

**CONTRIBUTIONS TO THE STATUS OF SUGAR-CANE INFESTATION WITH THE
PURPLE-LINED STEM BORER *Chilo agamemnon* Bles., (LEPIDOPTERA :
PYRALIDAE) JUST PRIOR MILLING**

(Received: 12.8. 2008)

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ABSTRACT

In Middle and Upper Egypt, sugar-cane plants are subjected to infestation with the Purple-lined stem borer, *Chilo agamemnon* Bles. (Lepidoptera: Pyralidae). This paper contributes to the pest's status on sugar-canes of the commercial variety "GT.54/C-9" just prior milling in 4 milling factories. Aspects considered throughout two successive milling seasons (1996 & 1997) were the rate of infestation in El-Minia, Souhag and Quena Governorates, the rate of infestation on plant-cane, 1st, 2nd, and 3rd ratoon plantations, the distribution of infestation on the different parts of sugar-cane stalk and stalk breakage. The highest rate of infestation occurred in Souhag and the lowest rate took place in El-Minia while the rate of infestation in Quena was slightly higher than it in El-Minia but comparatively less than in Souhag. Plant cane was the most susceptible plantation and the 3rd ratoon was the least susceptible plantation while the 1st and 2nd ratoon canes were subjected to intermediate infestation rates. Infestation was concentrated at the lower and middle thirds of the stalk. Roughly, about one third of the infestation took place on the lower third of the stalk and about one half of it occurred on its middle third whereas less than one sixth of the infestation was recorded on the upper third of the stalk. Stalk breakage occurred anywhere along the stalk but it mostly happened at the upper third and to a relatively less extent at the middle third while it rarely took place at the lower third of the stalk.

Key words: *Chilo agamemnon*, infestation rate, sugar-cane.

1. INTRODUCTION

Sugar-cane is extensively grown in Middle and Upper Egypt regions where it covers an annual area of more than 200 thousand feddans (Anonymous, 1999). Sugar-cane plantations are subjected to infestation with a variety of insect pests among which dominates the so-called "Purple-lined" or "Lesser" sugar-cane borer, *Chilo agamemnon* Bles. (Lepidoptera: Pyralidae). Willcocks (1925) believed that *Chilo* sp. had been imported to Egypt in some sugar-cane sets or straw packing from Japan. According to El-Sherif (1962 & 1965), *C. agamemnon* Bles. (= *C. suppressalis* Wlk. = *C. simplex* Butl.) is a pest on graminaceous crops in the tropics and sub-tropics. It is polyphagous and mainly attacks maize, sugar-cane and rice. Atries (1967) ascertained that the specific

nomenclature for the Egyptian *Chilo* is *C. agamemnon* Bles. Ezzat and Atries (1967) and El-Naggar (1968) referred to *C. agamemnon* as a key pest in sugar-cane fields in El-Minia Governorate. Isa and Awadallah (1972) followed by Isa (1979) then Awadallah *et al.* (1980) reported that *C. agamemnon* infestation extended to Assiut Governorate in 1971-1974 and Aswan Governorate in 1975-1977. Currently the pest occurs at all sugar-cane growing areas but the rate of infestation with it varies from one governorate to another.

Sugar-cane is a perennial crop that is harvested from the same field as plant-cane then 1st, 2nd, 3rd and, sometimes, 4th ratoons. El-Sherif (1970) mentioned that, at Abu-Qurqas (El-Minia Governorate), plant-cane was less susceptible to *C. agamemnon*

infestation than the 1st ratoon canes which, in turn, were less susceptible than the 2nd ratoon canes. Abu-Dooh (1980 & 1988) found that at Mallawy (El-Minia Governorate) plant-cane suffered less eye-bud damage than ratoon cane. Embaby (1996) reported that the highest infestation with *C. agamemnon* occurred on the 1st ratoon canes followed by the 2nd ratoon then the 3rd ratoon canes. Eskandar (1996) evaluated the susceptibility of 6 sugar-cane genotypes to infestation with *C. agamemnon* and concluded that plant-cane suffered less damage than the 1st ratoon. Tohamy (1999) mentioned that the least infestation with *C. agamemnon* occurred on plant-cane and the highest infestation took place on the 1st and 2nd ratoons.

In spite of the rich literature on *C. agamemnon* on its different host plants in Egypt including- of course- sugar-cane, there are still some gaps in the knowledge on it especially on the canes supplied to the milling factories. This paper contributes, therefore, to some of the aspects related to the status of the pest on sugar-canes just prior milling. Aspects considered were the rate of infestation in different governorates, rate of infestation on different plantations, distribution of infestation on the different parts of sugar-cane stalk and stalk breakage.

2. MATERIALS AND METHODS

Egypt operates several sugar-cane milling factories scattered along the Nile-valley. Four factories were selected for the current study on the status of *C. agamemnon* infestation to the harvested canes. Selected factories were located at Abo-Qurqas (El-Minia Governorate), Girga (Souhag Governorate) and Nagaa-Hamadi and Dishna (Quena Governorate) 267, 502, 533 and 578 kilometers south of Cairo, respectively. Abo-Qurqas factory represented Middle Egypt while the other three factories represented Upper Egypt. Sampled canes were taken from the harvest of different plantations representing plant-cane, 1st, 2nd and 3rd ratoons during the two successive milling seasons of 1996 & 1997. Sampling was practiced within a period of about one month by the middle of the milling season which extended from early December until late May (one factory/ week between mid-February and mid-March/ milling season). All sampled

canes belonged to the commercial sugar-cane variety "GT.54/C-9".

As a common practice, sugar-cane growers transport harvested canes to the factories in lorries or tractor-trailed trailers. Every consignment consists of canes representing a specific plantation (e.g. plant-cane, 1st ratoon, 2nd ratoon or 3rd ratoon). During each of the two milling study seasons and for every selected factory five consignments from each of the four above-mentioned cane plantations were randomly chosen immediately upon delivery and a random sample of 50 canes was then taken from every consignment. Thus, every specific plantation at each selected factory was represented by 250 canes that were carefully inspected for *C. agamemnon* infestation, then classified as infested and sound (uninfested) to work out the percentage of infested stalks (%IS). Canes were further examined for stalk breakage and the percentage of broken stalks (%BS) was determined. Broken stalks were arbitrarily classified according to the location of stalk breakage and the percentages of breakage at the lower, middle and upper thirds of the stalk were worked out. Another quantity of stalks weighing 20 Kg. was randomly taken from the same specific plantation, peeled off, washed thoroughly with water then re-examined to count the numbers of griddled stalks, infested joints and holes to determine the percentages of griddled stalks (%GS) and infested joints (%IJ) as well as the mean number of holes/stalk (H/S). Obtained data were handled in different ways to meet with the objectives of the study as follows:

2.1. Rate of infestation in different governorates

The means of five infestation parameters (%IS, %IJ, %BS, %GS and H/S) were calculated for all cane samples representing all plantations from each of El-Minia, Souhag and Quena Governorates during each of the two considered milling seasons then the "two -seasons" grand mean was worked out for every infestation parameter.

2.2. Rate of infestation on different plantations

The means of three infestation parameters (%IS, %IJ and H/S) were calculated for all cane samples representing the three considered governorates altogether during each of the two considered milling seasons

then the “two -seasons” grand mean was worked out for every infestation parameter

2.2.1. Distribution of infestation on the different parts of sugar-cane stalk

The means of three infestation parameters [no. of infested joints (IJ), no. of griddled joints (GJ) and no. of holes (H)] for all cane samples representing all plantations from all three study governorates during the two considered milling seasons were worked out for each of the lower, middle and upper thirds of the sugar-cane stalk. The relative distribution of infestation on the different parts of the sugar-cane stalk was expressed as percentages of infested joints/part, griddled joints/ part and holes/part.

2.2.2. Stalk breakage

Twelve hundred sugar -cane stalks, showing stalk breakage resulting from *C.agamemnon* infestation, were intentionally selected from the examined cane samples representing the four considered plantations obtained from the three considered governorates during the two considered milling seasons. Selected broken canes were classified according to the location of stalk breakage at the lower, middle or upper thirds of the stalk.

3. RESULTS AND DISCUSSION

3.1. Rate of infestation in different Governorates

The means of five different infestation parameters (%IS, %IJ, %BS, %GS and H/S) at three different sugar-cane growing governorates in Middle and Upper Egypt regions (El-Minia, Souhag and Quena) during the 1st and 2nd milling seasons are shown in Table (1). This table emphasizes

that the highest rate of infestation with *C.agamemnon* on sugar-canes occurred in Souhag Governorate and the lowest infestation rate took place in El-Minia Governorate. The rate of infestation in Quena Governorate was slightly higher than it in El-Minia Governorate but comparatively less than in Souhag Governorate.

Based on “2-sesaons grand means”, % IS recorded about 69% in Souhag compared to about 55% in El-Minia and 57% in Quena. The %IJ reached 7.2% and 7.9% in El-Minia and Quena ,respectively, whereas it increased to 11.7% in Souhag. The %BS was relatively higher in El-Minia (10.8%) than Quena (9.7%) but it almost doubled in Souhag (19.4%).The % GS was nearly similar in El-Minia and Quena (12.5% and 12.9%, respectively) and considerably higher in Souhag (20.6%). Similarly, the mean number of H/S recorded a maximum of 3.7in Souhag versus respective means of 2.4 and 2.7 in El-Minia and Quena. These results coincide with the observations of El-Naggar (1968) who stated that, in Egypt, the susceptibility of sugar-canes to borers infestation differs from one place to another and Embaby (1996) who pointed out that the percentage of infestation with *C. agamemnon* in sugar-cane fields varies at the different localities even within the same governorate.

3.2. Rate of infestation on different plantations

The means of three different infestation parameters (%IS, %IJ and H/S) for canes representing four different sugar-cane plantations (plant-cane, 1st , 2nd and 3rd ratoons) during the two successive milling seasons are shown in Table(2). This table

Table (1): Means of certain parameters of infestation with *C. agamemnon* at three different sugar -cane growing governorates in Middle and Upper Egypt regions in two successive milling seasons (1996 & 1997)

Governorate	Milling season	Infestation parameter				
		%IS	%IJ	%BS	%GS	H/S
El-Minia	1 st	58.0	7.4	10.8	9.8	2.4
	2 nd	51.1	6.9	10.8	15.1	2.3
	Grand mean	54.6	7.2	10.8	12.5	2.4
Souhag	1 st	71.0	11.4	18.7	17.8	3.8
	2 nd	65.9	11.9	20.1	23.3	3.5
	Grand mean	68.5	11.7	19.4	20.6	3.7
Quena	1 st	61.8	8.4	10.0	14.1	3.0
	2 nd	51.7	7.4	9.3	11.6	2.3
	Grand mean	56.8	7.9	9.7	12.9	2.7

%IS= per cent infested stalks %IJ= per cent infested joints H/S= mean number of holes/ stalk

indicates that all three considered infestation parameters oscillated irregularly from one plantation to another as well as from one

Some of the findings agree with the results revealed from the current investigation while others disagree with it. Supporting studies

Table (2) :Means of certain parameters of infestation with *C. agamemnon* on the canes of four different sugar-cane plantations in Middle and Upper Egypt regions in two successive milling seasons (1996 & 1997).

Plantation	Season	Infestation parameter		
		%IS	%IJ	H/S
Plant-cane	1 st	66.3	9.1	3.3
	2 nd	61.8	10.3	3.0
	Grand mean	64.1	9.7	3.2
1 st ratoon	1 st	62.9	7.1	2.5
	2 nd	55.9	9.0	3.0
	Grand mean	59.4	8.1	2.8
2 nd ratoon	1 st	67.1	10.4	3.4
	2 nd	54.3	9.0	2.8
	Grand mean	60.7	9.7	3.1
3 rd ratoon	1 st	62.9	10.4	3.4
	2 nd	50.3	7.4	2.3
	Grand mean	56.6	8.9	2.9

%IS=per cent infested stalks %IJ=per cent infested joint H/S = mean number of holes / stalk

milling season to the other without showing a distinct trend of change. Despite such discrepancy of results, the comparison based on the "2-seasons grand means" shows that plant-cane was the most susceptible plantation which harbored 64% infested stalks, 10.3% infested joints and 3.2 holes/ stalk while the 3rd ratoon was the least susceptible plantation that suffered about 57% infested stalks, 8.9% infested joints and 2.9 holes / stalk. The 1st and 2nd ratoon canes were subjected to intermediate infestation rates with *C.agamemnon* but the former plantation seemed to be relatively more susceptible to the pest than the latter one. For the 1st ratoon, %IS ranged 56-63% with a mean of about 59%, %IJ ranged 7.1-9.0 with a mean of 8.1 and H/S varied from 2.5 to 3.0 with a mean of 2.8. For the 2nd ratoon, on the other hand, the corresponding infestation parameters were about 54-67% with a mean of 61% IS, 9.0-10.4% with a mean of 9.7% IJ and 2.8- 3.4 H/S with a mean of 3.1 H/S. These results lead to the general conclusion that in Lower and Upper Egypt the highest rates of infestation with *C.agamemnon* occur on plant-cane followed by the 2nd ratoon and the lowest infestation rates take place on the 3rd ratoon followed by 1st ratoon plantations.

Several authors studied the relationship between sugar-cane plantations and infestation with *C.agamemnon* in Egypt.

include the works of El- Naggar (1968), Kira and El-Sherif (1973) and Mahmoud (2000) who coincided that plant- cane is more susceptible to infestation than ratoons. Also, El-Sherif (1970) added that the 2nd ratoons are more susceptible than the 1st ones. Moreover, Khedr (1981) and Embaby (1996) contributed that 3rd ratoons suffer the least infestation. In disagreement with the current findings, however, Abu-DooH (1988) and Tohamy (1999) claimed that at Mallawy (El-Minia Governorate), Matana (Quena Governorate) and Kom Ombo (Aswan Governorate) plant-canes are less susceptible to *C . agamemnon* than ratoons. Such discrepancy of findings might be attributed to the differences in study locations on one hand and relying on a variety of parameters for infestation assessment on the other hand.

3.2.1. Distribution of infestation on the different parts of sugar-cane stalks

The grand means of three infestation parameters [no. of infested joints (IJ), no. of griddled joints (GJ) and no. of holes (H)] on three parts of sugar-cane stalk (lower, middle and upper thirds) for cane samples representing four plantations (plant-cane, 1st , 2nd and 3rd ratoons) from three sugar-cane growing governorates (El-Minia, Souhag and Quena) during the two successive milling seasons of 1996 & 1997 are listed in Table

(3). The bold figures in the table indicate the distribution of each infestation parameter on the three considered thirds of cane stalk expressed as percentages.

percentage of bored joints on sugar-cane mid-stalk internodes is an important criterion for evaluating varietal response to *C.agagemnon* infestation. Also, Tohamy (1999) recorded

Table (3) : Grand means and percentages of three parameters of infestation with *C. agagemnon* on three different parts of sugar-cane stalks representing four plantations from three governorates in Middle and Upper Egypt during two successive milling seasons (1996 & 1997).

Infestation parameter	Plant part (Third)			Total
	Lower	Middle	Upper	
No.of infested joints/ part	0.10	0.12	0.04	0.26
%	38.5	46.2	15.3	100.0
No. of griddled joints/part	0.92	1.55	0.54	3.01
%	30.6	51.5	17.9	100.0
No. of holes/part	1.16	1.37	0.46	2.99
%	38.8	45.8	15.4	100.0

A glance to Table (3) emphasizes that *C. agagemnon* infestation is usually concentrated at the lower and middle thirds of the stem of sugar cane plant. Roughly, about one third of the infestation takes place on the lower third of the stem and about one half of it occurs on its middle third whereas less than one sixth of the infestation attacks the upper third of the stem. The lower third of sugar-cane stalk suffered about 39% of the infested joints and almost the same percentage of holes in addition to about 31% of the griddled joints. Meanwhile, the middle third of sugar-cane stem suffered about 46% of both infested joints and holes as well as about 52% of the griddled joints. Infestation on the upper third of sugar-cane stalk was often relatively less (about 15% for both infested joints and holes and about 18% for griddled joints).

Previous results lead to the general conclusion that all parts of sugar-cane stalk are subjected to infestation with *C.agagemnon*. However, the relative distribution of infestation on the different parts of the stalk varied markedly. The middle third of the stem seemed to be the most preferred part that suffered maximum amounts of infested joints, griddled joints and holes. The lower third of the stem was, apparently, less preferred but it was subjected to considerably high counts of infested joints, griddled joints and holes. On the other hand, the upper third of the stalk ranked as the least preferred part that harbored minimum amounts of infested joints, griddled joints and holes. In accordance with these findings, Temerak and Negm (1978) mentioned that the

the highest infestation with *C.agagemnon* to sugar-cane on the middle section of the stalk followed by the lower section while the upper section was the least infested.

3.2.2. Stalk breakage

Examination of 1200 sugar –cane stalks showing stalk breakage resulting from *C.agagemnon* infestation intentionally selected from samples representing four plantations (plant-cane, 1st, 2nd and 3rd ratoons) from three sugar-cane growing governorates (El-Minia, Souhag and Quena) during two successive milling seasons indicated that 60.2% of them were broken at or above the upper third of the stalk, 38.4% were broken somewhere along the middle third of the stalk and only 1.2% showed breakage at or below the lower third of the stalk. These percentages refer that stalk breakage caused by the active griddling and boring of *C.agagemnon* larvae possibly occurs anywhere along the stem but breakage is mostly concentrated at the upper third of the stalk and to a relatively less extent at the middle third while it rarely happens at the lower third of the stalk.

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إضافات للمعلومات عن حالة إصابة عيدان قصب السكر بدودة القصب الصغيرة
Chilo agamemnon Bles. (من عائلة Pyralidae ورتبة حرشفية الأجنحة)
قبل العصير مباشرة

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ملخص

تعرض نباتات قصب السكر في مصر السفلى و مصر العليا للإصابة بدودة القصب الصغيرة *Chilo agamemnon* ، وتتناول هذه الورقة العلمية إضافات للمعلومات عن حالة إصابة عيدان قصب السكر من الصنف " GT.54/C-9 " بتلك الآفة الهامة إقتصاديا قبل العصير مباشرة في أربعة مصانع بمحافظات المنيا وسوهاج وقتنا خلال موسمي عصير متتاليين (1996 و 1997) من حيث معدل الإصابة على كل من القصب الغرس و الخلفات الأولى والثانية و الثالثة، وتوزيع الإصابة على الأجزاء المختلفة لساق نبات قصب السكر، وموضع كسر الساق نتيجة للإصابة .

وقد سجلت أعلى معدلات الإصابة بمحافظة سوهاج وأدناها بمحافظة المنيا في حين كان معدل الإصابة في محافظة قنا أعلى قليلا عنه في محافظة المنيا ولكنه كان أقل بشكل ملحوظ عنه في محافظة سوهاج . ووجد أن القصب الغرس كان أكثر العروات قابلية للإصابة بالآفة بينما كانت الخلفة الثالثة أقلها قابلية للإصابة بها في حين أظهرت الخلفتان الأولى و الثانية قابلية متوسطة للإصابة. تركزت الإصابة بالآفة في الثلثين السفلى و الأوسط لساق نبات قصب السكر، وعلى وجه التقريب سجل نحو ثلث الإصابة على الثلث السفلى للساق ونحو نصفها على ثلثه الأوسط بينما إستقبل الثلث العلوى للساق أقل من سدس الإصابة. أظهرت الملاحظات أن كسر ساق نبات قصب السكر نتيجة للإصابة بالآفة يمكن أن يحدث عند أى جزء منه ولكنه يحدث في اغلب الأحيان عند الثلث الأعلى من الساق و بدرجة أقل عند ثلثه الأوسط ونادرا ما يحدث عند الثلث السفلى له.

المجلة العلمية لكلية الزراعة - جامعة القاهرة - المجلد (60) العدد الأول (يناير 2009):114-120.

