

EARLY EVALUATION OF NEW SUGARCANE CLONES IN TWO CROP CYCLES AND INTERRELATIONSHIPS AMONG YIELD AND AGRONOMIC TRAITS

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ABSTRACT

Selecting and developing new high-yielding cane varieties is crucial to enhance its production and meet the ever-increasing demands of sugar. Twenty sugarcane clones (genotypes) and one check cultivar were grown in a randomized complete block design, with three replications, at Mattana Agricultural Research Station (latitude of 25° 17' N and longitude of 32° 33'), Luxor Governorate, Egypt, during 2017-2018 and 2018-2019. The objective of this study was to evaluate and calculate interrelationships (correlations) among yield and quality traits in plant cane (PC) and 1stratoon crop (FR) at early clonal selection stage under Upper Egypt conditions. The results showed significant ($p \leq 0.05$) differences among the genotypes in cane yield and its component traits, sugar yield and quality traits, except for purity percentage. The interaction of genotype x crop cycle was highly significant for most studied traits ($p \leq 0.01$), and insignificant for purity, sugar recovery percentages and sugar yield. Genotype, viz., G.2017-68, showed substantial superiority over the others, recording the highest cane yield. Sugarcane G.2017-30 genotype produced the highest sugar yield/fed, while the lowest was given by G.2017-28. The correlation analysis manifested that the cane diameter, number of stalks per meter and cane height contributed the most in the harvestable cane yield. Different variations among the tested clones were noticed in the studied traits; it ranged from low for (stalk diameter cm; brix% and purity%) medium for (stalk length cm; sucrose% and sugar recovery%) to high for (number of stalks per m²; cane yield and sugar yields ton/fed). Based on the performance of the genotypes across the two crop cycles, the selection at the plant cane and 1stratoon can be recommended at early clonal stage though it cannot be considered sufficient for mid stages.

Key words: *Correlations, Interrelationships, Early evaluation, Crop cycles, Genotypes, Clones, Sugarcane (Saccharum spp).*

1. INTRODUCTION

Sugarcane (*Saccharum spp.* L.) is an important cash crop (Falcon, 1964). In Egypt, sugarcane is grown on 133.7 thousands ha with total annual cane production of 15.3 million tons (Annual Report of Sugar Crops Council, 2019). Plant breeders are continuously endeavoring to improve the genetic potential of yield and sucrose recovery of this crop to meet the demands of an ever increasing population and limitation of cultivated area in Egypt. Sugarcane variety development programmers primarily envisage breeding for high cane yields and high sugar content suitable for specific environmental conditions (Skinner *et al.*, 1987). Sugarcane varieties tend to run out, or decline after some years in a specific area (Khan *et al.*, 2009).

Evaluation of sugarcane clones performance in breeding cane quality attributes decreased time to identify superior clones (Bell *et al.*, 2008). Abu-Ellail *et al.*, (2017) found at early selection stage of sugarcane, that stalk diameter decreased with older crops, while stalk number, cane yield, juice quality traits, and sugar yield increased with older crops. Khan *et al.*, (2012) revealed that higher number of tillers, good cane weight endowed with better pol % cane and juice purity is the most important characters for consideration in the selection for high sugar yields in sugarcane genotype. Masri *et al.*, (2014) evaluated 30 sugarcane clones including one check cultivar in plant cane and ratoon crops for yield and important characters. Genotype × crops-year interaction was highly significant for

all traits, except cane yield (ton/fed) and Brix% which were insignificant. Abu-Ellail *et al.* (2018) reported significant differences among tested clones for stalk length, stalk diameter, number of stalks/fed, cane yield, Brix %, sucrose %, purity %, sugar recovery% and sugar yield in plant cane, 1st ratoon and across crops.

Correlation among phenotypic traits may reflect biological processes that are of considerable evolutionary interest; where correlation can be the result of genetic, functional and physiological or developmental characters (Wagner and Schwenk, 2000). While, Falconer (1989) reported that the association between two or more characters is due to apheliotropic gene action or linkage. Abu-Ellail *et al.* (2017) showed that the phenotypic correlation between cane yield and its components, *viz.* stalk diameter, stalk weight and number stalks/fed were highly significant in the positive direction across crop seasons. In plant breeding, correlation coefficient analysis measures the mutual relationship between two plant characters and it determines characters association for genetic improvement of yield and other economic traits (Ahmed *et al.*, 2010). The characters with higher repeatability and genetic gain can be used for selection. The correlations among various characters with yield and their mutual correlation study is important and also gives an insight between the parameters relation (Kang *et al.*, 1983). Masri *et al.* (2015) reported that phenotypic and genotypic correlation between cane yield and its components, *viz.* stalk diameter, stalk weight and number stalks/fed were highly significant in the positive direction in plant cane, 1stratoon and across crops. There was also a positive and significant correlation of cane yield with brix % and sugar yield. However, insignificant correlation was observed with stalk height at the phenotypic and genotypic level in both plant cane and 1stratoon crops. The objectives of this study were to: 1) Evaluate the yield and quality performance of 20 sugarcane genotypes under two crop cycles; plant cane (PC), and 1stratoon (FR) at early selection stage, 2) Identify promising clones of sugarcane for further testing, and 3) Calculate correlations among yield and quality traits.

2. MATERIALS AND METHODS

The present study was conducted at Mattana Agricultural Research Station (latitude of 25° 17' N and longitude of 32° 33'), Luxor Governorate.

The climate of Luxor is classified by the Köppen-Geiger system as desert, where rainfall is about 2 mm/year, with a mean summer temperature of 32.4°C, mean winter temperature of 23.2°C and relative humidity of 61.6% during 2017-2018 and 2018-2019. The materials composed 20 genotypes of sugarcane, which were tested along with one check commercial cultivar *viz.* GT54-9 (Table 1). The genotypes were grown in a randomized complete block design with three replicates. Plot area was 15 m², including 3 rows of sugarcane of 5-m long, spaced at 1.0 m. Planting was during March 2017 by fifteen 3-budded cane pieces in each row. Field was irrigated right after planting and all other agronomic practices were carried out as recommended. Plant cane was allowed to ratoon after harvest. Both plant cane and its first ratoon crops were harvested at age 12 months. At harvest, a sample of twenty stalks from each plot was collected to determine the following traits:

1. Number of stalks per m².
2. Stalk length (cm), which was measured from soil surface to the visible dewlap.
3. Stalk diameter (cm), which was measured at the middle part of stalk.
4. Cane yield/fed (ton), which was calculated on plot basis. (one feddan = 0.42 ha).
5. Brix (total soluble solids %), which was determined using a Hydrometer.
6. Sucrose percentage, which was determined using automatic Saccharimeter, according to A.O.A.C. (1980).
7. Juice purity% was estimated as (sucrose% / brix% x 100).
8. Sugar recovery% was calculated according to the formula described by Yadav and Sharma (1980): [Sucrose % - 0.4 (Brix-Sucrose %)] x 0.73
9. Sugar yield/fed (ton) was estimated by multiplying net cane yield/fed (ton) by sugar recovery %.

Separate RCBD and combined analyses of variance of collected data were performed according to Gomez and Gomez (1984). Differences between means were done using the least significant difference test (LSD) at 5% level of probability. SPSS version 21 was used on windows operating system for assessing the magnitudes of correlation among variables (Spearman's Correlation). Phenotypic (*r_p*) correlation coefficients and their standard errors were calculated for all the traits according to (Falconer, 1989) as flows:

Table (1): Sugarcane clones used in the present study and their pedigree.

Ser	Clones	Hybrid combinations	
		♀	♂
1	G.2017-9	G2009-18 x CP46-115	
2	G.2017-14		
3	G.2017-16		
4	G.2017-17		
5	G.2017-26	EI266-2 x selfing	
6	G.2017-28		
7	G.2017-30		
8	G.2017-33	CP46-115 x G2009-18	
9	G.2017-34		
10	G.2017-35		
11	G.2017-43	EI266-2 x CP46-115	
12	G.2017-44	EI24-2 x EI266-2	
13	G.2017-47		
14	G.2017-58		
15	G.2017-59		
16	G.2017-62		
17	G.2017-63		
18	G.2017-67	CP46-115 x EI266-2	
19	G.2017-68		
20	G.2017-70		
21	GT54-9	Check cultivar	

EH = Hwamdia, Egypt; Cp= Canal point, Florida, USA; G = Giza, Egypt.

$$r_{xy} = \frac{\sigma^2_{xy}}{\sqrt{\sigma^2_x \times \sigma^2_y}}$$

Where, r_{xy} = phenotypic correlation coefficient between characters X and Y. σ^2_{xy} = phenotypic covariance between x and y, σ^2_x = phenotypic variance of x trait, σ^2_y = phenotypic variance of y trait. The phenotypic correlation coefficients were tested for their significance with tabulated r-values at g-2 degrees of freedom, where g is the number of genotypes.

3. RESULTS AND DISCUSSION

Highly significant mean squares (ANOVA table is not presented) were observed among the genotypes for cane and sugar yields and its components, except for purity %. Crop-year mean squares were also highly significant, except for stalk length and purity% in crop-year, respectively. Genotype × Crop-year (G×Y) interaction mean squares were significant for most studied traits ($p \leq 0.01$), except for purity%, sugar recovery% and sugar yield, respectively. These results are in line with Tahir *et al.* (2014), Masri *et al.* (2014) and Abu-Ellail *et al.* (2018), who found highly significant mean squares at $P < 0.05$ for stalk length, cane yield and sugar yield, except stalk diameter and stalk number, which were not significant, On the other hand the genotype x crop mean squares were highly significant ($P < 0.01$) for the studied characters under this experiment.

3.1. Performance of genotypes for cane yield and components

Data presented in Table (2) revealed that the evaluated genotypes varied significantly for stalk length and stalk diameter in the plant cane, 1stratoon and across crops. The genotype (G.2017-14) recorded the highest mean of stalk length in the plant cane and across crops (259.67 and 259.83 cm), while, in the 1stratoon, the highest mean stalk length (271.00 cm) was recorded by the genotype (G.2017-17). Across crops; the genotype (G.2017-14) significantly exceeded the overall mean but was lower than that of the check variety G.T.54-9. These results are in harmony with those reported by Masri *et al.* (2014), who found significant differences among 30 genotypes and their interaction with crops-year for stalk length. Stalk diameter was significantly affected by crops cycles, the genotype (G.2017-63) recorded the highest mean of stalk diameter in the plant cane (3.10 cm), while in the 1st ratoon, the highest mean stalk diameter (2.63 cm) was registered by genotype (G.2017-17). Moreover, across crops, the highest mean of stalk diameter (2.86 cm) was recorded by the genotype (G.2017-63), which surpassed the overall mean, but was lower than that of the check variety G.T.54-9. These results are in agreement with those reported by Jamoza *et al.* (2014) who reported significant differences among the studied genotypes in stalk diameter at early stage.

Table (2): Mean performance of sugarcane genotypes for stalk length (cm) and stalk diameter (cm) in plant cane (PC), 1st ratoon (FR) and across crops (AC) during 2017-2018 and 2018-2019 seasons.

Genotypes	Stalk length (cm)			Stalk diameter (cm)		
	PC	FR	AC	PC	FR	AC
G.2017-9	210.33	240.00	225.17	2.55	2.40	2.48
G.2017-14	259.67	260.00	259.83	2.52	2.10	2.31
G.2017-16	259.00	253.67	256.33	2.65	2.42	2.53
G.2017-17	200.00	271.00	235.50	2.76	2.63	2.70
G.2017-26	243.33	196.87	220.10	2.52	2.31	2.42
G.2017-28	201.33	247.67	224.50	2.43	2.47	2.45
G.2017-30	232.67	263.67	248.17	2.49	2.37	2.43
G.2017-33	208.00	244.00	226.00	2.50	2.41	2.46
G.2017-34	220.67	262.67	241.67	2.58	2.22	2.40
G.2017-35	240.33	229.67	235.00	2.56	2.30	2.43
G.2017-43	254.00	231.33	242.67	2.53	2.17	2.35
G.2017-44	200.67	233.33	217.00	2.41	2.23	2.32
G.2017-47	215.67	259.00	237.33	2.43	2.17	2.30
G.2017-58	159.67	251.00	205.33	2.45	2.47	2.46
G.2017-59	251.00	243.33	247.17	2.84	2.40	2.62
G.2017-62	214.33	252.00	233.17	2.49	2.60	2.55
G.2017-63	213.00	229.33	221.17	3.10	2.61	2.86
G.2017-67	243.67	228.33	236.00	2.56	2.57	2.57
G.2017-68	206.00	232.67	219.33	2.40	2.36	2.38
G.2017-70	212.33	222.33	217.33	2.36	2.42	2.39
GT54-9	276.77	266.67	271.72	2.73	2.61	2.67
Mean	224.88	243.74	234.31	2.57	2.39	2.48
C.V %	11.4	7.3	6.1	6.8	6.4	5.6

L.S.D at 5%

Genotypes(G)	23.17	0.13
Crop-year (C)	NS	0.03
G×C	14.76	0.18

The means of stalks/m² in Table (3) indicated that genotype (G.2017-30) recorded the highest number of stalks/m² in the plant cane (25.67 stalks/m²), while in the 1st ratoon, the highest mean of stalks/m² (31.00 stalks/m²) was registered by genotype (G.2017-9). However, in the across crops, the highest mean number of stalks/m² (26.83 stalks/m²) was produced by genotype (G.2017-43). Also, it exceeded the overall mean by 4.86 stalks/m², but it did not exceed the check cultivar (G.T.54-9). Millable stalk numbers/fed increased from plant cane to 1stratoon and it was decreased by increasing more than 3 crops cycles as found by Abu-Ellail *et al.*, (2018). Cane yields and the 1st ratoon crops were significantly influenced by the interaction between sugarcane genotypes and crop-year. The genotype (G.2017-68) registered

the highest cane yield (ton/fed) in the plant cane (56.50 ton/fed), but in the 1st ratoon, the highest cane yield (58.80 ton/fed) was produced by genotype (G.2017-30 and G.2017-26). However, across crops the highest cane yield (56.25 ton/fed) was recorded by genotype (G.2017-68), also it exceeded the overall mean by 9.72 ton/fed and exceed the commercial cultivar G.T.54-9 by 6.17 ton/fed. Similar results were reported by Musa *et al.* (1997) and Abu-Ellail *et al.* (2018), who found significant differences among genotypes, where stalk diameter and stalk length were used to assess stalk weight, and these two traits were further combined with stalk number to express cane yield. El-Shafai and Ismail (2006) found significant differences among the tested sugar cane varieties for cane yield.

Table (3): Mean performance of sugarcane genotypes for number of stalks per m² and cane yield (ton/fed) in plant cane (PC), 1st ratoon (FR) and across crops (AC) during 2017-2018 and 2018-2019 seasons.

Genotypes	Number of stalks per m ²			Cane yield (ton/fed)		
	PC	FR	AC	PC	FR	AC
G.2017-9	18.67	31.00	24.83	50.10	56.60	53.35
G.2017-14	17.00	27.00	22.00	43.30	49.80	46.55
G.2017-16	18.33	18.00	18.17	35.50	42.00	38.75
G.2017-17	19.67	19.00	19.33	39.70	46.20	42.95
G.2017-26	22.33	22.00	22.17	52.30	58.80	55.55
G.2017-28	24.00	17.00	20.50	31.30	37.80	34.55
G.2017-30	25.67	22.00	23.83	52.30	58.80	55.55
G.2017-33	19.33	20.33	19.83	45.30	51.80	48.55
G.2017-34	24.33	29.00	26.67	45.03	51.53	48.28
G.2017-35	19.33	23.33	21.33	38.30	47.73	43.02
G.2017-43	25.00	28.67	26.83	52.70	53.47	53.08
G.2017-44	16.00	21.33	18.67	31.30	42.67	36.98
G.2017-47	25.00	26.00	25.50	44.50	48.93	46.72
G.2017-58	14.33	18.67	16.50	38.30	44.80	41.55
G.2017-59	20.33	19.00	19.67	35.50	46.20	40.85
G.2017-62	21.00	19.67	20.33	48.10	49.00	48.55
G.2017-63	18.00	21.67	19.83	35.50	47.40	41.45
G.2017-67	18.67	27.00	22.83	42.23	53.13	47.68
G.2017-68	18.33	21.33	19.83	56.50	56.00	56.25
G.2017-70	18.67	23.00	20.83	43.90	49.67	46.78
GT54-9	28.67	35.00	31.83	48.97	51.20	50.08
Mean	20.60	23.33	21.97	43.36	49.69	46.53
C.V %	15.9	17.8	13.2	17.1	11.3	13.7

L.S.D at 5%

Genotypes(G)	3.21	6.30
Crop-year (C)	1.31	3.28
G×C	2.54	4.91

3.2. Performance of genotypes for quality traits and sugar yield

The results given in Table (4) indicated that brix% and sucrose% varied significantly among in the plant cane, 1st ratoon and across crops. Genotype (G.2017-47) recorded the highest mean brix percentage in the plant cane (22.73%), while, in the 1st ratoon, the highest mean brix percentage (20.77%) was shown by genotype (G.2017-62). However, across crops, clone (G.2017-68) gave (21.46%). Also it exceeded the overall mean by about 1.29 % and G.T.54-9 by about 0.44 %. Similar results were reported by Masri *et al.* (2014) and Mohamed *et al.* (2017), they found that the studied sugarcane varieties differed significantly in brix %, sucrose %, pol%, sugar recovery %, and reducing sugars% as well as millable cane yield and recoverable sugar yield (ton/fed). Manjunath *et*

al.(2007) found significant differences among genotypes for brix % and sucrose %, which were increased significantly from plant cane to its ratoon crop. For sucrose percentage, the genotype (G.2017-47) recorded the highest mean sucrose percentage in the plant cane (14.95 %), while in the 1st ratoon, and across crops, the highest mean sucrose percentage (14.17 and 14.50 %, respectively) was recorded by genotype (G.2017-59). It also exceeded the overall mean by 1.43 % and G.T.54-9 by 0.02%. Similar results were reported by Abu-Ellail *et al.* (2018) who indicated that sucrose content and cane yield were the primary yield components of sugarcane, as considered by the breeder at the early selection stages. The interaction between genotypes and crop-year was significant for sucrose percentage (Table 4).

Table (4): Mean performance of sugarcane genotypes for brix% and sucrose% in plant cane (PC), 1stratoon (FR) and across crops (AC) during 2017-2018 and 2018- 2019 seasons.

Genotypes	Brix%			Sucrose%		
	PC	FR	AC	PC	FR	AC
G.2017-9	21.33	17.53	19.43	13.74	12.38	13.06
G.2017-14	20.47	17.73	19.10	12.72	10.83	11.78
G.2017-16	20.47	20.00	20.23	12.44	13.98	13.21
G.2017-17	19.22	18.30	18.76	12.09	11.48	11.79
G.2017-26	21.30	19.20	20.25	12.27	13.03	12.65
G.2017-28	19.05	18.21	18.63	12.34	11.97	12.15
G.2017-30	21.07	18.42	19.74	14.49	14.16	14.33
G.2017-33	21.63	17.60	19.62	12.81	11.83	12.32
G.2017-34	20.57	19.71	20.14	13.44	12.88	13.16
G.2017-35	21.25	19.47	20.36	15.95	12.05	14.00
G.2017-43	21.52	19.28	20.40	12.73	12.79	12.76
G.2017-44	20.87	18.03	19.45	12.35	12.20	12.28
G.2017-47	22.73	20.07	21.40	14.95	13.23	14.09
G.2017-58	20.93	19.83	20.38	13.59	13.02	13.30
G.2017-59	22.24	19.63	20.94	14.83	14.17	14.50
G.2017-62	22.13	20.77	21.45	14.48	12.13	13.31
G.2017-63	20.77	19.40	20.08	12.39	12.00	12.20
G.2017-67	22.33	19.63	20.98	12.52	13.02	12.77
G.2017-68	22.36	20.57	21.46	12.44	13.80	13.12
G.2017-70	20.73	18.80	19.77	13.51	13.00	13.26
GT54-9	21.13	20.91	21.02	14.30	14.67	14.48
Mean	21.15	19.20	20.17	13.35	12.79	13.07
C.V %	4.6	5.1	4.2	8.3	7.2	6.1

L.S.D at 5%

Genotypes(G)	1.11	1.32
Crop-year (C)	1.01	0.31
G×C	1.56	0.86

Results listed in Table (5) indicated that the purity and sugar recovery percentages % varied significantly among evaluated genotypes in the plant cane, 1st ratoon and across crops. The genotype (G.2017-35) registered the highest mean purity % and sugar recovery % in the plant cane (75.08 and 10.10 %, respectively), while, in the 1st ratoon and across crops, the highest mean purity% and sugar recovery percentage (76.90, 72.56, 9.09 and 8.87 %, respectively) was shown by genotype (G.2017-30). Across crops; the highest genotype (G.2017-30) exceeded the overall mean by (10.26, 7.76, 1.48 and 1.33 %, respectively) and G.T.54-9 by (6.76, 3.66, 0.2 and 0.2 %, respectively). Similar results were reported by El-Taib (1999) and Masri *et al.* (2014), who found for sugar recovery percentage significant differences among genotypes, and their interaction between crop-year was not

significant. Hagos *et al.*(2014), who reported that a significant difference for quality parameters was observed among four sugarcane varieties.

Sugar yield (ton/fed) varied significantly among evaluated genotypes in the plant cane, 1stratoon and across crops. The genotype (G.2017-30) recorded the highest mean sugar yield (ton/fed) in the plant cane, 1stratoon, and across crops ;(4.53, 5.35 and 4.93 ton/fed). The highest genotype in sugar yield (G.2017-30) exceeded the overall mean by (1.29, 1.57 and 1.42 ton/fed) and it exceeded the check variety G.T.54-9 by (0.39, 0.8 and 0.59 ton/fed), for plant cane, 1st ratoon and across crops, respectively. Abu-Ellail *et al.* (2017) and Bell *et al.* (2008) found significant differences among genotypes and insignificant interaction between genotypes and crop-year for sugar yield

Table (5): Mean performance of sugarcane genotypes for purity%, sugar recovery% and sugar yield (ton/fed) in plant cane (PC), 1stratoon (FR) and across crops (AC) during 2017-2018 and 2018 -2019 seasons.

Genotypes	Purity%			Sugar Recovery%			Sugar yield%		
	PC	FR	AC	PC	FR	AC	PC	FR	AC
G.2017-9	64.42	70.61	67.21	7.81	7.53	7.67	3.91	4.26	4.09
G.2017-14	62.15	61.07	61.65	7.02	6.89	6.96	3.04	3.43	3.24
G.2017-16	60.78	69.90	65.29	6.74	8.45	7.59	2.39	3.55	2.94
G.2017-17	62.93	62.72	62.82	6.74	7.39	7.07	2.68	3.41	3.03
G.2017-26	57.60	67.85	62.46	6.32	7.71	7.02	3.31	4.53	3.90
G.2017-28	64.76	65.71	65.22	7.05	6.92	6.98	2.21	2.61	2.41
G.2017-30	68.77	76.90	72.56	8.66	9.09	8.87	4.53	5.35	4.93
G.2017-33	59.20	67.20	62.79	6.78	6.95	6.86	3.07	3.60	3.33
G.2017-34	65.35	65.37	65.36	7.73	7.41	7.57	3.48	3.82	3.65
G.2017-35	75.08	61.89	68.77	10.10	6.63	8.36	3.87	3.16	3.60
G.2017-43	59.18	66.34	62.56	6.73	7.44	7.08	3.54	3.98	3.76
G.2017-44	59.18	67.65	63.11	6.53	7.20	6.87	2.04	3.07	2.54
G.2017-47	65.78	65.94	65.86	8.64	7.66	8.15	3.85	3.75	3.81
G.2017-58	64.91	65.65	65.27	7.78	7.52	7.65	2.98	3.37	3.18
G.2017-59	66.70	72.16	69.26	8.66	8.75	8.71	3.08	4.04	3.56
G.2017-62	65.44	58.42	62.04	8.34	6.33	7.33	4.01	3.10	3.56
G.2017-63	59.68	61.87	60.74	6.60	7.60	7.10	2.34	3.60	2.94
G.2017-67	56.05	66.33	60.86	6.28	7.57	6.92	2.65	4.02	3.30
G.2017-68	55.63	67.10	61.12	6.18	8.10	7.14	3.49	4.53	4.02
G.2017-70	65.18	69.15	67.07	7.75	7.80	7.78	3.40	3.87	3.64
GT54-9	67.67	70.14	68.90	8.44	8.89	8.67	4.14	4.55	4.34
Mean	63.14	66.64	64.80	7.47	7.61	7.54	3.24	3.78	3.51
C.V %	7.4	6.3	4.9	14.1	9.0	8.3	21.0	16.5	16.5

L.S.D at 5%

Genotypes (G)	NS	1.38	0.82
Crop-year (C)	NS	0.07	0.32
G×C	NS	NS	NS

(ton/fed). They concluded that cane yield of most tested genotypes increased in older crops, but crop cycle had no effect on juice quality traits.

3.3. Interrelationships among yield and agronomic traits

Phenotypic (r_p) correlation coefficients between all pairs of the studied traits across crops are presented in Table (6). Stalk height gave a positive and highly significant correlation with stalk diameter, cane yield (ton/fed) and sugar yield (ton/fed). Meanwhile, it gave a positive and non-significant correlation with each of brix%, sucrose%, purity% and sugar recovery%. A negative and non-significant correlation existed between stalk height and the number of stalks/m². James (1971) reported a negative association between stalk diameter and

stalk number, however it was positively associated with cane yield. Cane length was positively and substantially correlated with cane yield as reported by Chaudhary *et al.* (2003). Stalk diameter though had positive and significant association with characters like cane yield and sugar yield at phenotypic level, it showed a positive and non-significant association with brix %, sucrose %, purity % and sugar recovery% at phenotypic level. Furthermore, it gave a negative and non-significant correlation with the number of stalks/m². Results showing positive association of cane diameter with cane yield have already been reported by several investigators (Singh and Sharma, 1997). Number of stalks/m² showed positive and significant phenotypic correlations with each of cane yield and sugar

Table (6): Phenotypic (r_p) correlation coefficients among the yield and its components of twenty sugar cane clones across crops (AC) during 2017-2018 and 2018-2019.

Traits		1	2	3	4	5	6	7	8
1.Stalk height	r_p	1.00							
2.Stalk diameter	r_p	0.445*	1.00						
3.Number of stalks/m ²	r_p	- 0.268	- 0.115	1.00					
4.Cane yield	r_p	0.595**	0.087*	0.186*	1.00				
5.Brix%	r_p	0.179	0.105	- 0.10	0.276	1.00			
6.Sucrose%	r_p	0.207	0.283	0.095	0.201	0.605**	1.00		
7.Purity%	r_p	0.252	0.357	0.073	0.048	- 0.001	0.757**	1.00	
8.Sugar recovery%	r_p	0.293	0.256	0.021	0.218	0.396	0.939**	0.883**	1.00
9.Sugar yield	r_p	0.651**	0.213*	0.193*	0.857**	0.418*	0.587**	0.460*	0.647**

*, ** Significant at 5% and 1% probability levels, respectively.

yield. On the other hand, number of stalks/m² had a negative and significant correlation with brix % at the phenotypic level, it showed a positive and non-significant association with sucrose %, purity% and sugar recovery% at phenotypic level. Masri *et al.*, (2015) found that the number of millable canes had negative correlations with all the other traits except cane yield in both crops. A strong negative correlation between the number of millable canes and diameter was recorded. Cane yield (ton/fed) had a positive and highly significant correlations with sugar yield at the phenotypic level. However, such correlations were positive and insignificant with each of brix %, sucrose %, purity % and sugar recovery % at the phenotypic level. Our results are in agreement with those mentioned by Sanghera *et al.*(2015), who reported that cane yield was correlated positively with morphological and cane characters. The cane yield, considered as the most important character of sugarcane, had a negative correlation with sucrose%, and purity% (Masri *et al.*, 2015).

Brix reading showed positive and highly significant correlations with each of sucrose % and sugar yield at the phenotypic level, while this trait (brix %) had a negative and non-significant correlation with purity%, but a significant and positive correlation with sugar recovery %. Chang (1997) evaluated six sugarcane cultivars and indicated that the greatest phenotypic correlations existed among brix % and sugar content. Sucrose percentage exhibited positive and highly significant correlations with each of purity %, sugar

recovery % and sugar yield at the phenotypic level. Abu-Ellail *et al.* (2017) found that sucrose content in juice was positively and significantly associated with purity and sugar yield. Purity percentage showed positive and highly significant correlations with each of sugar recovery % and sugar yield at the phenotypic level. Positive and highly significant correlations existed between sugar recovery % and sugar yield at the phenotypic level. Singh *et al.* (2013) showed significant and positive genotypic correlations between sugar yield and each of cane weight, cane yield, brix % and sucrose %.

Conclusions

It may be concluded that some of the evaluated clones could be selected under different crop cycles with higher productivity associated with higher stalk number, stalk diameter and cane and sugar yields. Therefore, these traits could be considered as useful tools during crop breeding procedure in order to make this process more rapid and cheaper. There were variations among the tested clones that may be noticed according to the studied traits; it ranges from low, medium to high. Our results found that clones, G2017-68 (56.25 and 4.02 ton/fed), G2017-9 (53.35 and 4.09 ton/fed), and G2017-30 (55.55 and 4.93 ton/fed), respectively, produced the highest cane and sugar yields. This indicates that they are of greater promise and can be evaluated in subsequent regional selection programs and at different age levels. A wide scale study is yet needed; therefore, these genotypes were selected for zonal varietal testing trials for further testing at different locations under diverse agro-climatic conditions.

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التقييم المبكر لبعض التراكيب الوراثية الجديدة من قصب السكر في دورتين محصوليتين وعلاقة المحصول ببعض الصفات الزراعية

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ملخص

يعتبر انتخاب واستنباط اصناف جديدة من قصب السكر عالية الإنتاجية أمراً مهماً لزيادة إنتاج السكر بما يلبي المتطلبات المتزايدة من السكر باستمرار. وفي هذا الصدد فلقد تم تقييم عشرين تركيب وراثي من قصب السكر الجديدة مع مقارنتها بالصنف التجارى كمعاملة قياسية بهدف تقييم حاصل العيوان وصفات الجودة كما استهدف ايضا حساب الارتباطات بين صفات كمية المحصول والجودة. في قصب الغرس (PC) ومحصول الخلفة الاولى (FR) في مرحلة الانتخاب المبكرة تحت ظروف مصر العليا. اجريت التجارب الحقلية فى تصميم القطاعات الكاملة العشوائية مع ثلاث مكررات، في محطة المطاعنة للبحوث الزراعية (خط عرض 25 ° 17 شمالاً وخط طول 32 ° 33)، محافظة الأقصر، خلال موسمي 2017-2018 و 2018-2019. أوضحت النتائج وجود فروق معنوية احصائياً ($p \leq 0.05$) بين التراكيب الوراثية لمعظم الصفات الانتاجية المرتبطة بحاصل العيوان، وكذلك لنسبة حاصل السكر وصفات جودة العصير باستثناء درجة النقاوة% التي اظهرت تأثير غير معنوى. كان تأثير التركيب الوراثي وتفاعله مع السنوات (الغرس والخلفة الاولى) ذا أهمية كبيرة بالنسبة لمعظم الصفات المدروسة ($P \leq 0.01$) بينما كان غير مهم لصفة النقاوة %، وناتج السكر النظرى %، وحاصل السكر. أظهر التركيب الوراثي (G.2017-68) تفوقاً كبيراً حيث سجل أعلى محصول عيوان (56.25 طن/ للفدان) مقابل (50.08 طن / للفدان) من الصنف التجارى (GT54-9). سجل التركيب الوراثي (G.2017-30) تفوقاً على جميع التراكيب الوراثية المتضمنة فى الدراسة الحالية من حيث العائد من حاصل السكر (4.93 طن / للفدان). فى حين ان اقل حاصل من السكر سجله التركيب الوراثي بمعدل G.2017-28 (2.40 طن سكر / للفدان). أظهر تحليل معامل الارتباط أن قطر الساق وعدد العيوان فى المتر المربع وطول النبات قد ساهم أكثر فى غلة حاصل العيوان. يمكن ملاحظة اختلافات كبيرة بين التراكيب الوراثية المختبرة وفقاً للصفات المدروسة حيث تراوحت من منخفضة (قطر الساق، البركس% والنقاوة%) متوسطة (طول الساق؛ السكروز% وناتج السكر%) إلى العالي (عدد السيقان لكل متر مربع؛ محصول العيوان وإنتاجية السكر). استناداً إلى أداء التراكيب الوراثية عبر دورتين محصوليتين. فإنه يمكن التوصية بفاعلية الانتخاب فى قصب الغرس والخلفة الاولى لتحديد كفاءة الانتخاب فى الاجيال المبكرة ولكنه قد لا يكون ذو فاعلية فى الاجيال المتقدمة.

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