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PERFORMANE OF SOME PROMISING SUGAR CANE VARIETIES AS AFFECTED BY DELIVERY DELAYING PERIODS

Osman, A. M. H.; E.F.A. Aly and Ranya M. Abdel Aziz
Sugar Crops Res. Inst., Agric. Res. Center, Giza, Egypt

ABSTRACT

Two field trials were conducted at El-Mattana Agricultural Research Station (Luxor Governorate) planted as a spring plant cane in 2009/2010 and 2010/2011 seasons and the 1st ratoon crops grown in 2010/2011 to study the effect of delivery delaying periods (1, 4 and 7 days) on yield and quality of two promising sugar cane varieties (G.98-28 and G.99-80 beside G.T.54-9).

The results indicated that G.98-28 surpassed G.T.54-9 and G.99-80 varieties, attaining the lowest values of brix% and stalk fresh weight losses%. While, the highest cane and sugar yields/fed, purity% and sugar recovery%., respectively in plant canes and 1st ratoon crops. Brix% and stalk fresh weight loss% tended to increase as post harvest storage periods were prolonged up to 7 days after harvest, while, sucrose%, purity%, sugar recovery% as well as cane and sugar yields/fed decreased as the period after harvesting was extended.

The interaction between delivery delaying periods and sugarcane variety were significantly differed for sugar recovery%, cane and sugar yields/fed in the 1st plant cane and 1st ratoon crops.

Delivery of sugarcane immediately after harvesting to the mill is recommended to attain the best quality and maximum cane and sugar yields.

INTRODUCTION

In Egypt, sugarcane is the main source of raw material for sugar industry. It is considered the most important economic crop in Upper Egypt. The extracted sugar basically depends upon varieties and agronomical processes. However, changes in juice quality after harvest are broadly affected by the prevalent conditions at harvest and up to delivery. Oncemore, sugar cane varieties differed significantly in brix%, sucrose%, purity% as well as, cane and sugar yields as reported by Sharma *et al.* (1991) and Mohamed (2001). Several investigations reported that brix% and stalk fresh weight losses were increased by increasing post harvest storage period. Sayed *et al.* (1983) showed that extracted juice of cane stalks was decreased after 6 days from harvest date. Shahid *et al.* (1990), Dendsay *et al.* (1992), Rao *et al.* (1993), Besheit (1996) and Besheit *et al.* (2004) they indicated that increasing the storage period up to 8 days led to an increase in reducing sugars%, juice extraction% and total soluble solids (brix%). Futhermore, sucrose% and purity% were considerably increased in cane stored for 4 days and for 6 days, respectively, thereafter, a great reduction had been recorded. Stalk weight losses, cane and sugar yields/fed were significantly decreased with increasing post-harvest storage periods. Solomon *et al.* (1990), Batta and Singh (1991), Chalapathi (1992), Romero *et al.* (1993) and Azzazy *et al.* (1999) recorded that significant losses in juice quality with the increase in

time elapsed between harvesting and milling. Ahmed *et al.* (2002) and El-Sogheir and Abd El-Razek (2008) found that brix%, stalk fresh weight loss tended to increase as post harvest storage periods were prolonged up to six days after harvest. Also, the extracted juice, sucrose%, purity%, sugar recovery%, as well as, cane and sugar yields/fed were decreased as the period after harvesting was extended. Phill.8013 variety recorded the highest values of sugar recovery%, cane and sugar yields than the other varieties, namely G.98-28, G.98-87 and G.99-165. Sugarcane G.98-28 variety recorded the lowest values of purity%, extracted juice%, cane and sugar yields/fed.

The present work aims at studying the effect of delivery delaying period on yields/fed and quality under Luxor Governorate conditions representing Upper Egypt.

MATERIALS AND METHODS

Two field trials were conducted at El-Mattana Agricultural Research Station (Luxor Governorate) planted as a spring plant cane successive crushing of 2009/2010 and 2010/2011 seasons and the 1st ratoon crops grown in 2010/2011 to study varietal differences and the effect of storage periods before crushing (1, 4 and 7 days) on juice quality traits, cane and sugar yields/fed of three sugarcane varieties, i.e. (G.98-28 and G.99-80 beside G.T.54-9) as a commercial variety. Nine treatments were studied represent the combinations of three sugarcane varieties and three post harvest periods. Some physical and chemical properties of the experimental soil determined according to Jakson (1967), showed that the upper 20 cm of the soil was clay loam which comprised of 18.0% sand, 29.3% silt and 52.2 clay and contained 27.0, 17.0, 395 ppm N, P and K, respectively at pH of 7.25. The meteorological data of Luxor Governorate during the period of study from 15 – 19 March 2009/2010 and 2010/2011 are recorded in Table 1. A split plot design with four replications was used in the plant cane and 1st ratoon crops. Storage periods treatments were allocated in the main plots, while, sugar cane varieties were randomely distributed in the sub-plots. The sub-plot area was 35 m^2 (including 5 ridges of 1 m width and 7 m in length). Two rows of three-budded cane cuttings were used in planting. The previous crop was Faba Bean. Plant cane was planted in the 1st week of March and 1st ratoon crop raised in the 1st week of March. Both plant cane and 1st ratoon crop were harvested at age of twelve months. Nitrogen fertilizer as urea 46.5%, was added at the rate of 210 kg/fed in two equal doses. In the plant cane, the 1st N dose was applied two months after planting and preceded with hoeing. In the 1st ratoon, the 1st N dose was added one month after harvesting the plant cane and after furrowing (ditching between rows of sugarcane) and earthing up. The 2nd N dose was added one month after the 1st one, for both cane crops. Phosphorus fertilizer was added during seed bed preparation at rates of 45 kg P_2O_5 as calcium superphosphate 15.5% P_2O_5. Potassium fertilizer was added at rate of 24 kg K_2O/fed as potassium sulphate 48% K_2O

with the 2nd nitrogen level. The other agricultural practices were followed as recommended by Sugar Crops Research Institute.

Table 1: Meteorological data from 7-14 March in Luxor Governorate at harvest.

Date after harvest (storage)	2009/2010			2010/2011		
	Temperature °C		Humidity %	Temperature °C		Humidity %
	Minimum	Maximum		Minimum	Maximum	
7 March	11.4	28.8	26.0	11.6	29.5	31.0
11 March	12.1	29.9	31.0	12.2	30.9	36.0
14 March	12.8	30.8	35.0	12.9	31.3	40.0

Cited after Central Laboratory for Agricultural Climate, ARC., Giza, Egypt.

Recorded data:

At harvest, a random sample of 240 stalks from each of the three sugar cane varieties was kept under conditions of open air. The sugar cane stalks were divided into 4 separated piles represent replicates. A sample of 20 stalks was taken from each pile at 1, 4 and 7 days after harvest, weighed and send to the laboratory for chemical analysis.

I. Vegetative criteria:

1. Cane fresh weight losses% (CFWL%) was calculated according to the following equation: CFWL% = Stalk weight at harvest – stalk weight at the defined day of determination / Stalk weight at harvest x 100.

II. Cane and sugar yield (ton/fed):

2- Cane yield (tons/fed) at harvest: three guarded ridges of each variety were cut, cleaned, topped, weighed and cane yield in tons/fed was calculated.

3- Sugar yield (tons/fed) was calculated using the following equation:

Sugar yield (ton/fed) = net cane yield (ton/fed) x sugar recovery%.

III. Juice quality traits:

Juice extraction%, about 58-60% from cane weight which was calculated using the following equation:

Juice extraction% = Juice weight x 100/Stalk weight.

4. Total soluble solids% (brix%) was determined using Brix Hydrometer standardized at 20°C.
5. Sucrose% was determined using "Saccharemeter" apparatus according to A.O.A.C. (2005).
6. Purity% was calculated according to following equation:

Purity% = Sucrose% / Brix% x 100.

7. Sugar recovery% was calculated according to the equation described by Yadav and Sharma (1980). Sugar recovery% = {Sucrose - 0.4 (brix – sucrose) 0.73}.

The obtained data were analysis according to Snedecor and Cochran (1981).

RESULTS AND DISCUSSION

I. Varietal differences:

The results in Table 2 reveal that the tested sugarcane varieties significantly differed in stalk fresh weight losses%, cane and sugar yields/fed, as well as brix%, sucrose%, purity% and sugar recovery% in the plant canes and 1st ratoon crop after storage periods.

1. Stalk fresh weight losses%:

Table (2) cleared that the evaluated sugarcane varieties significantly differed in individual cane stalk weight after harvesting in the plant canes and 1st ratoon crop. Sugarcane G.99-80 variety recorded the highest values of stalk fresh weight losses%, while, G.98-28 variety recorded the lowest average value of this trait. The differences among varieties in this trait could be due to their variable gene structure. These results are in agreement with those obtained by Besheit (1996) and El-Sogheir and Abd El-Razek (2008).

2. Cane and sugar yield (ton/fed):

Results in Table 2 exhibit a significance variance among the evaluated sugar cane varieties in cane and sugar yields/fed in the plant canes and 1st ratoon crop. The highest cane and sugar yields/fed were produced by sugarcane G.98-28 variety, were (1.33, 2.29 ton/fed for cane yield), (0.43 and 0.92 ton/fed for sugar yield) in the 1st plant cane 2009/2010, (1.74 and 3.13 ton/fed for cane yield), (0.41 and 0.76 ton/fed for sugar yield) in the 2nd plant cane 2010/2011 as well as (2.04 and 3.71 ton/fed for cane yield), (0.83 and 1.45 ton/fed for sugar yield in the 1st ratoon crop 2010/2011), while, the other sugarcane varieties ranked in between, in the plant canes and 1st ratoon crop, respectively. The differences among varieties in cane and sugar yields/fed could be attributed to the variation in their gene structure. The effective role of varieties on cane and sugar yields has been reported by Mohamed (2001) and El-Sogheir and Abd El-Razek (2008) mentioned that Phill.8013 variety recorded the highest values of cane and sugar yields than the other varieties, namely G.98-28, G.98-87 and G.99-165. sugarcane G.98-28 variety recorded the lowest values of cane and sugar yields/fed.

3. Total soluble solids % (Brix%):

Table 2 show that tested sugarcane varieties significantly differed in brix% in the plant canes and 1st ratoon crop. Sugarcane G.99-80 variety recorded the highest mean values, meanwhile, the lowest mean values was given by sugarcane G.98-28 variety in the plant canes and 1st ratoon crop. The differences among sugar cane varieties in brix% could be attributed to their gene make-up. These results are in agreement with Gauer and Desai (1988) and El-Sogheir and Abd El-Razek (2008) found that sugarcane G.98-28 variety recorded the lowest values of extracted juice%.

4. Sucrose%:

The obtained results in Table 2 indicate to a significant superiority of sugarcane G.98-28 variety over the other examined ones for sucrose% in the plant canes and 1st ratoon crop compared with the other varieties. The differences among cane varieties in sucrose% may be refereed to the variability of their gene structure. These results are in accordance with

Sharma *et al.* (1991) and El-Sogheir and Abd El-Razek (2008) sugarcane G.98-28 variety recorded the lowest values of extracted juice%.

5. Purity%:

Results in Table 2 show significant differences among sugar cane varieties in purity%. Sugarcane G.98-28 variety recorded the highest value of this trait in the plant canes and 1st ratoon crop, meanwhile, the lowest value was given by sugarcane G.99-80 variety. Differences among cane varieties in this trait may be attributed o their different gene make-up. This result is in good line with El-Sogheir and Abd El-Razek (2008) sugarcane G.98-28 variety recorded the lowest values of purity%.

6. Sugar recovery%:

Results in Table 2 show that the examined sugarcane varieties significantly differed in sugar recovery% in the plant canes and 1st ratoon crop. It was found that sugarcane G.98-28 variety recorded the highest values of sugar recovery%, while, sugarcane G.99-80 variety had the lowest one compared with the other varieties. The differences among varieties in this trait may be due to their genetic structure. These results are in accordance with those reported by Romero *et al.* (1993) and El-Sogheir and Abd El-Razek (2008) Phill.8013 variety recorded the highest values of sugar recovery% than the other varieties, namely G.98-28, G.98-87 and G.99-165. sugarcane G.98-28 variety recorded the lowest values of extracted juice%.

Table 2: Effect of sugar cane varieties on growth, quality traits and yields at harvest.

Varieties	CFWL%	CY	SY	Brix%	Sucrose%	Purity%	SR%
Plant cane 2009/2010							
G. 98-28	5.8	37.87	3.73	19.2	17.1	89.06	9.8
G.T. 54-9	7.1	36.54	3.30	20.1	15.4	76.62	8.96
G. 99-80	9.8	35.58	2.81	21.6	13.3	61.57	7.79
LSD at 5%	0.35	0.12	0.51	0.23	1.25	6.25	1.55
Plant cane 2010/2011							
G. 98-28	6.9	42.04	4.47	19.5	17.5	89.74	10.54
G.T. 54-9	8.7	40.30	4.06	20.3	15.8	77.83	10.01
G. 99-80	10.0	38.91	3.71	21.9	14.0	63.93	9.48
LSD at 5%	0.24	0.97	0.25	0.12	1.32	6.95	0.17
First ratoon crops 2010/2011							
G. 98-28	6.2	41.98	4.51	19.1	16.9	88.48	10.70
G.T. 54-9	7.0	39.94	3.68	19.9	15.1	75.88	9.17
G. 99-80	9.0	38.27	3.06	20.7	14.2	68.60	7.94
LSD at 5%	0.26	0.85	0.21	0.13	0.85	5.12	1.48

(CFWL%) = cane fresh weight losses%, CY = cane yield (ton/fed), SY = sugar yield (ton/fed), SR% = sugar recovery%.

II. Delivery delaying periods (days):

The results in Table 3 showed that the delivery delaying periods had significant effects on stalk fresh weight losses%, cane and sugar yields/fed, as well as brix%, sucrose%, purity% and sugar recovery% in the plant canes and 1st ratoon crop.

1. Stalk fresh weight losses%:

Results in Table 3 show a gradual increase in the fresh weight losses% of single cane stalk up to 7 days after harvesting relative to its fresh weight determined directly at harvest, in the plant canes and 1st ratoon crops. Increasing the losses% in the fresh weight of canes is probably referred to the increase in plant moisture transpired to the air which is affected by weather factors as high solar radiation, low relative humidity and etc. as the period of cane exposure to these factors is prolonged. Chahapathi (1992) recorded that significant losses in stalks with the increase in time elapsed between harvesting and milling, Besheit *et al.* (2004) they indicated that a great reduction had been recorded at stalk weight losses was significant decrease with increase post-harvest storage periods and El-Sogheir and Abd El-Razek (2008) reported that high temperature and weather factors increased the rate of water loss.

2. Cane and sugar yield (ton/fed):

Results in Table (3) mentioned that prolonging storage period of sugar cane from 1, 4 to 7 days after harvest caused a significant reduction in cane and sugar yields/fed were (6.27, 8.12 ton/fed for cane yield), (0.09 and 1.42 ton/fed for sugar yield) in the 1st plant cane 2009/2010, (5.87 and 7.24 ton/fed for cane yield), (1.29 and 1.64 ton/fed for sugar yield) in the 2nd plant cane 20/10/2011 as well as (2.87 and 6.90 ton/fed for cane yield), (0.63 and 1.37 ton/fed for sugar yield in the 1st ratoon crop 2010/2011) compared with, sugar cane weighed immediately at harvest (1 day). These results are mainly due to the losses in the fresh weight of individual cane stalks (Table 3) and sugar recovery% as sugar cane delivery to the mill was delayed. These results are in accordance with those obtained by Gaur and Desai (1988), Rao *et al.* (1993) and Romero *et al.* (1993) and El-Sogheir and Abd El-Razek (2008) found that cane and sugar yields/fed were decreased as the period after harvesting was extended to six days.

3. Total soluble solids % (Brix%):

The obtained results in Table (3) cleared that delaying delivery of sugar cane to the mill up to 7 days led to a significant and gradual increase in juice brix% compared to that delivered immediately, in the plant canes and 1st ratoon crop. These results could be due to the decrease in water content in cane juice after harvesting represented in cane fresh weight loss and hence an increase in the total soluble solids expressed as a percentage as the period of storage and the exposure of canes to the open air was prolonged. These results are in harmony with those recorded by Shahid *et al* (1990) they indicated that increasing the storage period up to 8 days led to an increase in the total soluble solids was decreased significantly with increasing post-harvest storage periods. Mohamed (2001) reported that brix% was increased by increasing post harvest storage period and El-Sogheir and Abd El-Razek (2008) found that brix% tended to increase as post harvest storage periods.

4. Sucrose%:

Results given in Table 3 show that prolonging the storage duration of sugar cane up to 7 days from harvesting caused a significant reduction in sucrose% in the plant canes and 1st ratoon crop. These results could be due to hydrolysis and hence the conversion of sucrose% (di-saccharide) to

glucose and fructose (mon-saccharide), as a result of cane moisture reduction and the increase in respiration rate of canes after ripening. These results are in agreement with those reported by Sayed *et al.* (1983) showed that extracted juice of cane stalks was decreased after 6 days from harvest date. Azzazy *et al.* (1999) and El-Sogheir and Abd El-Razek (2008) recorded that significant losses in quality with the increase in time between harvesting and milling.

5. Purity%:

Mentioned results in Table 3 clear that purity% was significantly reduced when the delivery of the harvested sugar cane was delayed to 7 days after harvesting of plant cane and 1st ratoon crop, in comparison with that crushed immediately after harvesting. This finding was probably due to the reduction in sucrose%, since purity% expresses the ratio of sucrose to the total soluble solids in cane juice. These results are in accordance wih those obtained by Batta and Singh (1991) and Besheit (1996) they indicated that increasing the storage period up to 8 days led to an increase in purity% were considerably increased in cane stored for 4 days and for 6 days, respectively, thereafter, a great reduction had been recorded. Ahmed *et al.* (2002) and El-Sogheir and Abd El-Razek (2008) they reported that juice purity was decreased by increasing the post harvest storage periods.

Table 3: Effect of delivery delaying periods on growth, quality traits and yields at harvest.

Storage period (days)	CFWL%	CY	SY	Brix%	Sucrose%	Purity%	SR%
Plant cane 2009/2010							
1	2.3	41.46	4.19	19.4	16.5	85.05	10.10
4	7.4	35.19	4.10	20.8	15.4	74.04	9.87
7	13.0	33.34	2.77	21.7	14.4	66.36	8.31
LSD at 5%	0.14	0.55	0.46	0.10	1.14	2.95	1.10
Plant cane 2010/2011							
1	4.5	44.79	5.06	20.1	17.9	89.05	11.28
4	9.8	38.92	3.77	20.3	15.4	75.86	9.66
7	16.7	37.55	3.42	21.7	14.6	67.28	9.09
LSD at 5%	0.12	1.75	0.11	0.01	1.14	3.95	1.10
First ratoon crops 2010/2011							
1	2.5	43.32	4.42	20.1	16.9	84.08	10.17
4	7.3	40.45	3.79	20.9	15.1	72.25	9.33
7	12.3	36.42	3.05	21.9	14.8	67.58	8.31
LSD at 5%	0.16	1.24	0.34	0.28	0.41	4.85	1.12

(CFWL%) = cane fresh weight losses%, CY = cane yield (ton/fed), SY = sugar yield (ton/fed), SR% = sugar recovery%.

6. Sugar recovery%:

Results in Table 3 show that sugar recovery% was significantly decreased when the delivery of sugar cane to the mill was delayed up to 7 days after harvesting compared with that determined directly at harvesting in the plant canes and 1st ratoon crops. These results are mainly referred to the

reduction in both sucrose and purity%. These results are in harmony with those reviewed by Ahmed *et al.* (2002) and El-Sogheir and Abd El-Razek (2008) found that sugar recovery% were decreased as the period after harvesting was extended.

III: Interactions effects:

Results in Table 4 showed that the interaction between sugar cane varieties and the delivery delaying periods had a significant influence on sugar recovery%, cane and sugar yields/fed in the plant canes and 1st ratoon crop. Delaying delivery of G.98-28 sugarcane variety to the mill for one day recorded the highest average of values at sugar recovery%, cane and sugar yields/fed in the plant canes and 1st ratoon crop, whereas, delaying sugarcane delivery up to 7 days mostly recorded the lowest ones with G.99-80.

Table 4: Effect of interaction between varieties x storage period days

1st Plant cane 2009/2010									
Sugar cane	Sugar recovery%			Cane yield (ton/fed)			Sugar yield (ton/fed)		
	Storage period (days)								
Varieties	1	4	7	1	4	7	1	4	7
G. 98-28	10.25	9.98	9.17	43.10	36.29	34.21	4.42	3.62	3.14
G.T. 54-9	10.00	8.45	8.44	41.11	35.16	33.35	4.11	2.97	2.81
G. 99-80	9.35	6.71	7.32	40.17	34.12	32.45	3.76	2.29	2.37
LSD at 5%	0.92			5.22			0.95		
1st Plant cane 2009/2010									
G. 98-28	11.93	10.22	9.47	46.81	40.17	39.15	5.58	4.11	3.71
G.T. 54-9	11.25	9.62	9.17	44.35	39.25	37.31	4.99	3.78	3.42
G. 99-80	10.67	9.14	8.62	43.21	37.33	36.18	4.61	3.41	3.12
LSD at 5%	0.85			7.12			0.65		
1st ratoon crop 2010/2011									
G. 98-28	11.38	10.89	9.84	45.23	42.30	38.42	5.15	4.61	3.78
G.T. 54-9	10.11	9.29	8.11	43.24	40.29	36.29	4.37	3.74	2.94
G. 99-80	9.02	7.81	6.99	41.50	38.75	34.55	3.74	3.03	2.42
LSD at 5%	0.66			6.95			0.44		

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أداء بعض اصناف القصب المبشرة متاثرة بتاخير فترات التوريد

عادل محمود حسن عثمان ، اسلام فتحى عبد الفتاح على و رانيا محمد عبد العزيز
معهد بحوث المحاصيل السكرية – مركز البحوث الزراعية – الجيزة – مصر

اقيمت تجربتان حقليتان بمحطة البحوث الزراعية بالمطاعنة بمحافظة الاقصر لدراسة تاثير تاخير فترات التوريد (١ – ٤ – ٧ يوما) بعد الحصاد على محصول وجودة بعض اصناف القصب المبشرة وهى جيزة ٩٨-٢٨ وجيزة ٩٩-٨٠ والصنف التجارى جيزة تايوان ٥٤-٩ كمقارنة خلال موسمى ٢٠٠٩/٢٠١٠ و ٢٠١٠/٢٠١١ كغرس ربيعى و٢٠١٠/٢٠١١ كخلفة اولى.

أوضحت النتائج:

١. زيادة النسبة المئوية للمواد الصلبة الذائبة الكلية ونقص الوزن الطازج للسيقان والنسبة المئوية للسكروز والسكر المستخلص ومحصولى العيدان والسكر بزيادة فترات التخزين بعد الحصاد حتى ٧ ايام.
٢. حقق الصنف جيزة ٩٨-٢٨ اعلى القيم بينما حقق الصنف جيزة ٩٩-٨٠ اقل القيم للصفات المدروسة.
٣. ادى التفاعل بين فترات التخزين والاصناف لاستجابة معنوية لكلا من الصفات الاتية النسبة المئوية لناتج السكر ومحصولى العيدان والسكر للفدان فى كلا من محصولى الغرس والخلفة الاولى على التوالى.
٤. تحت ظروف هذا البحث يمكن التوصية بعدم تاخير توريد القصب بعد الكسر عن يوم واحد لتحقيق اعلى محصول وجودة من العيدان وسكر طن/للفدان.

قام بتحكيم البحث

أ.د / محسن عبد العزيز بدوى — كلية الزراعة – جامعة المنصورة
أ.د / عبد الله محمد عبد الله الشافعى — مركز البحوث الزراعية