول وجـــود الـــذرة السكرية"

بدوى سيد حسانين رمضان
قسم المحاصيل – كلية الزراعة – جامعة القاهرة

أجريت تجربتان حقليتان خلال موسمى ٢٠٠٣ ، ٢٠٠٤ فى محطة التجـــارب الزراعيـــة بكلية الزراعة – جامعة القاهرة فى تربة طينية لدراسة تأثير التسميد النتروجينى (صفر ، ٤٠ ، ٨٠ ، ١٢٠ كجم نتروجين / فدان) والمسافة بين الجور (٢٠ ، ٢٥ ، ٣٠سم) علـــى محـــصول وجودة العصير فى الذرة الرفيعة السكرية .أظهرت النتائج أن زيادة التسميد النتروجينى من صفر الى ١٢٠ كجم نتروجين للفدان أدت الى زيادة قطر وطول الساق والسكريات الأحادية بينمـــا أدت الى انخفاض نسب كل من السكروز والبركس . كما أدت زيادة التسميد النتروجينى الى زيادة وزن الساق ونسبة الاستخلاص ومحصول السيقان النظيف وكذلك محصول العسل بالجـــالون / فـــدان وايضا محصول السكر فى العصير حتى ١٢٠ كجم نتروجين / فدان

أدت زيادة المسافة بين الجور حتى ٣٠ سم الى زيادة وزن وطول وقطر الساق ونسبة كل من البركس والسكروز وكذلك السكريات الأحادية والنقاوة ، بينما أدت الزراعة على مسافة ٢٥ سم الى زيادة محصول السيقان النظيف ومحصول العسل والسكر فى العصير .

كان التفاعل بين التسميد النتروجينى والمسافة بين الجور معنويا فى بعض الـــصفات تحـــت الدراسة .ونتج أعلى محصول من السيقان النظيف والعسل والسكر فى العصير بالزراعـــة علـــى مسافة ٢٥ سم بين الجور . والتسميد بمعدل ١٢٠ كجم نتروجين / فدان .