The Effect of Planting Date, Ploughing Practice and Distance between Hills on Sugarcane Yield and Its Components

Shahrzad M.M. Neana.;[1] and Kamla A.E. Abd El Hak[2]

ABSTRACT

Two field experiments were carried out at the Research Experimental Farm of Sabahia, Agricultural Research Station, Alexandria during the two successive growing seasons of 2011/ 12 and 2012/ 13. G2006-77 sugarcane variety (*Saccharum officinarum L.*) was cultivated to investigate the effect of two planting dates, October (autumn planting) and in March (spring planting), three soil ploughing treatments (two, three and four passes). and two distances between hills (100 and 125 cm.) on sugarcane yield and its components. The results indicated that planting date did not affect the stalk diameter, stalk yield and sugar yields but it significantly increased stalk length with spring planting. Four soil ploughings is fair enough for producing higher stalk length and sugar yield No-significant differences between values of stalk diameter and stalk yield affected by different soil ploughing numbers from 2, 3 and 4 in the 1st and 2nd seasons. No significant effect were found in stalk diameter, stalk yield and sugar yield during the two seasons by planting at (100 and 125 cm.) between hills.The interaction among planting date soil ploughing and distances between hills were significant with respect to stalk diameter, stalk yield and sugar yields during both successive seasons.

The planting dates had no significant effect during the 1 st and 2nd seasons on T.S.S. % and purity %. However there was significant effect during the two seasons on sucrose %. The highest values of sucrose % (15.60 and 15.64 %) were obtained as a result of spring planting in both seasons, respectively.

Significant differences in T.S.S. %, sucrose % and purity % by number of ploughing were found in the two consecutive seasons.

T.S.S. % the1 st season and sucrose % in the 1st and 2nd seasons were significantly different decreased with the distances between hills, No significant effect was found in purity % during the two seasons and T.S.S. % the 2nd season by planting at (100 and 125 cm.) between hills. Generally, as a conclusion and on the basis of the obtained results that planting G2006-77 sugarcane variety in spring planting season, 4 ploughings and 125 cm between hills produced the highest values of stalk length(cm.), stalk diameter (cm.), stalk yield (ton/ fed) and sugar yields(ton/ fed) as well as T.S.S.%, sucrose% and purity % under Alexandria conditions

Keywords: Sugarcane (*Saccharium officinarium L.*), planting date, soil ploughing, distances between hills., stalk length, stalk diameter, stalk yield, sugar yields, T.S.S%, sucrose% and purity%

INTRODUCTION

Improvement of sugarcane (*Saccharum officinarum L*) production can be achieved through optimizing the cultural practices such as planting date, soil ploughing and plant density.

Planting date influences sugarcane canopy development and biomass accumulation Robertson and Donaldson, (1998). Research demonstrated that Planting date affects sugarcane yields, crop development, crop maturity and sucrose% Ryan *et al.,* (2005). Prior research indicated that optimum planting dates differed among cultivars, Garrison *et al.*, (2000,) and Rashwan (2008). Most cultivars, though, had greater yields with a September planting date. Matherne,(1976), and White *et al.,* (2010). Research also showed that planting date does not affect ration crops Garrison *et al.*, (2000) and Hoy *et al.*, (2006).

Soil ploughing is one of the main practices operation before sugarcane planting which control the suitability of the physical conditions of the soil . While deep tillage has increased cane yields, number and length of millable cane in some studies Osman *et al*., (2004), El-Geddawy *et al.,(*2004) El-Shafai and Ismail,(2006) Ahmed and Khaled, (2008) and Ahmed *et al*., (2011). it has reduced yields in other studies Yang and Quintero, (1995), This means that the response of cane to tillage cannot be generalized as it is site specific and is probably dependent on the soil physical characteristics, the water regime and the rooting habits of the cultivar.

Distances between hills have a direct influence on plant population. It plays an important 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., El-Geddawy *et al.*, (2004), El-Shafai and Ismail, (2006) Ahmed and Khaled,(2008) and Ahmed *et al.*., (2011)

[1]Sabahia Research Station- Sugar Crops Institute
Agricultural Research Center.Giza
[2]Sabahia Research Station- Regional Research Station-
Agricultural Research Center
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The current study evaluate the effects of planting date, soil ploughing number and distances between hills on sugarcane yield and its components.

MATERIALS AND METHODS

Two field experiments were conducted in the Research Experimental Farm of Sabahia Agricultural Research, Alexandria Station, during the successive growing seasons of 2011/ 12 and 2012/ 13. G2006-77 sugarcane variety (*Saccharum officinarum L*) was cultivated to study the effect of planting date, soil ploughing and distances between hills on sugarcane yield and its components.

48 Plots (15 m^2) for each treatments, were used to carry out the experiment with four replicates in a split-split plot design. Main plots were used for the planting dates, where sugarcane planted in October 2011/ 12 and October2012/ 13 (autumn planting), while (spring planting) planted in March 2011/ 12 and March 2012/13 were randomly occupied with the sub plots,ie; three ploughing treatments (two, three and four passes). Two distances between hills (100 and 125 cm.). were randomly distributed in the sub sub plots . G2006-77 sugarcane variety was obtained from Sugar Crops Research Institute, Agricultural Research Center,Giza. Seeds were hand planted and all the agronomic practices for sugarcane production were done as recommended by the Sugar Crops Research Institute.

At harvested five guarded plants from each sub sub plot were taken at random to determine the following data: Stalk length , Stalk diameter, Stalk yield

The total soluble solids (T.S.S.%) was measured by hand refractometer according to the methods outlined in the A.O.A.C.(1985).

Sucrose (%) was determined by Digital Automatic Polarimeter according to A.O.A.C.(1985).

Purity (%) was calculated using the following formula according to Singh and Singh (1998).

Juice purity(%)= sucrose(%), / T.S.S.(%) X100. Sugar yield (ton /fed) was determined by multiply yield of stalks X sucrose%.

The obtaind data of the two investigated seasons were computed and statistically analyzed for testing the significance of the tested factors and the possible interaction between them by L.S.D. test according to Steel and Torrie (1981).

RESULTS AND DISCUSSIONS

1- Yield and yield components:

Results in (Table 1) demonstrated that spring planting date significantly increased stalk length by 4.98% and 4.15% compared to autumn planting in the first and second seasons, respectively.

The results indicate clearly that 4 soil ploughings were fair enough for producing the tallest stalks (223.8 and 225.0 cm.) and sugar yields (5.46 and 5.47 ton/ fed) in the two successive seasons

Meanwhile, Data showed that there were no-significant differences between values of stalk diameter. and stalk yield with different soil ploughings number (2, 3 and 4) in the 1st and 2nd seasons.

No significant effect was found in stalk diameter, stalk yield and sugar yields during the two seasons by planting at (100 and 125 cm.) between hills but in the stalk length it could be noticed that was significantly affected by plant spacing between hills. The highest stalk length 204.3 and 221.1 cm were produced due to 125 cm. between hills in the during 1 st and 2 nd seasons, respectively. it may be attributed to less inter-plant competition for light and nutrients.These results were similar to those found by Osman *et al*., (2004), El-Geddawy *et al.*,1 (2004), El-Shafai and Ismail, (2006), Ahmed and Khaled, (2008) and Ahmed *et al.*, (2011).

As for the second order interaction among the studied factors, the results obtained in (Table 1) clear that a statistically significant effect on stalk diameter , stalk yield and sugar yields through two successive seasons 2011/12 and 2012/13. Data in (Table 2) revealed statistically significant differences of planting date, number of soil ploughing and differences of distances between hills on stalk diameter during the two seasons. The thickest stalks were those resulting from spring planting, 4 soil ploughings and 125 cm between hills during 1 st season whereas in the 2 nd season the thickest stalks were obtained from autumn planting 3 soil ploughings and 125 cm between hills . Thise results were in harmony with that obtained by El-Geddawy *et al.*, (2004), El-Shafai and Ismail,(2006) and Ahmed *et al.*, (2011).

From the results it can be concluded that the greatest stalk yield (35.75 and 35.42 ton/fed) were obtained from spring planting 4 soil ploughings and 125 cm between hills during 2011/12&2012/13 seasons, respectively. On the contrast, the lowest stalk yield (25.81 ton/ fed) obtained from autumn planting, 2 soil ploughings and 100 cm between hills during 1 st season whereas in the 2 nd season the lowest stalk yield (27.73 and 28.47 ton/ fed) obtained from spring and autumn planting respectively, 2 soil ploughings and 100 cm between hills.

Table 1. Means of stalk length, stalk diameter, stalk yield, and sugar yield as affected by sowing dates, soil ploughing and distance between hills and their interactions during 2011/12, 2012/13 seasons

Factors	Stalk length (cm)		Stalk diameter (cm)		Stalk yield (ton /fed)		Sugar yield (ton /fed)	
Seasns	1st	2nd	1st	2nd	1st	2nd	1st	2nd
A-Planting dates								
Spring planting	204.45[a]	213.5[a]	2.74[a]	2.68[a]	32.86[a]	33.68[a]	4.72[a]	4.98[a]
Autumn plantig	194.75[b]	204.9[b]	2.53[a]	2.54[a]	31.37[a]	29.28[a]	4.76[a]	4.54[a]
$LSD_{0.05}$	3.2	3.8	ns	ns	ns	ns	ns	ns
B- soil Ploughing no.								
2	173.9[c]	188.0[c]	2.54[a]	2.39[a]	30.51[a]	30.17[a]	4.16 [c]	4.25 [b]
3	201.2[b]	214.11[b]	2.71[a]	2.70[a]	32.11[a]	32.01[a]	4.42 [b]	4.55 [b]
4	223.8[a]	225.0[a]	2.68[a]	2.74[a]	33.73[a]	32.25[a]	5.64[a]	5.47[a]
$LSD_{0.05}$	4.9	4.6	ns	ns	ns	ns	0.67	0.69
Distances between hills								
100cm	194.9[b]	197.3[b]	2.58[a]	2. 42[a]	31.27[a]	30.03[a]	4.59[a]	4.74[a]
125cm	204.3[a]	221.1[a]	2.69[a]	2.80[a]	32.96[a]	32.92[a]	4.89[a]	4.78[a]
$LSD_{0.05}$	4.4	6. 9	ns	ns	ns	ns	ns	ns
D-Interactions								
A× B	ns	ns	ns	ns	ns	ns	ns	ns
A× C	ns	ns	ns	ns	ns	ns	ns	ns
B×C	ns	ns	ns	ns	ns	ns	ns	ns
A×B×C	ns	ns	*	*	*	*	*	*

Mean followed by different letters within each column are significantly different at 0.05 level of probability.
*: significant at 0.05 level of probability of probability
ns : Not significant.

Data depicted in Table (2) declared that the interaction among planting date, number of soil ploughing and distances between hills were significant differences with respect to sugar yield during both successive seasons. This result means that the response of sugar yield due to planting date, soil ploughing and distances between hills were different from rate to anther. We could observe that the application of spring planting, 4 soil ploughings and 125 cm between hills gave the highest sugar yields (5.19 and 5.28 ton/fed) in the 1st and 2nd seasons ,in succession

2 - Juice quality

Juice quality measurements of sugar cane in terms of T.S.S (%), sucrose (%) and purity (%) as affected by planting date, number of soil ploughing and distances between hills as well as their interactions.

The planting dates had no significant effect during the1 st and 2nd seasons on T.S.S. (%) and purity (%) as show in table (3).This result was in agreement with Garrison *et al*., (2000) and Hoy *et al*., (2006). There was significant effect during second season on sucrose (%) where the highest value of sucrose % (15.64 %) were obtained under the application of spring planting.

Significant differences in T.S.S (%) by number of soil ploughing were found in the two consecutive seasons while sucrose(%) and purity (%) did not significantly affected in the second season as shown in Table (3).

It could be seen that the highest value of T.S.S (%) of sugarcane (19.98%) is obtained under 4 soil ploughings in the1 st season whereas in the 2 nd season data showed that there were no-significant differences between T.S.S (%) values with 3 and 4 soil ploughings number. The highest value of sucrose (%) and purity (%) (17.09% and 85.85%) are obtained under 4 soil ploughings in the1 st season where no-significant differences between values of sucrose(%) and purity (%) with different soil ploughings number from 2, 3 and 4 in the 2nd season. This result are in harmony with that obtained by Ahmed and Khaled,(2008) and Ahmed *et al.*, (2011).

Furthermore, result in the same table revealed that T.S.S. (%) in the1 st season and sucrose (%) in the 1st and 2nd seasons, in succession were significantly different decreased with decreasing the distances between hills where planting sugarcane at 125 cm. between hills gave the highest values of these traits compared with 100 cm. No significant effect was found in purity (%) during the two seasons and T.S.S. (%) in the 2nd season by planting at (100 and 125 cm.) between hills.

Table (4) revealed that statistically significant variance of interaction differences between planting date, number of soil ploughing and distances between hills on total soluble solids (%) (T.S.S.), sucrose (%) and purity (%) in both seasons (2011/ 12, 2012/ 13). The greatest (T.S.S.) (20.61% and 20.69%) were obtained under the application of autumn planting season, 4 soil ploughings and 125 cm between hills in the first and second seasons, respectively.

The highest values of sucrose percentage (17.57 and 16.94%) were recorded from application spring planting season, 4 soil ploughings and 125 cm between hills The minimum value of sucrose percentage (12.13 and13.56 %)were obtained from applying spring planting season, 2 soil ploughings and 100 cm between hills in the 1st and 2nd seasons, respectively.

The highest values of purity percentage (87.77 and 91.64 %) were produced from application spring planting, 4 soil ploughings and 125 cm between hills

Generally, as a conclusion and on the basis of the obtained results that planting G2006-77 sugarcane variety in spring planting, 4 soil ploughings and 125 cm between hills produced the highest values of stalk length, stalk diameter, stalk yield and sugar yields (ton/ fed) as well as T.S.S. (%), sucrose(%) and purity (%) under Alexandria conditions

Table 3. Means of Total Soluble Solids% (T.S.S.), sucrose (%) and purity (%) as affected by sowing dates, soil ploughing and distance between hills and their interactions during 2011/12, 2012/13 seasons

Factors	T.S.S.%		Sucrose %		Purity %	
Seasons	**1st**	**2nd**	**1st**	**2nd**	**1st**	**2nd**
A-Planting dates						
Spring planting	19. 29[a]	19.53[a]	15.60[a]	15.64[a]	81.68[a]	80.18[a]
Autumn planting	18.97[a]	19.34 [a]	15.36 [a]	15.34[b]	80.23[a]	79.32[a]
LSD 0.05	ns	ns	ns	0.22	ns	ns
B- soil Ploughing no.						
2	18.38[b]	18.28 [b]	14.07[c]	15.15 [a]	76. 65[b]	78.44 [a]
3	19.03[b]	19.71[a]	15.27[b]	15.16 [a]	80.39[b]	79. 77[a]
4	19.98[a]	20.32[a]	17.09[a]	15.15[a]	85.85[a]	81.03[a]
LSD 0.05	0.80	1.69	0.64	ns	5.29	ns
C- Distances between hills						
100cm	18.65[b]	19.09[a]	15.09[b]	15.14[b]	80.83[a]	79.45[a]
125cm	19. 61[a]	19.78[a]	15.86[a]	15.84[a]	81.08[a]	80.04[a]
LSD 0.05	0.51	ns	0.56	0.18	ns	ns
D-Interactions						
A× B	ns	ns	*	**	ns	ns
A× C	**	**	ns	**	ns	ns
B×C	ns	ns	**	**	**	ns
A×B×C	**	**	**	**	**	**

Mean followed by different letters within each column are significantly different at 0.05 level of probability.
*: significant at 0.05 level of probability of probability
** significant at 0.01 level of probability.
ns : Not significant.

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الملخص العربي

تأثير ميعاد الزراعة وعملية الحرث والمسافة بين الجور علي محصول ومكونات قصب السكر

شهرزاد محمد مرشدي نعينع، كامله عبد الحق ابراهيم عبد الحق

أقيمت تجربتان حقليتان خلال موسمى الزراعة ٢٠١٢/١١، ٢٠١٣/١٢ بمحطة البحوث الزراعية بالصبحية، مركز البحوث الزراعية بالاسكندرية بهدف دراسة تأثير ميعاد الزراعة والحرث والمسافة بين الجور علي محصول ومكونات قصب السكر.

وقد أستخدم فى التجربة تصميم القطع المنشقه مرتين Split split –plot design في اربعة مكررات حيث احتوت القطع الرئيسية علي ميعادين للزراعة (زراعة ربيعي وزراعة خريفي) بينما أحتوت القطعه الشقيةالاولي علي مرات الحرث(٢و٣و٤) وأحتوت القطعه الشقية الثانية على المسافات بين الجور(١٠٠و١٢٥سم) ويمكن تلخيص أهم نتائج هذه الدراسة فيما يلى:

لم يكن هناك تأثير معنويا لميعاد الزراعة علي كل من: سمك ساق القصب ومحصول العيدان ومحصول السكر ونسبة المواد الصلبة الكلية (T.S.S.%) ونسبة النقاوه فى موسمى الزراعة، بينما ادت الزراعة الربيعي الي زيادة النسبة المئوية للسكروز.

زيادة عدد مرات الحرث الي اربعة مرات ادي الي زيادة معنوية في طول ساق القصب وفي محصول السكرو نسبة المواد الصلبة الكلية (T.S.S.%) ونسبة النقاوة والنسبة المئوية للسكروز الا ان سمك ساق القصب ومحصول العيدان لم يتأثرا معنويا بزيادة عدد مرات الحرث.

لم يتأثرمعنويا كل من: سمك ساق القصب ومحصول العيدان ومحصول السكر ونسبة النقاوة بالمسافات بين الجوربينما ادي زيادة المسافة بين الجور الي ١٢٥ سم الي زيادة معنوية في نسبة المواد الصلبة الكلية (T.S.S.%) والنسبة المئوية للسكروز.

واستنادا إلى النتائج السابقة يمكن الحصول علي اعلي محصول العيدان ومحصول السكر(طن/الفدان) ودرجة النقاوه ونسبة السكروز ونسبة المواد الصلبة الكلية عند تطبيق زراعة قصب السكرصنف G2006-77 في فصل الخريف مع الحرث ٤ مرات علي مسافة ١٢٥ سم بين الجور تحت ظروف محافظة الإسكندرية.