MONITORING OF YIELD LOSS IN MAIZE CAUSED BY *CHILO AGAMEMNON* BLES. (LEPIDOPTERA : PYRALIDAE)

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ABSTRACT

A field trial was carried out in Fayoum Governorate, Egypt, in 2003 and 2004 seasons for monitoring yield loss in maize caused by *Chilo agamemnon* infestation. Based on data obtained from simulated and natural infestation using a given equation, yield loss could be estimated by field survey of the number of stems broken at different levels of the plants which compensate for the traditional method of dissecting the plants in search for the number of holes or larvae, in addition to the need for yield weight. The actual loss in yield was 1.59, 0.5 and 1.02 kg/200 plants in March, May and June plantations, respectively, compared to 1.44, 0.6 and 1.25 kg/200 plants estimated by the given equation. The differences between the actual and estimated loss in yield is not considerable. This finding ascertains that the use of such equation facilitates the assessment of *C. agamemnon* damage to maize plants through field observation of symptoms of infestation (broken stems only). Also, results showed that larvae bore into the ear shank and not the ear itself and confirmed that, the month of May is the suitable planting date for maize in Egypt.

Key words: *Chilo agamemnon,* Equation, Maize, Yield loss

INTRODUCTION

The purple-lined borer *Chilo agamemnon* Bles. is one of the most injurious lepidopteran pests infesting maize (Zea mays L.), sugarcane and rice fields in Egypt. This insect attacks maize plants making tunnels into the nodes or internodes of maize stems. The initial infestation starts 5-6 weeks after emergence of seedlings with the highest number of egg-masses found on plants (Ismail, 1989).

Semeada 1998, reported 25-29 % yield loss in maize (variety Giza 2) due to *C. Agamemnon* infestation in Giza, Egypt. Also, Mesbah *et al*. 2002, reported that *C. agamemnon* in addition to other corn borers demonstrates great damage and yield loss in maize.

The aim of the present work is to evaluate *C. agamemnon* damage in natural and simulated field infestations and to set up a simple equation to estimate yield loss in maize. Simulation was practiced instead of the need to dissect the plants in search for larvae or tunnels. Yield reductions in different planting dates were compared.

MATERIALS AND METHODS

1- Simulated *C. agamemnon* damage to maize:

Seeds of (Balady variety) were sown in two planting dates; mid March and mid May, 2003 and 2004 in Fayoum. The experimental area for each planting date was 1/3 feddan, divided into 4 equal plots x 4 replicates. Every

replicate contained 20 rows x 6 m long and 70 cm wide and the distance between hills was 24 cm.
The experimental area received the normal agricultural practices and was sprayed three times with Sevin to prevent natural infestation.

Eight weeks after emergence of plants, damage of *C. agamemnon* was simulated by cutting the stem at one of two levels; three leaves above the ear, and at ear internode. On the basis that cutting of the stem below ear results in no yield, such treatment was neglected.

This technique seems to provide a simple and practical method to evaluate insect damage and yield loss as indicated in soy bean by Simmons and Yeargan, 1990.

At harvest, 200 ears/treatment, were collected including the control. The ears were air dried for one month. The weight of ears and cobs were then obtained, from which the weight of kernels/ear was calculated.

2- Evaluation of natural damage of *C. agamemnon* to maize:

Seeds of Balady variety were sown in three planting dates; end of March, mid May and mid June, 2004. The experimental area (1/3 feddan) was divided into 4 equal plots and received the normal agricultural practices but no insecticides were used.

Three weeks after plantation, all plots were weekly examined to record the damage (number of broken stems) at three levels; a) 3 leaves above the ear; b) at ear level; and c) below the ear. At harvest a total of 200 ears of each plot were dissected to assess damage to ears. The loss in yield was estimated using the following equation:

$$L = X \left[n + \frac{(n_1 r_1 + n_2 r_2)}{100} \right]$$

Where: L = Yield loss
X = mean weight of kernels per ear
n = number of broken plants below ear level
n_1 = number of broken plants above ear level
n_2 = number of broken plants at ear level
r_1 = % yield reduction (in n_1)
r_2 = % yield reduction (in n_2)

RESULTS AND DISCUSSION

1- Effect of simulation of damage on yield:

a- Weight of kernels:

Data (table 1) showed that the weight of kernels in May plantations of control plots averaged 1014.5 gm/10 ears, which was higher than that of March plantations being 927.4 gm/10 ears.

Simulated *C. agamemnon* damage above ear reduced yield by 10.7% in March plantations and 23.8% gm/10 ears in May plantations. Simulated damage at ear level reduced yield by 30.8 and 35.1%, respectively. Such data

could be recommended to set up a simple equation to determine the effect of *C. agamemnon* simulated (or natural)damage on yield loss in maize.

Table (1): Effect of *C. agamemnon* damage simulation in maize plants on kernels yield during 2003 and 2004 seasons.

Simulated damage	2003 season				2004 season				Average w.		Average % reduction		
											Seasonal		Total
	March		May		March		May		March	May	March	May	
	W	R	W	R	W	R	W	R					
Above ear	828.5	8.6	797.6	22.3	827.0	12.8	748.0	25.3	827.7	772.8	10.7	23.8	17.3
At ear level	660.5	27.1	687.2	33.1	621.1	34.5	628.3	37.3	640.8	657.7	30.8	35.2	33.1
Below ear	-	-	-	-	-	-	-	-	-	-	100	100	100
Control	906.5	-	1027.1	-	948.3		1001.2		927.4	1014.1	-	-	-

W = Kernel weight of 10 ears in gm.
R = % yield reduction compared with control

b- Weight of ears:

Data (table 2) showed that the weight of ears in May plantations of control plots averaged 1247.3 gm/10 ears, which was higher than that of March plantations being 1158.7 gm/10 ears.

Simulated *C. agamemnon* damage above ear reduced yield by 9.5% in March plantations and 23.4% gm/10 ears in May plantations. Simulated damage at ear level reduced yield by 31.7 and 33.8%, respectively. The total reduction percent in ears yield were 16.5 and 32.8% for broken stems above ear and at ear level.

Table (2): Effect of damage simulation of *C. agamemnon* on maize plants on ears yield during 2003 and 2004 seasons.

Simulated damage	2003 season				2004 season				Average w.		Average % reduction		
	March		May		March		May		March	May	Seasonal		Total
	W	R	W	R	W	R	W	R			March	May	
Above ear	1044.9	8.6	962.6	22.6	1051.7	10.4	948.2	24.2	1048.3	955.4	9.5	23.4	16.5
At ear level	811.8	29.0	831.1	33.2	769.6	34.4	780.1	37.6	790.7	805.6	31.7	33.8	32.8
Below ear	-	-	-	-	-	-	-	-	-	-	100	100	100
Control	1143.7	-	1243.5	-	1173.7	-	1251.2	-	1158.7	1247.3	-	-	-

3- Effect of natural infestation and plantation date on maize yield.

Considering that *C. agamemnon* larvae cause three types of damage symptoms to maize plants; stem break below ear, at ear level, and at higher level above ear, data (table 3) showed that the number of infested ears was generally low, being 0.0, 1.0 and 3.5% in March, May and June plantations, respectively. Also observations showed that larvae bore into the ear shank and not the ear. The broken plant stems below ear started to appear 7 weeks after plantation regardless of planting date. Broken stems at ear level appeared after 8 weeks after plantation (50 day-old plants) in March and May plantations and after 7 weeks in June plantation. The broken plant stems above ear level appeared after 10, 8 and 9 weeks for March, May and June plantations, respectively. In this regard, Abed-Elgayed 1996, found that *C. agamemnon*

infestation started 4 or 5 weeks after plantation in April or June, i.e. damage symptoms appeared after 2 or 3 weeks of *C. agamemnon* invasion.

Monitoring in the three planting dates the corresponding infestation levels of *C. agamemnon*, the mean number of broken maize plants below ear level was 12.5, 5.0 and 9.75 stem/200 plants for March, May and June plantations, respectively. The mean number of broken stems at ear level was 7.5, 2.0 and 6.0 stem/200 plants, respectively. The mean number of broken plant stems above ear level was 3.0, 3.0 and 6.25 stem/200 plants, respectively. The percentages of damaged maize plants were extremely high in the early and late planting dates being 11.5% in March and 11.0 % in June. May plantation showed the lowest infestation level where % damage was only 5%. These results confirm the recommended planting date (May) for maize in Egypt given by Ismail *et al* (1974). The corresponding yield was 17.38, 18.48 and 19.52 kg/200 plants.

Table (3): Monitoring damaged of natural infestation with *C. agamemnon* to maize plants in three plantation dates during 2004 season at Fayoum.

Inspection date	Plant age (days)	Average number of broken stems / 200 plants			% infested plants	% damaged ears	Yield (Kg)
		Above ear	At ear level	Below ear			
March plantation							
April 18 May 9	14 - 35	0.00	0.00	0.00	0.00	0.0	17.38
May 16	42	1.0	0.00	0.00	0.50		
23	49	4.5	3.00	0.00	3.75		
30	56	10.00	6.50	0.00	8.25		
June 6	63	11.50	7.00	1.00	9.75		
13	70	12.00	7.50	2.25	10.87		
20	77	12.50	7.50	3.00	11.50		
27	84	12.50	7.50	3.00	11.50		
July 3	91	12.50	7.50	3.00	11.50		
May plantation							
June 11– July 2	14 - 35	0.00	0.00	0.00	0.00	1.0	19.52
July 9	42	0.5	0.00	0.00	0.25		
16	49	3.0	0.25	0.25	1.75		
23	56	4.25	1.0	2.0	3.62		
30	63	5.0	1.5	2.25	4.37		
Aug. 6	70	5.0	1.75	2.25	4.50		
13	77	5.0	2.0	3.0	5.00		
20	84	5.0	2.0	3.0	5.00		
27	91	5.0	2.0	3.0	5.00		
June plantation							
July 2 - 23	14 - 35	0.00	0.00	0.00	0.00	3.5	18.48
July 30	42	4.5	0.25	0.00	2.37		
Aug. 6	49	5.75	0.75	0.00	3.25		
13	56	6.75	1.75	1.0	4.75		
20	63	9.5	2.75	2.25	7.25		
27	70	9.5	4.25	5.25	9.5		
Sep. 3	77	9.75	5.5	6.25	10.75		
10	84	9.75	6.0	6.25	11.0		
17	91	9.75	6.0	6.25	11.0		

The actual yield loss relative to control (undamaged plants) was 1.59, 1.02 and 0.5 kg/200 plants in March, May and June plantation, respectively. Semeada (1998) reported that the percentages of infested plants with *C. agamemnon* were 10.68 and 16.28% for July and August plantations and these percentages resulted in 25-29 % yield loss.

Applying the above mentioned equation to estimate yield loss, the following weights were obtained : 1.44, 0.6 and 1.25 kg/200 plants for the same plantation dates, respectively. Therefore, the actual loss in yield was not considerably different from those estimated using the equation. This finding ascertains that the use of such equation facilitates the assessment of *C. agamemnon* damage to maize plants through field observation of symptoms only, i.e. counting the number of plants damaged at different stem levels without the need to search for larvae or holes or to obtain yield weight.

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تقدير الفقد في محصول الذرة الشامية الناتج عن الإصابة بدودة القصب الصغيرة *Chilo agamemnon*

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أجريت هذه الدراسة بمحافظة الفيوم خلال عروات موسمي ٢٠٠٣ /٢٠٠٤ وذلك لتقدير الفقد في محصول الذرة الشامية الناتج عن الإصابة الطبيعية بدودة القصب الصغيرة *C. agamemnon*. أو محاكاتها ولتحليل النتائج المتحصل في الحالتين استخدمت معادلة لتقدير الفقد في المحصول عن طريق عد السيقان المكسورة أو الجافة في مستويات مختلفة من النبات كبديل عن الطريقة التقليدية بتشريح النبات للبحث عن اليرقات أو الثقوب مع اخذ وزن المحصول الناتج من النباتات السليمة والمصابة في الاعتبار وبتطبيق المعادلة:

$$\text{الفقد في المحصول} = \frac{\text{و} [\text{ن} + (\text{ن}_1 \text{س}_1 + \text{ن}_2 \text{س}_2)]}{١٠٠}$$

حيث:

و = متوسط وزن الكوز.
ن = عدد النباتات المكسورة أسفل مستوى الكوز.
$ن_1$ = عدد النباتات المكسورة أعلى مستوى الكوز.
$ن_2$ = عدد النباتات المكسورة في مستوى الكوز،
س١ = النسبة المئوية للخفض المحصول في $ن_1$.
$س_2$ = النسبة المئوية للخفض في المحصول في $ن_2$.

أوضحت النتائج أن الفقد في المحصول المقدر تقليديا (بوزن المحصول) لثلاث عروات هو ١.٥٩، ٠.٥، ١.٠٢ كجم/٢٠٠ نبات لزراعة مارس ومايو ويونيو على الترتيب. وكان الفقد في المحصول المقدر بتطبيق المعادلة لنفس مواعيد الزراعة هو ١.٤٤، ٠.٦، ١.٢٥ كجم/٢٠٠نبات على الترتيب. ومن الواضح أن الفرق بين الطريقتين غير معنوي أي انه يمكن الاعتماد على استخدام هذه المعادلة لتقدير الفقد في محصول الذرة الشامية حقليا بعد حصر النباتات التي تظهر عليها أعراض الإصابة (المكسورة) في مستوياتها المختلفة بدلا من الطريقة التقليدية بتشريح النباتات وتسجيل تعداد اليرقات والثقوب ووزن المحصول مما يوفر كثيرا من الوقت والجهد. كذلك أظهرت النتائج أن اليرقات تصيب حامل الكوز في نهاية المحصول، كما أكدت أن الزراعة خلال شهر مايو هي انسب ميعاد للزراعة.