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Evaluation of Thirty Sugarcane Genotypes to Concurrent Infestation Criteria and Favorite Stalk Portion Infested by *Chilo agamemnon* Bles. and *Saccharicoccus sacchari* CKll.

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Abstract: A field trial was carried out at the experimental farm of Agricultural Research Station, Agricultural Research Center, Giza, Egypt during 2017/2018 season (as plant cane) and 2018/2019 (as first ratoon) to study: A) the relative susceptibility of thirty sugarcane genotypes [20 genotypes imported from global breeding stations (ISG) and 10 Egyptian sugarcane genotypes bred in Egypt (ESG)] under natural infestation by two key sugarcane insects, purple lined borer (*Chilo agamemnon* Bles.) and pink mealybug (*Saccharicoccus sacchari* Ckll.), B) Relationship (concurrent) between both insects, C) Which portion of sugarcane stalk insects prefer? D) measure the infestation effect on some sugarcane characteristic (Stalk components i.e. stalk weight, length, diameter, number/m^2 and sucrose content). The concurrent infestation criteria with both tested insects were divided into three parts: Absolute concurrent infestation (ACI), Partial concurrent infestation (PCI) and Accident /Random concurrent infestation (A/RCI). Results cleared that dealing to relative susceptibility, POJ 2878 and F. 161 were uninfested by both insects (These genotypes could be used in breeding programs), the least infested genotypes were G. 84-47 and N11 during both tested seasons. Otherwise, PR 1013 was the highest infested ones for both tested insects (It could be used as trap crop for those insects or for the source to collect such insect for plant protection studies). Average the two seasons ISG gained less infestation than ESG. The highest infested ISG and ESG by *C. agamemnon* were PR 1013 and EH 87/26-11, respectively and to *S. sacchari* were PR 1013 and CO 413. Further, average intensity infestation % with purple lined borer ranged from 1.7 to 16.7% and with pink mealybug ranged from 5.1 to 33.6%. As for portions stalk, *C. agamemnon* preferred the middle portion followed by upper and basal portions, respectively. While, *S. sacchari* preferred the upper portion followed by the middle and basal ones, respectively in both seasons. Characteristics such as stalk length, diameter and sucrose% significantly increased in the 1st ratoon than the plant cane, on the contrary, stalk weight in plant cane was much higher than the first ratoon. With regard to concurrent infest criteria, PR 1059, ROC 10, TUC 5120, EH 26-2 and G.T. 54-9 had ACI, while, G. 84-47 had A/RCI and the rest of genotypes owned PCI. Thus, preliminary results indicate that there were no relationships between the infestation by *C. agamemnon* or *S. sacchari* for stalk weights. No clear relationships between sucrose % and the infestation by two key sugarcane insects. Multiple regression signified that infestation basal portion (BC) of stalk by purple lined borer gave positive and negative effects on stalk diameter and numbers, respectively and infestation middle portion (MS) of stalk by *S. sacchari* had the negative effect on stalk weight and length, where, infestation upper and basal portion (US & BS) of stalk by the same insect gave the negative effect on stalk number and diameter. The findings of this research illustrated that the parameter of main sugarcane cultivar G.T.54-9 in Egypt depressed, therefore, it must be replaced or ancillary by another cultivar, such as G. 84-47 and G. 2003-47. To provide evidence of our findings, it must be used more sugarcane cultivars, different locations and seasons.

Key words: Evaluation · Genotypes *Chilo agamemnon* · *Saccharicoccus sacchari* · Sugarcane

INTRODUCTION

Nowadays, the total sugar production reached about 2.3 million tons from both sugarcane and sugar beet. This production covered about 70.2% from the total consumption. The gap between sugar production and consumption was about 29.8% (968, 000 tons) imported from the global market [1]. Therefore, several methods to

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reduce this gap such as increasing sugarcane productivity of area unit via improve agricultural practices, use high sugar genotypes and reduce infestation by sugarcane pests etc. Consequently, to reduce insect infestation, it must be used tolerance sugarcane genotypes instead of susceptible ones [2-7]. Also, most of researchers concentrated on study the effect of one pest and neglect the effect of another pest on the same time which found in the same place of plant or other parts that had negative effect on crop productivity [8].

In Egypt, the most deleterious insects infesting sugarcane are the purple lined borer, *Chilo agamemnon* Bles., the pink borer, *Sesamia cretica* Led. and the pink mealybug, *Saccharicoccus sacchari* Ckll. which cause magnitude losses in sugarcane yield [2, 3, 4, 8, 9]. In this connection, [10], indicated that *C. agamemnon* infestation caused 1.47-8.37% loss of stalk yield. However, [3, 9, 11, 12], reported that the reduction in cane yield by *S. sacchari* Ckll. infestation greatly related to the of infestation intensity percentage and cane age.

The "Mixed infestation" may be between two nematodes species such as *Meloidogyne incognita* and *Rotylenchulus reniformis* [13] and medically between species of helminthes and protozoa [14]. While, "Associated infestation" was mentioned by Gadoury [15] between fruit-feeding insects or between *Botrytis cinerea* (pathogen) and grape berry moth larvae (insect) [16]. A "multi-infestation" of more than two individuals has been observed [17]. Errard [18] revealed that multiple-pest infestations have received little interest. The studies of concurrent infestation were rare. The first attempt was done on sugarcane insects by Ebieda [8] in Egypt under the effect of applying pesticides. The sparse data may be return to difficulty explanation the relation between two insects and more difficulty among more than two insects or pests. Therefore, the main objectives of this study were:

- Susceptibility of the tested sugarcane genotypes to infest by purple lined borer (*Chilo agamemnon* Bles.) and pink mealybug (*Saccharicoccus sacchari* Ckll.).
- Which portion (upper, middle and basal) of sugarcane stalk insect prefer?
- If sugarcane was infested by one insect, the other insect could/couldn't infest the same portion/stalk.
- Does sugarcane characteristic affect with individual or concurrent infestations?
- Relation between two tested insects to infest stalk of sugarcane.
- Which portion the insects effects on the tested sugarcane characters?

MATERIALS AND METHODS

A field trial was conducted at Giza Research Station, Agricultural Research Center during 2017/2018 as plant cane (first growing season) and 2018/2019 as first ratoon (second growing season) to assess the susceptibility of thirty sugarcane genotypes (shown in the Table 1) to infest by two key sugarcane insects, purple lined borer (*Chilo agamemnon* Bles., Lepidoptera, Pyralidae) and pink mealybug (*Saccharicoccus sacchari* Ckll., Homoptera, Pseudococcidae) for breeding and plant protection programs. The concurrent infestation criteria with both tested insects were divided into three parts:

Absolute Concurrent Infestation: (ACI) means that the infestation by first insect must be followed by infestation by the 2nd ones and we that these few relationship, one of the hand control is very important because the appearance of the first insect means must be followed to get the plant a second insect and so the third. Therefore, the control of any of both insects must use pesticides to combat both insects. This relationship does not depend on plant or environmental conditions. The main example for this relationship was the relation between predator or parasite and its host.

Partial Concurrent Infestation: (PCI) means that the appearance of one insect on the plant may get a second or third insect. There is minor relationship between infestations of both insects. This relationship depends on the plant and environmental conditions.

Accident /Random Concurrent Infestation (A/RCI): appropriates that this infestation category is random syndrome dealing with frail temporary hit. Both insects may appear together or individually. No relationship could be recognized between the two insects.

The genotypes of sugarcane were divided into 2 groups which were imported Sugarcane Genotypes (ISG) and Egyptian Sugarcane Genotypes (ESG). These genotypes were planted in a Randomized Complete Block Design (RCBD). Sown date was on March 6, 2017 and 2018 in two seasons, respectively, using fixed number of three budded cane sets. The experiment received the

Table 1: Geographic origins of the tested cane materials

No	Genotypes	Origin	No	Genotypes	Origin
1	BO 19	Bihar, Orissa, India	16	PR 1059	Puerto, Rico, USA
2	CO 413	Coimbatore, India	17	ROC 10	China
3	CO 419	Coimbatore, India	18	SP 59-56	Sao Paulo, Brazil
4	CP 44-101	Canal point, Florida, USA	19	SP 79-2233	Sao Paulo, Brazil
5	CP 76-331	Canal point, Florida, USA	20	TUC 5120	Angentina
6	F 153	Taiwan	21	EH 87/ 26-11	Hawamdia, Egypt
7	F. 161	Taiwan	22	EH 26-2	Hawamdia, Egypt
8	M 57-351	Mauritius	23	G.T. 54-9	Giza, Egypt, Taiwan
9	MIX 2001-80	Mexico	24	G. 74-96	Giza, Egypt
10	N 11	Natal, South Africa	25	G. 84-47	Giza, Egypt
11	N 26	Natal, South Africa	26	G. 95-19	Giza, Egypt
12	NCO 292	South Africa, India	27	G. 95-21	Giza, Egypt
13	NCO 310	South Africa, India	28	G. 98-28	Giza, Egypt
14	POJ 2878	Indonesia	29	G. 2003-47	Giza, Egypt
15	PR 1013	Puerto Rico, USA	30	G. 2009-73	Giza, Egypt

usual recommended agricultural practices and chemical control was entirely avoided. The plants were exposed to normal field conditions and natural infestation. At harvest period, samples of 30 stalks of each millable cane genotype chosen [samples of 10 stalks were taken randomly of three replicates for each millable cane genotype chosen]. The sugarcane stalk was divided into three portions (upper, middle and basal portions) and carefully examined to determine total number of joints (internode) and number of infested joints by, *C. agamemnon* and *S. sacchari* for each portion and for each sugarcane genotype. The following parameters were calculated the percentage of infested internodes (intensity infestation). Sugarcane characteristics such as stalk weight, diameter, length and numbers/m^2 were documented.

Sucrose percentage (Sucrose in 100 cubic centimeter clarified juice) was determined by direct polarization using Saccharimeter apparatus.

Percentage data was transformed by Arc-sine units before statistical analysis. Analysis of variance was computed by using MSTAT statistical package (MSTAT-C) for each trait in the two seasons and the combined analysis for both seasons were carried out according to Steel and Torrie (1980). Treatment means were compared using L.S.D. at 5% level of probability.

RESULTS AND DISCUSSION

Response of the Tested Sugarcane Genotypes to Infestation by *C. agamemnon* Bles. and *S. sacchari*

***Chilo agamemnon* Bles:** Results in Table (2) revealed the response of 30 sugarcane genotypes to infest by purple lined borer (*C. agamemnon* Bles.) during two successive season in 2017/18 and 2018/19 as plant cane and first ratoon, respectively. Intensity infestation over all genotypes recorded 6.9% for the plant cane which significantly decreased than 1st ratoon (7.3 %). Further, infested imported sugarcane genotypes (ISG) (7.3 %) were higher than Egyptian sugarcane genotypes (ESG) (6.2 %) during the plant cane. In contrast, in the first ratoon, ESG had higher infestation intensity (9.1%) than ISG (6.3%).

Sugarcane Genotypes

Imported Sugarcane Genotypes (ISG): During the plant cane (1st season), uninfested ISG were F. 161 and POJ 2878, while, in the 1st ratoon (2nd season) were BO 19, F 161, M 57-351, NCO 292, NCO 310, POJ 2878 and SP 59-56. Moreover, only two sugarcane genotypes F. 161 and POJ 2878 were uninfested by *C. agamemnon* during both tested seasons. Data over the two seasons, the highest and the lowest infested ISG with such insect were PR 1013 (16.7 %) and NCO310 (2.9%) respectively. These findings were in harmony with many reviewers such as [6, 7, 19, 20].

Egyptian Sugarcane Genotypes (ESG): Uninfested ESG were EH 26-2 and G. 2003-47 during the plant cane and was G.T.54-9 during the 1st ratoon. Consequently, uninfested ESG over both seasons with C. *agamemnon* was not recorded. Further, the highest and the lowest infested ESG by *C. agamemnon* were EH 87/26-11 (12.6 %) and G.T.54-9 (1.7%). Similar results were reported by [2, 4, 6, 7, 21].

Stalk Portions

ISG: Results in Table (2) indicated that in addition to the uninfested genotypes mentioned before in all stalk portions and whole stalk as well in both seasons, BO 19 was free of infestation in the upper portion only in both

Table 2: Susceptibility of 30 sugarcane genotypes to infest by *Chilo agamemnon* Bles. during two successive season in 2017/2018-2018/2019

		Plant cane				1st ratoon				Average two seasons			
No	Sugarcane genotypes	U	M	B	W	U	M	B	W	U	M	B	W
						Imported Sugarcane Genotypes (ISG)							
1	BO 19	0.0	4.2	3.0	7.2	0.0	0.0	0.0	0.0	0.0	2.1	1.5	3.6
2	CO 413	2.3	4.5	1.3	8.1	3.1	5.7	1.3	10.0	2.7	5.1	1.3	9.1
3	CO 419	2.2	3.1	0.0	5.3	0.0	4.7	0.0	4.7	1.1	3.9	0.0	5.0
4	CP 44-101	3.7	5.2	3.2	12.0	5.0	5.6	0.0	10.6	4.3	5.4	1.6	11.3
5	CP 76-331	2.1	5.0	2.5	9.6	3.1	5.7	0.0	8.8	2.6	5.3	1.3	9.2
6	F 153	2.3	3.9	3.9	10.1	3.0	5.0	2.1	10.1	2.7	4.4	3.0	10.1
7	F. 161	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	M 57-351	1.6	3.8	2.5	7.8	0.0	0.0	0.0	0.0	0.8	1.9	1.2	3.9
9	MIX 2001-80	2.6	3.5	2.5	8.6	2.2	4.1	1.3	7.5	2.4	3.8	1.9	8.0
10	N 11	0.0	2.1	2.7	4.8	2.6	5.1	3.0	10.7	1.3	3.6	2.8	7.7
111	N 26	3.2	3.6	1.8	8.6	4.4	4.5	1.0	9.9	3.8	4.1	1.4	9.2
12	NCO 292	4.9	3.3	0.0	8.2	0.0	0.0	0.0	0.0	2.5	1.6	0.0	4.1
13	NCO 310	2.6	3.2	0.0	5.8	0.0	0.0	0.0	0.0	1.3	1.6	0.0	2.9
14	POJ2878	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	PR 1013	4.1	9.1	2.8	16.1	5.8	11.5	0.0	17.3	5.0	10.3	1.4	16.7
165	PR 1059	1.9	4.9	2.4	9.2	0.0	7.0	0.0	7.0	1.0	6.0	1.2	8.1
17	ROC 10	2.8	0.0	1.4	4.2	4.1	4.0	1.3	9.4	3.4	2.0	1.3	6.8
18	SP 59-56	2.4	2.8	2.0	7.2	0.0	0.0	0.0	0.0	1.2	1.4	1.0	3.6
19	SP 79-2233	3.0	1.6	0.0	4.7	4.7	4.0	1.2	9.9	3.9	2.8	0.6	7.3
20	TUC 5120 5120	4.7	3.4	0.0	8.2	6.2	4.8	0.0	11.0	5.4	4.1	0.0	9.6
	Mean	2.3	3.4	1.6	7.3	2.2	3.6	0.6	6.3	2.3	3.5	1.1	6.8
		Egyptian Sugarcane Genotypes (ESG)											
21	EH 87/26-11	4.8	4.9	2.6	12.3	6.7	6.3	0.0	13.0	5.7	5.6	1.3	12.6
22	EH 26-2	0.0	0.0	0.0	0.0	3.5	2.2	1.4	7.1	1.8	1.1	0.7	3.5
23	G.T. 54-9	1.5	0.0	1.8	3.3	0.0	0.0	0.0	0.0	0.8	0.0	0.9	1.7
24	G. 74-96	3.8	4.6	1.7	10.0	6.1	7.4	0.0	13.5	5.0	6.0	0.8	11.8
25	G. 84-47	1.5	1.9	2.5	5.9	1.7	1.8	2.8	6.3	1.6	1.8	2.7	6.1
26	G. 95-19	3.9	3.9	2.8	10.6	5.6	6.1	2.0	13.7	4.8	5.0	2.4	12.1
27	G.95-21	2.7	4.0	0.0	6.7	5.2	7.6	0.0	12.8	4.0	5.8	0.0	9.8
28	G. 98-28	1.7	5.7	1.7	9.0	2.9	7.6	1.3	11.8	2.3	6.6	1.5	10.4
29	G. 2003-47	0.0	0.0	0.0	0.0	2.8	1.7	0.0	4.5	1.4	0.8	0.0	2.2
30	G. 2009-73	0.0	3.6	0.0	3.6	3.2	5.1	0.0	8.3	1.6	4.4	0.0	6.0
	Mean	2.0	2.9	1.3	6.2	3.8	4.6	0.8	9.1	2.9	3.7	1.0	7.6
	G. Mean	2.2^{b}	3.2^{a}	1.5^{c}	6.9^{B}	2.7^{b}	3.9^{a}	0.6^{c}	7.3^{A}	2.5^{b}	3.6^{a}	1.1^{c}	7.1
	% portions	32.1	46.3	21.7		37.6	53.9	8.5		34.9	50.2	14.9	
	$LSD_{0.05}$ A		0.1467				0.2804				0.1314		
	$LSD_{0.05}$ B		0.3538				0.3873				0.2614		

$LSD_{0.05}$ seasons = 0.1053 U=Upper M=Middle B=Basal W= Whole A= Portions B= Genotypes G. Mean=General Mean

seasons, N11 in upper portion in plant cane only and ROC 10 in the middle part in plant cane, while, TUC 5120 was uninfested in basal portion in plant cane and first ratoon, moreover, CP 44-101, CP 76-331 and PR 1013 were uninfested in basal portion in the 1st ratoon only, also, CO 419 and PR 1059 genotypes in the first ratoon was uninfested in upper and basal portions however, uninfested in the basal portion only. Noteworthy, the infested whole portions were (18) and (13) sugarcane genotypes at plant cane and 1st ratoon, respectively.

ESG: The infestation only upper, basal, upper & basal or middle & basal was not recorded during the two tested seasons. However, the infested the middle part was observed for G. 2009-73 during the plant cane. Additionally, the following genotypes i.e. EH 87/26-11, G. 74-96, G. 95-21, G. 2003-47 and G. 2009-73 were infested the upper and middle portions during the plant cane and the 1st ratoon, respectively.

Only one sugarcane infested both upper and basal portions of stalk (G.T. 54-9) in plant cane. While, the infested whole portions were (8) and (9) sugarcane genotypes at plant cane and 1st ratoon, respectively.

Generally, over all studied genotypes the infestation with *C. agamemnon* illustrated that the highest infested portion was the middle ones (3.2 % Infestation Intensity (I.I.) + 46.3% portions and 3.9 % I.I + 53.9 % portions) followed with the upper portion (2.2% I.I. + 32.1%

Table 3: Susceptibility of 30 sugarcane genotypes to infest by *Saccharicoccus sacchari* Ckll.) during two successive season in 2017/2018 and 2018/2019

		Plant cane				1st ratoon				Average two seasons			
No	Sugarcane genotypes	U	M	B	W	U	M	B	W	U	M	B	W
	Imported Sugarcane Genotypes (ISG)												
1	BO 19	13.5	7.4	3.4	24.3	5.1	1.8	0.0	6.9	9.3	4.6	1.7	15.6
2	CO 413	8.2	2.3	0.4	10.9	10.8	2.7	0.5	14.0	9.5	2.5	0.5	12.5
3	CO 419	8.2	6.3	3.5	18.0	8.6	8.7	4.8	22.1	8.4	7.5	4.1	20.0
4	CP 44-101	7.2	6.6	4.0	17.8	13.9	9.9	1.1	24.9	10.6	8.2	2.6	21.4
5	CP 76-331	14.3	8.5	4.2	27.0	10.8	7.5	2.9	21.2	12.5	8.0	3.6	24.1
6	F. 153	7.3	4.2	1.3	12.8	8.4	4.9	2.3	15.6	7.9	4.5	1.8	14.2
7	F. 161	3.2	0.1	0.8	4.1	11.3	5.2	4.0	20.5	7.2	2.7	2.4	12.3
8	M 57-351	8.8	5.2	2.1	16.1	8.0	1.7	0.0	9.7	8.4	3.4	1.0	12.8
9	MIX 2001-80	3.0	3.0	3.6	9.6	5.9	2.1	0.0	8.0	4.5	2.5	1.8	8.8
10	N 11	3.1	1.5	0.2	4.8	5.0	2.4	2.2	9.6	4.0	1.9	1.2	7.1
11	N 26	8.4	5.0	3.3	16.7	7.6	9.9	3.7	21.2	8.0	7.5	3.5	19.0
12	NCO 292	8.8	6.4	5.5	20.7	5.5	6.3	2.3	14.1	7.2	6.3	3.9	17.4
13	NCO 310	12.3	0.9	0.2	13.4	4.5	1.9	1.3	7.7	8.4	1.4	0.8	10.6
14	POJ2878	7.8	5.1	2.2	15.1	10.0	6.7	4.2	20.9	8.9	5.9	3.2	18.0
15	PR 1013	18.1	14.0	5.8	37.9	12.1	8.1	2.8	22.9	15.1	11.1	4.3	30.5
165	PR 1059	14.5	9.0	3.8	27.3	8.1	5.6	2.8	16.5	11.3	7.3	3.3	21.9
17	ROC 10	8.8	3.5	1.2	13.5	12.0	5.7	1.8	19.5	10.4	4.6	1.5	16.5
18	SP 59-56	8.1	6.6	3.7	18.4	12.1	2.5	0.0	14.6	10.1	4.6	1.9	16.6
19	SP 79-2233	7.1	5.1	1.4	13.6	12.7	2.3	1.1	16.1	9.9	3.7	1.2	14.8
20	TUC 5120	8.0	5.1	1.8	14.9	3.4	0.0	0.0	3.4	5.7	2.6	0.9	9.2
	Mean	8.9	5.3	2.6	16.9	8.8	4.8	1.9	15.5	8.9	5.0	2.3	16.2
	Egyptian Sugarcane Genotypes (ESG)												
21	EH 87/26-11	14.8	7.9	2.8	25.5	10.3	3.0	0.0	13.3	12.5	5.4	1.4	19.3
22	EH 26-2	19.2	10.1	4.7	34.0	5.5	3.6	0.0	9.1	12.3	6.8	2.4	21.5
23	G.T. 54-9	1.4	3.8	2.3	7.5	4.2	6.7	1.9	12.8	2.8	5.3	2.1	10.2
24	G. 74-96	8.0	5.3	2.4	15.7	4.7	3.6	5.1	13.4	6.4	4.4	3.7	14.5
25	G. 84-47	2.1	1.1	0.9	4.1	2.4	1.9	1.7	6.0	2.3	1.5	1.3	5.1
26	G. 95-19	7.6	3.5	1.3	12.4	7.9	5.4	2.0	15.3	7.7	4.5	1.6	13.8
27	G. 95-21	9.8	6.6	5.5	21.9	9.7	5.3	1.9	16.9	9.8	5.9	3.7	19.4
28	G. 98-28	18.1	14.2	5.3	37.6	10.2	13.2	6.3	29.7	14.2	13.7	5.8	33.7
29	G. 2003-47	1.6	3.7	2.8	8.1	4.5	4.4	2.8	11.7	3.0	4.1	2.8	9.9
30	G. 2009-73	4.3	5.3	3.6	13.2	4.3	0.0	4.1	8.4	4.3	2.6	3.9	10.8
	Mean	8.7	6.2	3.2	18.0	6.4	4.7	2.6	13.7	7.5	5.4	2.9	15.8
	G. Mean	8.9^a	5.2^b	2.8^c	17.2^A	8.0^a	4.8^b	2.1^c	14.9^B	8.4^a	5.2^b	2.5^c	
	% Portions	51.4	32.4	16.2		53.7	32.2	14.1		52.2	32.3	15.5	
	$LSD_{0.05}$ A		0.3508				0.4000				0.2210		
	$LSD_{0.05}$ B		0.8531				0.7132				0.5541		

$LSD_{0.05}$ seasons = 0.1133 U=Upper M=Middle B=Basal W= Whole A= Portions B= Genotypes G. = General Mean

portions and 2.7% I.I + 37.6 % portions) and basal portions (1.5 % I.I. + 21.7 % and 0.6 % I.I + 0.8 % portions) in both seasons, respectively with significant differences. Furthermore, the infestation with *C. agamemnon* in the plant cane (6.9% I.I.) significantly decreased than the 1st ratoon (7.3 % I.I.). ESG gained less infestation with C. *agamemnon* than ISG in the plant cane and vice versa trend has been observed during the 1st ratoon. Therefore, C. *agamemnon* preferred the middle portion except SP 79-2233 and TUC 5120 the insect preferring the upper portion and G. 84-47 basal portion. PR 1013 gained the highest infestation with this insect. On contrary, POJ 2827 and F.161 uninfested with C. *agamemnon* during the two tested seasons. Therefore, the last two genotypes could be used in breeding program and PR 1013 could be used to collect or as a trap to C. *agamemnon*.

***Saccharicoccus sacchari* Ckll.:** As demonstrated in Table (3), the response of sugarcane genotypes to infestation by *S. sacchari* Ckll. varied from one to another. In addition, all portions were infested with such insect during the plant cane. However, during the 1st ratoon, the infestation with differed with respect to stalk portions.

Sugarcane Genotypes

ISG: Regarding pink mealybug infestation recorded in the whole stalk (Table 3), data illustrated that during the plant cane, only PR 1013 had the highest infestation intensity (37.9%) with *S. sacchari* Ckll. However, the infestation intensity with this insect fluctuated between 20% and 30% were recorded by the following genotypes PR 1059 (27.3%), CP 76-331 (27%), BO 19 (24.3%) and NCO 292 (20.7%). Further, most other cultivars showed infestation intensity between 10% and less than 20%. In addition, the infestation intensity less than 10% were observed for only three sugarcane genotypes [F. 161 (4.1%), MIX 2001-80 (9.6%) and N 11 (4.8%)]. Therefore, these last three sugarcane genotypes were considered more tolerance to the infestation by pink mealybug than the other seventeen genotypes.

The infestation with the tested insect on the whole stalk during the 1st ratoon clarified that the infestation intensity more than 20% were recorded by the following genotypes i.e. CP 44-101, PR1013, CO 419, CP 76-331, N 26, POJ 2878 and F. 161 sugarcane genotypes. Moreover, seven sugarcane genotypes i.e. ROC 10, PR 1059, SP 79-2233, F. 153, SP 59-56, NCO 292 and CO 413 were infested with less than 20% and more than 10%. Meanwhile, M 57-351, N11, MIX 2001-80, NCO 310, BO 19 and TUC 5120 were infested less than 10%. Meantime, the least infested ISG was TUC 5120 (3.4%). The obtained results are agreement with numerous reports such [3, 11, 22], who indicated that sugarcane germplasm classified according to their susceptibility to infestation by mealybug into five separated groups i.e. very highly susceptible, highly susceptible, susceptible, moderately and resistant.

ESG: Regarding the whole stalk infestation, data in Table (3) indicated that G. 98-28 genotype exhibited the highest infestation intensity by pink mealybug insect in both plant cane and ratoon crops recording 37.6 % and 29.7%, respectively. However, G. 84-47 genotype recording the lowest (4.1% and 6.0%) in both crops. These findings in line with those of [3, 12, 23].

Moreover, average over all genotypes cleared that infestation intensity significantly higher for plant cane (17.2%) than the first ratoon (14.9%) which gave evidence that plant cane was more sensitive to this insect.

Stalk Portions

ISG: The infestation by *S. sacchari* Ckll. was slightly higher in the plant cane (16.9%) than the 1st ratoon (15.5%).

In the plant cane, the highest infested intensity for upper, middle and basal portions were 18.1, 14.0 and 5.8% for PR 1013 genotype, respectively. While, the lowest values for the previous mentioned portions were 3.2, 0.1 and 0.8% for F. 161 followed by N 11 were 3.1, 1.5 and 0.2% corresponding with three portions. The preferring portion for ISG to infest by *S. sacchari* Ckll. was upper one (8.9%) followed by middle (5.3%) and basal one (2.6%) for all ISG excluding MIX 2001-80 the insect preferring the basal one. Such effect may be greatly related to fiber content of various stalk portions which distributed in descending order as follows basal > middle > upper.

In the 1st ratoon, TUC 5120 had the lowest infestation with such insect, where, only upper portion (3.4% I.I.) was infested. Also, the upper portion was infested by *S. sacchari* Ckll. for all tested ISG. The basal portion was not infested by this insect for BO 19, M 57-351, MIX 2001-80, SP 59-56 and TUC 5120. The highest infested middle portion was recorded to CP 44-101 and N 26 (9.9% I.I.) for both genotypes. CO 419 (4.8% I.I.) had the highest infested basal portion. The same trend was recorded for the order of portions as mentioned in the plant cane except N 26 and NCO 292 such insect preferring the middle one.

ESG: The infestation intensity with *S. sacchari* Ckll. in the plant cane (18.0%) significantly higher than the 1st ratoon (13.7%).

In descending order, the infestation intensity for the tested portions were upper (8.7%) > middle (6.2%) > basal (3.2%) ones for plant cane season. With exception G.T.54-9, G. 2003-47 and G. 2009-73 the insect preferred the middle portion. The highest infested intensity portion for ESG were EH 26-2 (19.2%), G. 98-28 (14.2%) and G. 95-21 (5.5%) for the upper, middle and basal portions, respectively. The lowest infested upper portion for ESG was G.T. 54-9 (1.4%) and G. 2003-47 (1.6%). In addition, G. 84-47 had the lowest middle (1.1%) and basal (0.9%) portions.

In the first ratoon, the same order of infested portion was recorded except G. 98-28 and G.T. 54-9 the insect preferred the middle portion.

In general, *S. sacchari* preferred the upper portion (>50%) followed by the middle and basal ones, respectively, with exception G.T. 54-9, where, the insect preferred the middle portion for both crops. ISG was higher infested by mealybug than ESG. The susceptibility to infestation was much higher in plant cane than in the first ratoon. On contrast, [24], declared that in Qena Governorate the susceptibility to infestation was less in virginal cane than in the first ratoon cane. Also, Yakoub [3], found that plant cane considered as a resistant one recorded the lowest damage followed by 1st and 2nd ratoons in El-Minia Governorate.

G. 48-47 and N 11 were the least infested genotypes during both tested seasons and could be use in breeding program with regard to its relatively high tolerance. However, the highest infested ISG and ESG by *S. sacchari* were PR 1013 and G. 98-28 could be use in testing the sensitivity of the new colonies or strains to mealybug infestation.

Response of the Tested Sugarcane Genotypes Characters to Infestation by *C. agamemnon Bles.* and *S. sacchari* Ckll.: Data concerning the changes in stalk weight and sucrose percentage of ISG and ESG during the two tested crops (plant cane and first ratoon) were shown in Tables 4 and 5.

Stalk Weight: Data in Table (4) stated that the average stalk weights were differed significantly among the thirty tested genotypes in both plant cane and first ratoon.

ISG: The heaviest stalk weights were recorded to MIX 2001-80 (1046.7 g) for the plant cane and TUC 5120 (1005.0 g) for the 1st ratoon (Table 4). On contrary, the lightest ones were observed to CP 44-101 (695 g) and CP 76-331 (670 g) during the plant cane and the 1st ratoon, respectively.

In regard to the average two seasons, the heaviest and lightest stalk weights were noticed for MIX 2001-80 (1018.3 g) and CP 44-101 (692.5 g), respectively.

ESG: G.95-19 and G.95-21 had the heaviest stalk weights during two tested seasons. While, G. 98-28 followed by G.T. 54-9 exhibited the lowest stalk weights during the plant cane and G.T. 54-9 followed by G.74-96 during the 1st ratoon.

Mean over both plant cane and first ratoon in Table (4), demonstrated that stalk weight over all the used genotypes showed that the plant cane (871.6 g) significantly increased than the 1st ratoon (841.3 g). Moreover, ESG (859.8 g) had higher stalk weight than ISG (858.5 g), data also revealed that MIX 2001-80 and TUC 5120 had the highest stalk weights. In addition, CP 44-101, CP 76-331 had the lowest ones. In this connection, [2, 25, 26], reported that variation in stalk weight among sugarcane cultivars could attributed to the differences in stalk height and diameter.

Sucrose

ISG: PR 1013 had the highest sucrose percentage (18.8 and 19.1%) during both seasons. While, CP44-101, M 57-351 and SP 59-56 produced the lowest sucrose percentages (14.1%, 15.7% and 15.7%) during the plant and 1st ratoon, respectively. Moreover, the other ISG genotypes were between those mention levels (Table 4).

ESG: The highest percentages of sucrose 18.3 and 18.8 % were recorded by G.T. 54-9 followed by G.2003-47 (17.7 and 18.1%) during both seasons. Otherwise, data in the Table (4) showed the least sucrose percentage value was of G. 95-21 which was less than 13%. Moreover, the other ESG genotypes were between those mention levels.

In this respect, over all the tested genotypes plant cane exhibited less sucrose percentage (16.8 %) (Statistically not significant) than the 1st ratoon (17.1 %). Nevertheless, the values of sucrose percentages of ISG in both seasons were not markedly differed than that of ESG.

In general, PR 1013 and G.T. 54-9 gave the highest sucrose percentage and M 57-351, SP 59-56 and G. 95-21 owned the lowest ones. The variation in sucrose content among the used genotypes may be due to genetic causes. These findings are in accordance with those reported by El-Soghier and Beshiet [27], Yakoub [3], Abd El-Razek *et al.* [21], Abd El-Azez *et al.* [28] and Teama *et al.* [29], who found that cane varieties differed markedly in sucrose content at harvest in either plant cane or ratoon crops.

Stalk Diameter: The results tabulated in Table (5) indicated the stalk diameters, lengths and numbers of the tested sugarcane genotypes during two successive seasons.

ISG: The highest stalk diameter was recorded for PR 1059, PR 1013 and TUC 5120 during the two tested seasons. Further, in both seasons CO 413 and POJ 2878 gave the lowest diameter, in addition to CO 419, N 11 and N 26 in the first ratoon.

ESG: G. 2003-47 and G. 2009-73 gained the highest stalk diameter during the plant cane. Likewise, G. 2003-47 and G.T. 54-9 had the highest values during the 1st ratoon. Furthermore, in both seasons G. 98-29 genotype gave the lowest values of stalk diameter.

General principles, although the differences between two seasons was small, but the diameter of stalk in plant cane (2.5 cm) significantly increased than the 1st ratoon (2.4 cm).

Table 4: Stalk weights and sucrose percentage of 30 sugarcane genotypes during 2017/2018 and 2018/2019 seasons

		Stalk weight (gm)			Sucrose %		
No	Sugarcane genotypes	Plant cane	1st ratoon	Mean	Plant cane	1st ratoon	Mean
			Imported Sugarcane Genotypes (ISG)				
1	BO 19	855.0	845.0	850.0	18.0	18.1	18.0
2	CO 413	905.0	840.0	872.5	15.9	16.0	16.0
3	CO 419	865.0	800.0	832.5	17.5	17.8	17.7
4	CP 44-101	695.0	690.0	692.5	14.1	16.0	15.0
5	CP 76-331	750.0	670.0	710.0	16.5	16.8	16.7
6	F. 153	920.0	885.0	902.5	18.5	18.8	18.7
7	F. 161	950.0	923.3	936.7	17.7	18.3	18.0
8	M 57-351	790.0	745.0	767.5	15.7	15.7	15.7
9	MIX 2001-80	1046.7	990.0	1018.3	17.4	17.0	17.2
10	N 11	945.0	885.0	915.0	18.3	18.6	18.4
11	N 26	940.0	933.3	936.7	16.7	16.6	16.6
12	NCO 292	890.0	845.0	867.5	17.0	17.4	17.2
13	NCO 310	875.0	860.0	867.5	18.6	18.7	18.6
14	POJ2878	850.0	810.0	830.0	17.1	18.2	17.7
15	PR 1013	865.0	825.0	845.0	18.8	19.1	19.0
16	PR 1059	890.0	845.0	867.5	17.0	16.9	16.9
17	ROC 10	860.0	850.0	855.0	17.0	17.5	17.3
18	SP 59-56	750.0	790.0	770.0	15.6	15.7	15.7
19	SP 79-2233	755.0	750.0	752.5	16.2	16.7	16.4
20	TUC 5120	980.0	1005.0	992.5	17.6	17.8	17.7
	Mean	874.1	842.9	858.5	16.8	17.2	17.0
			Egyptian Sugarcane Genotypes (ESG)				
21	EH 87/26-11	880.0	860.0	870.0	17.3	17.5	17.4
22	EH 26-2	925.0	870.0	897.5	16.9	17.0	17.0
23	G.T. 54-9	826.7	765.0	795.8	18.3	18.8	18.5
24	G. 74-96	840.0	805.0	822.5	16.1	16.9	16.5
25	G. 84-47	840.0	875.0	857.5	16.4	16.6	16.5
26	G. 95-19	975.0	880.0	927.5	16.0	16.4	16.2
27	G. 95-21	980.0	915.0	947.5	12.5	12.8	12.7
28	G. 98-28	825.0	810.0	817.5	16.4	16.6	16.5
29	G. 2003-47	830.0	835.0	832.5	17.7	18.1	17.9
30	G. 2009-73	850.0	838.3	844.2	14.9	15.2	15.0
	Mean	876.1	843.5	859.8	16.5	16.8	16.7
	G.Mean	871.6a	841.3b		16.8a	17.1a	17.0
	$LSD_{0.05}$ G	89.0	64.0		1.13	0.82	
	$LSD_{0.05}$ S		5.340			NS	

G= Genotypes S= Seasons

In addition, there were no significant differences between ISG and ESG (Table 5). PR 1059, PR 1013, TUC 5120 and G. 2003-47 had the highest stalk diameter and G. 98-28 recorded the lowest ones.

Stalk Length

ISG: N 11 and N 26 owned the shortest stalk length. However, SP 79-2233, SP 59-56 and PR 1013 had the tallest ones during the two tested seasons.

ESG: The tallest stalk was G. 2003-47 and G. 2009-73, followed by G.T. 54-9. While, the shortest one was G. 95-19 which recorded the lowest value of stalk length during 2018/2019 and 2019/2020 seasons.

Data in Table (5) illustrated that plant cane gave less stalk length (246.7 cm) than the 1st ratoon (262.7 cm). There were no significant differences between ISG and ESG during the two seasons. While, in the 1st ratoon, ESG (274.4 cm) was taller than the ISG (256.9cm). The increase in stalk length in the first ratoon as compared with plant cane may be due to that the first ratoon characterizes by high tillering ability (plant density) as shown later.

Stalk Number: Data in Table (5) recorded that ISG achieved higher stalk numbers (13.1 m^2) than ESG (12.0 m^2). Also, the 1st ratoon (14.2 m^2) significantly increased stalk number than the plant cane (12.1 m^2). Such effect may be due to abundance of buds and hence tillers for the first ratoon [30].

Table 5: Stalk diameter, length and numbers of 30 sugarcane genotypes during to 2017/2018 and 2018/2019 seasons

		Stalk diameter			Stalk length			Stalk No.		
No	Sugarcane genotypes	Plant cane	1^{st} ratoon	Mean	Plant cane	1^{st} ratoon	Mean	Plant cane	1^{st} ratoon	Mean
					Imported Sugarcane Genotypes (ISG)					
1	BO 19	2.5	2.4	2.5	249.0	268.0	258.5	11.3	14.7	13.0
2	CO 413	2.3	2.3	2.3	250.0	265.0	257.5	12.0	12.0	12.0
3	CO 419	2.4	2.0	2.3	261.0	275.0	268.0	13.0	16.0	14.5
4	CP 44-101	2.4	2.3	2.4	232.0	257.0	244.5	12.0	15.0	13.5
5	CP 76-331	2.8	2.5	2.7	233.0	252.0	242.5	14.0	16.0	15.0
6	F. 153	2.4	2.3	2.4	241.0	251.0	246.0	15.0	18.0	16.5
7	F. 161	2.5	2.2	2.4	214.3	235.0	224.7	12.0	14.0	13.0
8	M 57-351	2.7	2.3	2.5	226.0	233.0	229.5	11.0	15.0	13.0
9	MIX 2001-80	2.7	2.5	2.6	257.0	266.0	261.5	10.0	14.0	12.0
10	N 11	2.5	2.0	2.3	200.0	215.0	207.5	12.0	13.0	12.5
11	N 26	2.7	2.0	2.4	214.0	210.0	212.0	9.0	12.0	10.5
12	NCO 292	2.5	2.4	2.5	243.0	266.0	254.5	16.0	17.0	16.5
13	NCO 310	2.4	2.5	2.5	248.0	263.0	255.5	12.0	15.0	13.5
14	POJ 2878	2.3	2.2	2.3	227.0	239.0	233.0	12.0	13.0	12.5
15	PR 1013	2.8	2.7	2.8	263.3	280.3	271.8	11.0	13.0	12.0
16	PR 1059	3.0	2.8	2.9	252.0	267.0	259.5	10.0	9.0	9.5
17	ROC 10	2.6	2.4	2.5	257.0	273.0	265.0	13.0	14.0	13.5
18	SP 59-56	2.5	2.4	2.5	264.0	281.0	272.5	14.0	14.0	14.0
19	SP 79-2233	2.5	2.4	2.5	270.0	276.0	273.0	12.0	13.0	12.5
20	TUC 5120	2.8	2.8	2.8	246.0	265.0	255.5	11.0	13.0	12.0
	Mean	2.6	2.4	2.5	242.4	256.9	249.6	12.1	14.0	13.1
					Egyptian Sugarcane Genotypes (ESG)					
21	EH 87/26-11	2.4	2.3	2.4	240.0	254.0	247.0	14.0	17.0	15.5
22	EI 266-2	2.5	2.5	2.5	246.0	265.0	255.5	15.0	17.0	16.0
23	G.T. 54-9	2.5	2.8	2.7	278.0	294.0	286.0	9.0	11.0	10.0
24	G. 74-96	2.3	2.2	2.3	249.0	261.0	255.0	12.0	16.0	14.0
25	G. 84-47	2.3	2.4	2.4	245.0	262.0	253.5	10.0	12.0	11.0
26	G. 95-19	2.5	2.3	2.4	218.0	245.0	231.5	14.0	18.0	16.0
27	G. 95-21	2.4	2.4	2.4	246.0	260.0	253.0	14.0	13.0	13.5
28	G. 98-28	2.1	2.0	2.1	265.0	274.0	269.5	15.0	14.0	14.5
29	G. 2003-47	2.7	2.9	2.8	285.0	313.0	299.0	10.0	14.0	12.0
30	G. 2009-73	2.7	2.2	2.5	281.0	316.0	298.5	9.0	12.0	10.5
	Mean	2.5	2.4	2.5	255.3	274.4	264.9	11.0	13.0	12.0
	G. Mean	2.5^{a}	2.4^{b}		248.9^{b}	265.7^{a}		12.1^{b}	14.2^{a}	
	$LSD_{0.05}$ G	0.23	0.16		15.17	23.55		2.73	3.00	
	$LSD_{0.05}$ S		0.0201			2.37		0.3913		

G= Genotypes S= Seasons

ISG: Stalk numbers of F. 153 and NCO 292 had the highest values during the two tested seasons (Table 5). Contrary, N 26 and PR 1059 had the lowest stalk number in both plant cane and first ratoon.

ESG: The lowest stalk number was recorded by G.T. 54-9, G. 2009-73 and G. 84-47 during both tested seasons. While, in plant cane, the highest value of this trait was observed by EH 26-2 and G.98-28 and by EH 87/26-11, EH 26-2 and G. 95-19 in the1^{st} ratoon cane. In this connection, numerous of workers referred to mealybug insect as serious pest in sugarcane plantations worldwide such as [3, 5, 24, 31-36], who reported that stalk height, diameter, weight and number of stalk per square meter were greatly differed among sugarcane genotypes.

Based on, the findings of this research illustrated that most economic traits of main sugarcane genotype G.T. 54-9 in Egypt was depressed, nevertheless, it must be replaced by another genotypes to keep the high productivity under Egyptian conditions. Therefore, the obtained results we suggest G. 84-47 and G. 2003-47.

Relationship Between *Chilo agamemnon Bles*. and *Saccharicoccus sacchari* CKll: The relationship between the two tested insects may be to help in explain the behavior of these insects and its control (Tables 6-8).

Table 6: Correlation between two insects at same portion at each genotypes for two seasons

		C. agamemnon vs *S. sacchari* for the same Portion			
No	Sugarcane genotypes	Upper (U) 8-5	Middle (M) 13-7	Basal (B) 14-4	Whole (W) 9-4
		Imported Sugarcane Genotypes (ISG)			
1	BO 19	ND	-0.87*	0.97**	0.98**
2	CO 413	0.58	0.24	0.30	0.81*
3	CO 419	-0.54	0.91*	ND	-0.66
4	CP 44-101	0.89*	-0.90*	0.87*	-0.57
5	CP 76-331	-0.61	-0.48	0.82*	0.66
6	F. 153	0.39	0.43	-0.86*	0.16
7	F. 161	ND	0.94**	0.98*	ND
8	M 57-351	0.46	-0.93**	0.94**	0.95**
9	MIX 2001-80	-0.51	0.01	0.95**	0.56
10	N 11	0.85*	0.46	0.83*	0.84*
11	N 26	-0.51	0.85*	-0.45	0.77
12	NCO 292	0.92**	0.16	ND	0.93**
13	NCO 310	0.97**	-0.81*	ND	0.91*
14	POJ 2878	ND	-0.99**	ND	ND
15	PR 1013	-0.79	-0.72	0.92**	-0.36
16	PR 1059	0.96**	-0.95**	0.93**	0.95**
17	ROC 10	0.90*	0.83*	0.82*	0.98**
18	SP 59-56	-0.86*	0.97**	-0.82*	0.78
19	SP 79-2233	0.64	0.91*	-0.92**	0.46
20	TUC 5120	-0.96**	-0.89*	0.99**	-0.95**
		Egyptian Sugarcane Genotypes (ESG)			
21	EH 87/26-11	-0.87*	-0.83*	0.89*	-0.46
22	EH 26-2	-0.98**	0.98**	0.98**	-0.99**
23	G.T. 54-9	-0.84*	0.99**	0.93**	-0.91*
24	G. 74-96	-0.80	-0.81*	-0.93**	-0.56
25	G. 84-47	0.26	-0.04	0.74	0.72
26	G. 95-19	-0.21	0.86*	-0.48	0.55
27	G. 95-21	0.001	-0.44	ND	-0.76
28	G. 98-28	-0.97**	-0.87**	-0.52	-0.94**
29	G. 2003-4	0.98**	0.42	ND	0.96**
30	G. 2009-73	0.15	0.97**	ND	-0.62
	All genotypes	0.141*	0.375**	0.036	0.311**

LSD 5% significant= 0.81 1% significant =0.92

Between Two Insects at the Same Portion: Data concerning the relationship between two tested insects for the same portion were shown in Table (6)

ISG: The relationship between all tested portions (U, M, B and W) for the two insects was significant for only PR 1059, ROC 10 and TUC 5120. The relationships of PR 1059 were positive except middle portion, also, last genotype were negative except basal portion. Therefore, these genotypes had Absolute Concurrent Infestation (ACI). The highest number of genotypes which had significant correlation was basal portion (14 cv.) followed by middle (13 cv.) and the least number was observed with upper one (8 cv.). The highest number of genotypes which had negative correlation was middle portion. Most of correlation coefficients were positive.

ESG: The relationship between the two tested insects, only EH 26-2 and G.T. 54-9 genotypes had significant differences for all portions. These results cleared that both genotypes had ACI relationship. Vice versa, all relation between two insects for portions of G. 84-47 and G. 95-21 were not significant. Therefore, these genotypes had A/RCI relationship. Middle portion had the highest number of genotypes (7 cv.) that gained significant correlations. The highest number of genotypes which owned negative correlations was observed at upper and whole plant portions followed by middle one. Where, the majority of correlations between two insects of ESG were negative.

Generally, the relation between two tested insects and all portions for all tested genotypes were significances except basal portion. Also, the relationship

Table 7: Correlation between sucrose percent with different insects at different portions to each genotype in two seasons

		C. agamemnon				*S. sacchari*			
No	Sugarcane genotypes	Upper	Middle	Basal	Whole	Upper	Middle	Basal	Whole
		Imported Sugarcane Genotypes (ISG)							
1	BO 19	ND	-0.31	-0.24	-0.28	-0.04	-0.17	-0.21	-0.12
2	CO 413	-0.49	-0.07	0.20	-0.24	-0.51	-0.82*	-0.95**	-0.74
3	CO 419	-0.29	0.34	ND	-0.10	-0.29	0.53	0.01	0.26
4	CP 44-101	0.11	0.26	-0.45	-0.38	0.33	0.55	-0.71	0.29
5	CP 76-331	0.51	0.10	-0.42	-0.11	-0.20	-0.25	-0.67	-0.35
6	F. 153	-0.33	0.19	-0.26	-0.66	0.98**	0.16	0.45	0.82*
7	F. 161	ND	ND	ND	ND	0.67	0.77	0.78	0.73
8	M 57-351	-0.03	-0.10	-0.03	-0.06	-0.35	0.12	-0.11	-0.08
9	MIX 2001-80	0.78	0.35	0.50	0.95**	-0.65	0.37	0.71	0.34
10	N 11	0.39	0.21	0.80	0.36	0.55	0.15	0.41	0.44
11	N 26	0.10	-0.43	-0.23	-0.36	0.34	-0.18	0.57	0.04
12	NCO 292	-0.41	-0.34	ND	-0.38	-0.21	-0.15	-0.36	-0.30
13	NCO 310	-0.38	-0.48	ND	-0.44	-0.32	0.12	0.28	-0.34
14	POJ2878	ND	ND	ND	ND	0.66	0.92**	0.82*	0.95**
15	PR 1013	0.50	0.50	-0.54	0.41	-0.28	-0.30	-0.36	-0.32
16	PR 1059	0.21	-0.13	0.07	0.13	0.05	-0.04	-0.27	-0.01
17	ROC 10	0.75	0.51	-0.47	0.52	0.54	0.35	-0.07	0.45
18	SP 59-56	-0.05	0.01	-0.20	-0.07	0.26	-0.22	-0.13	-0.04
19	SP 79-2233	-0.09	0.29	0.21	0.15	0.44	-0.40	0.27	0.45
20	TUC 5120	0.20	0.31	ND	0.27	-0.30	-0.40	-0.48	-0.38
		Egyptian Sugarcane Genotypes (ESG)							
21	EH 87/26-11	0.66	0.29	-0.42	0.47	-0.71	-0.67	-0.53	-0.67
22	EH 26-2	0.33	0.20	0.15	0.26	-0.21	-0.27	-0.12	-0.21
23	G.T. 54-9	-0.57	ND	-0.47	-0.52	0.19	0.22	0.32	0.28
24	G. 74-96	0.60	0.66	-0.78	0.61	-0.83*	-0.40	0.74	-0.51
25	G. 84-47	0.55	-0.54	0.22	0.13	0.06	0.75	0.64	0.73
26	G. 95-19	0.52	0.47	-0.69	0.42	-0.27	0.24	0.41	0.13
27	G. 95-21	0.18	0.32	ND	0.27	0.14	-0.7	-0.33	-0.47
28	G. 98-28	0.14	0.11	0.52	0.27	-0.23	-0.23	0.24	-0.23
29	G. 2003-47	0.62	0.63	ND	0.63	0.68	-0.19	0.25	0.47
30	G. 2009-73	0.45	0.49	ND	0.47	-0.30	-0.43	0.17	-0.47
	All genotypes	-0.01	0.06	0.10	0.06	-0.03	0.09	0.002	0.02

5% significant= * 1% significant =** ND = Not detected (zero Data)

between two insects for the same portion was significance for at least one portion except G. 84/47 and G. 95-21 where this relationship was insignificant in all portions and the whole as well. The middle and basal had the highest number of genotypes which had the significant correlation.

The majority of ISG correlations were positive, on contrary most of ESG correlations were negative. Consequently, the correlation between two insects for the same portion depended on the characteristics of the genotypes.

In regards to criteria of concurrent infestation, the significant correlation was sometimes positive or negative values. This observation due to the variation among sugarcane genotypes takes place when these correlations are among genotypes. Therefore, genotypes PR 1059, ROC 10, TUC 5120, EH 87/26-11 and G.T. 54-9 had Absolute Concurrent infestation (ACI). However, meteorological characters when these correlations are for the same genotype. On contrast, G. 84-47 and G. 95-21 had Accident/ Random Concurrent infestation (A/RCI). The rest of genotypes owned Partial Concurrent infestation (PCI).

Between Each Insect with Sucrose %: The simple correlation between the infestations with *C. agamemnon* or *S. sacchari* and sucrose % at the plant cane and first ratoon were summarized in Table (7).

Table 8: Correlation between stalk weights with different insects at different portions to each genotype in two seasons

		C. agamemnon				*S. sacchari*			
No	Sugarcane genotypes	Upper	Middle	Basal	Whole	Upper	Middle	Basal	Whole
		Imported Sugarcane Genotypes (ISG)							
1	BO 19	ND	0.16	0.13	0.15	-0.35	0.03	0.11	-0.02
2	CO 413	-0.21	-0.76	-0.18	-0.56	0.55	-0.94**	-0.74	-0.76
3	CO 419	0.62	-0.75	ND	0.16	0.67	-0.14	0.70	0.65
4	CP 44-101	-0.33	-0.54	-0.08	-0.54	0.04	-0.28	-0.44	-0.23
5	CP 76-331	-0.80	0.13	0.83	0.62	0.66	0.63	0.68	0.69
6	F. 153	0.28	-0.17	0.27	0.65	-0.12	-0.50	-0.14	-0.65
7	F. 161	ND	ND	ND	ND	0.39	0.38	0.34	0.37
8	M 57-351	0.43	0.47	0.43	0.45	0.36	-0.21	-0.33	-0.25
9	MIX 2001-80	-0.48	-0.78	0.55	-0.31	0.71	-0.21	0.46	0.48
10	N 11	-0.71	-0.72	-0.76	-0.77	-0.30	-0.26	0.64	0.12
11	N 26	-0.28	-0.35	0.11	-0.42	-0.30	-0.11	-0.44	-0.37
12	NCO 292	0.48	0.49	ND	0.48	0.52	0.11	0.56	0.50
13	NCO 310	0.65	0.87	ND	0.79	0.81	-0.67	-0.38	0.48
14	POJ2878	ND	ND	ND	ND	0.44	-0.35	-0.55	-0.49
15	PR 1013	-0.82	-0.61	0.66	-0.65	0.76	-0.08	-0.82	-0.71
16	PR 1059	0.35	-0.45	0.54	0.46	-0.24	-0.37	-0.10	-0.55
17	ROC 10	-0.42	-0.21	0.14	-0.25	-0.23	0.03	0.21	-0.04
18	SP 59-56	-0.63	-0.68	-0.49	-0.62	0.45	0.28	0.83	0.49
19	SP 79-2233	0.24	-0.02	0.03	0.08	-0.44	-0.04	0.52	-0.06
20	TUC 5120	0.27	0.49	ND	0.39	0.25	-0.29	0.34	0.10
		Egyptian Sugarcane Genotypes (ESG)							
21	EH 87/26-11	-0.45	-0.06	0.17	-0.38	0.18	-0.18	0.22	0.10
22	EH 26-2	-0.60	-0.67	-0.67	-0.64	0.76	0.73	0.75	0.75
23	G.T. 54-9	0.50	ND	0.62	0.57	-0.57	-0.66	-0.29	-0.60
24	G. 74-96	-0.54	-0.41	0.43	-0.53	-0.68	0.10	0.20	-0.17
25	G. 84-47	0.15	0.20	0.46	0.44	-0.17	0.06	-0.60	-0.45
26	G. 95-19	-0.46	-0.54	0.93**	-0.38	-0.86*	-0.81*	0.84*	-0.84*
27	G. 95-21	-0.17	-0.20	ND	-0.19	-0.29	0.02	0.19	-0.05
28	G. 98-28	-0.46	-0.55	-0.13	-0.61	0.25	-0.5	-0.04	-0.05
29	G. 2003-47	0.07	0.03	ND	0.05	-0.46	0.01	-0.03	-0.33
30	G. 2009-73	-0.25	-0.18	ND	-0.23	-0.28	-0.27	-0.32	-0.28
	All genotypes	0.03	-0.06	0.11	0.00	-0.16	-0.26	-0.13	-0.23

5% significant= * 1% significant =** ND= Not detected (zero Data)

***C. agamemnon*:** There were no significant correlations between *C. agamemnon* and sucrose % for all tested sugarcane genotypes (ISG and ESG) except MIX 2001-80 for only whole stalk (0.95**).

S. sacchari

ISG: Only for ISG, three genotypes (CO413, F. 153 and POJ 2878) had significant correlations with *S. sacchari*. The first genotype had the negative and significant correlation for middle and basal stalks. The 2nd genotype gained positive and significant correlation for upper and whole portions (Table 7). While, the last genotype owned the positive and significant correlation for middle, basal and whole stalks. Further, most genotypes had not significant correlation where some positive and the other negative.

ESG: No significant correlation between sucrose % and such insect at different portions for all ESG except for G. 74-96 that had negative and significant correlation for infested upper portion of stalk (-0.83*).

Therefore, there were no obvious relationship between sucrose % and the infestation with *C. agamemnon* or *S. Sacchari*.

Between Each Insect with Stalk Weight: It is interested to mention that, no ISG or ESG had significant correlations for *C. agamemnon* except G. 95-19 where positive and significant correlation in the basal portion had been recorded in Table (8). Meantime, all the thirty genotypes showed insignificant correlation with *S. Sacchari* except CO 413 of ISG had negative and significant correlation in the middle portion and G.95-19 of ESG had negative and significant correlation at all portions (Table 8). Thus, these findings indicated that there were no and/or very weak relationship between the infestation with *C. agamemnon* or *S. Sacchari* for stalk weights.

Multiple Regression Between Each Sugarcane Characters and All Infested Portions: As mentioned before, few numbers of genotypes had relationship between the infestation with the tested insects, which may be return to characteristic of sugarcane genotypes. Therefore, using multiple regressions may be explained which factors affected the tested sugarcane characters. The following data on the infestation of both tested insects in an experiment (Table 9) were utilized for constructing a multiple regression equation. There were six independent characters viz, UC (Upper- *C. agamemnon*), MC (Middle- *C. agamemnon*), BC (Basal- *C. agamemnon*), US (Upper- *S. sacchari*), MS (Middle- *S. sacchari*) and BS (Basal - *S. sacchari)* which presumed to have an influence on sugarcane characters (Y).

Sucrose %: Only regression coefficient (R^2) for the 1st season (plant crop) was significant and both BC and MS had positive effect on sucrose %.

Stalk Weight: All regression coefficients were significant and the 2nd season (First ratoon) (R^2= 0.24***) was more affected. For 1st and both seasons, just MS was negative and significant. While in the 2nd season, both BC and US were significant.

Stalk Length: The effects on stalk length followed the equivalent trend as stalk weight; in addition, US was negative and significant values for both seasons.

Stalk Diameter: Regression coefficients were significant for all tested seasons. The regression coefficient of the 1st season was higher than the 2nd and both seasons. BC gained positive and significant value for all tested seasons (Table 9). While, US and BS owned positive, negative and significant values for the 1st and 2nd seasons, respectively.

Stalk Numbers: In the 1st season, although regression coefficient was not significant, MS had the positive significant value. In addition, the 2nd and both seasons gained significant effect on stalk numbers. UC had the negative significant value for the 2nd and both seasons. Also, BC gave negative significant value for both seasons only.

It is likely that during the 1st season, MS had positive effect on sucrose% and stalk numbers. On contrast, it had the negative effect on stalk weight and length. BC gave the positive effect on sucrose% and stalk diameter. US gave the positive effect on stalk diameter.

During the 2nd season, BC gave the positive effect on stalk weight, length and diameter. At the same time, US had the negative effect on stalk weight and length, while, BS had the negative and positive effect on stalk diameter and numbers, respectively. UC had negative effect on stalk numbers.

In regarding to the two tested seasons (both), MS had the negative effect on stalk weight and length. BC gave the positive and negative effects on stalk diameter and numbers, respectively. US and UC gave the negative effect on stalk length and numbers.

These findings give evidence that the multi regression in Table (9) cleared that the infestation by both insects on upper portion gave negative effect on number of tillers, weight, length and diameter of stalks in the first ratoon and reflected on cane yield. With regarding to middle portion both insects affected positively sucrose % and negatively on stalk weight and length. Meantime, basel portion positively affected sucrose % in plant cane, while, length, diameter and weight were affected in first ratoon.

Collectively, our findings for the main tested sugarcane genotypes for breeding program were recorded in Table (10). It could be concluded that PR 1013 had the highest infestation with both tested insects. Also, G. 98-28, CP 76-331, PR 1059 and EI 266/2 gave highest infestation with *S. sacchari*. EH 87/26-11, G. 95-19, G 74-96, CP 44-101, G 98-28 and F. 153 had the highest infestation with C. *agamemnon*. On contrary, G.T. 54-9, G. 2003-47, NCO 310, EH 26-2 and BO 19 had the lowest infestation with C. *agamemnon*. In addition, G. 84-47, N11, Mix 2001-80, TUC 5120 and G. 2003-47 had the lowest infestation with *S. sacchari*. Regarding to sugarcane characters, PR 1013, F 153, G.T. 54-9 and G. 2003-47 had the highest sucrose %, while, M 57-351, CP 44-101, G. 2009-73 and G. 95-21 had the lowest value of sucrose % (Table 10). However, Mix 2001-80, TUC5120, G. 95-21, F. 161, N 26 and G. 95-19 gained the highest stalk weight and CP 44-101, CP 76-331 and G.T. 54-9 had the lowest one. On the other, PR1059, PR1013, TUC5120, G. 2003-47 and G.T.54-9 gained the highest stalk diameter, while, G. 98-28, G. 74-96, N11 and POJ2878 had the lowest ones.

Table 9: Multiple regressions between some sugarcane characters and the infestations with *C. agamemnon* (C) and *S. Sacchari* (S) at all tested portions for all sugarcane genotypes

Dependent variable (Y)	Seasons	Multiple regressions	R2
Sucrose %	1^{st}	$Y = 16.99 - 0.072 \times UC - 0.110 \times MC + 0.225 \times BC^{*} - 0.109 \times US + 0.281 \times MS^{*} - 0.225 \times BS$	0.14^{*}
	2^{nd}	$Y = 16.56 - 0.031 \times UC + 0.048 \times MC + 0.231 \times BC + 0.009 \times US + 0.052 \times MS - 0.005 \times US$	Ns
	Both	$Y = 17.00 - 0.0492 \times UC + 0.054 \times MC + 0.094 \times BC - 0.065 \times US + 0.128 \times MS - 0.135 \times BS$	Ns
Stalk Weight	1^{st}	$Y = 892.83 + 0.992 \times UC + 4.863 \times MC - 6.825 \times BC + 6.725 \times US -17.240 \times MS^{***} + 2.806 \times BS$	0.14^{*}
	2^{nd}	$Y = 905.42 +3.353 \times UC +0.986 \times MC +15.468 \times BC^{*} - 8.262 \times US^{***} -4.107 \times MS -0.514 \times BS$	0.24^{***}
	Both	$Y = 874.01 + 3.368 \times UC - 1.700 \times MC + 9.892 \times BC + 0.499 \times US -9.260 \times MS^{**} + 5.459 \times BS$	0.10^{**}
Stalk length	1^{st}	$Y = 255.75-0.463 \times UC + 1.938 \times MC - 2.412 \times BC + 1.593 \times US -4.5212 \times MS^{***} + 0.175 \times BS$	0.20^{**}
	2^{nd}	$Y = 287.37 + 0.303 \times UC + 1.129 \times MC + 4.287 \times BC^{*} - 2.995 \times US^{***} -1.555 \times MS - 0.577 \times BS$	0.28^{***}
	Both	$Y = 269.47 + 0.072 \times UC + 1.825 \times MC - 1.610 \times BC - 0.618 \times US^{***} -2.516 \times MS^{***} - 0.613 \times US$	0.17^{***}
Stalk diameter	1^{st}	$Y = 2.363 + 0.023 \times UC - 0.019 \times MC + 0.053 \times BC^{*} + 0.020 \times US^{**} -0.006 \times MS - 0.021 \times BS$	0.20^{**}
	2^{nd}	$Y = 2.487 - 0.033 \times UC + 0.028 \times MC + 0.052 \times BC^{*} - 0.010 \times US - 8.92 \times 10^{-4} \times MS - 0.040 \times BS^{*}$	0.14^{*}
	Both	$Y = 2.356 - 0.005 \times UC - 0.003 \times MC + 0.070 \times BC^{***} + 0.011 \times US -0.005 \times MS - 0.012 \times US$	0.14^{***}
Stalk number	1^{st}	$Y = 11.85 - 0.138 \times UC - 0.192 \times MC + 0.098 \times BC - 0.128 \times US + 0.393 \times MS^{**} + 0.003 \times BS$	Ns
	2^{nd}	$Y = 14.20 - 0.50 \times UC^{***} - 0.042 \times MC + 0.109 \times BC + 0.113 \times US -0.092 \times MS + 0.449 \times BS^{*}$	0.29^{***}
	Both	$Y = 13.83 - 0.386 \times UC^{***} + 0.073 \times MC - 0.356 \times BC^{*} - 0.0415 \times US + 0.091 \times MS + 0.111 \times US$	0.11^{**}

U = Upper potion M = Middle Portion B = Basal portion

Table 10: Response main sugarcane genotypes to infestation by *C. agamemnon* (C) and *S. sacchari* (S) and their characteristics

				Stalk			
Sugarcane genotypes	C	S	Sucrose %	Weight	Diameter	Length	Number
			Imported Sugarcane genotypes (ISG)				
BO 19	L						
CP 44-101	H	-	L	L	-	-	-
CP 76-331	-	H	-	L	-	-	-
F. 153	H	-	H	-	-	-	H
F161	L	-	-	H	-	-	-
M 57-351			L				
MIX 2001-80	-	L	-	H	-	-	-
N 11	-	L	-	-	L	L	-
N 26	-	-	-	H	L	L	L
NCO 292	-	-	-	-	-	-	H
NCO310	L	-	-	-			
POJ 2878	L	-	-	-	L	-	-
PR 1013	H	H	H	-	H	H	-
PR 1059	-	H	-	-	H	-	L
SP 59-56	-	-	-	-	-	H	-
SP 79-2233					H	H	
TUC 5120	-	L	-	H	H	-	-
ISC	L	L	ND	L	ND	ND	H
			Egyptian Sugarcane Genotypes (ESG)				
EH 87/26-11	H	-	-	-	-	L	-
EH 26-2	L	H	-	-	-	-	H
GT 54-9	L	-	H	L	H	-	-
G. 74-96	H				L		
G 84-47	-	L	-	-	-	-	H
G. 95-19	H	-	-	H	-	L	-
G. 95-21	-	-	L	H	-	-	-
G. 98-28	H	H	-	-	L	-	-
G. 2003-47	L	L	H	-	H	H	L
G. 2009-73	-	-	L	-	-	H	L
ESC	H	H	ND	H	ND	ND	H

H = Highest L= Lowest ND= Not different difference

CONCLUSION

Results obtained cleared that dealing to relative susceptibility, POJ 2878 and F. 161 were uninfested by both insects (These genotypes could be used in breeding programs), the least infested genotypes were G. 84-47 and N11 during both tested seasons. Otherwise, PR 1013 was the highest infested ones for both tested insects (It could be used as trap crop for those insects or for the source to collect such insect for plant protection studies). Average the two seasons ISG gained less infestation than ESG. As for portions stalk, *C. agamemnon* preferred the middle portion followed by upper and basal portions, respectively. While, *S. sacchari* preferred the upper portion followed by the middle and basal ones, respectively in both seasons. With regard to concurrent infest criteria, PR 1059, ROC 10, TUC 5120, EH 26-2 and G.T. 54-9 had ACI, while, G. 84-47 had A/RCI and the rest of genotypes owned PCI. The findings of this research illustrated that the parameter of main sugarcane cultivar G.T.54-9 in Egypt depressed, therefore, it must be replaced or ancillary by another cultivar, such as G. 84-47 and G. 2003-47. To provide evidence of our findings, it must be used more sugarcane cultivars, different locations and seasons.

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