Assessment of Maize Yield Loss to Determine Economic Injury Levels (Eils) Due To the Infestation by Stem Borers with Insecticidal Control under the Egyptian Conditions

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ABSTRACT

This investigation was conducted in two subsequent (2014 and 2015) summer seasons, for the purpose of appraising grain yield losses to corn plants (*Zea mays* L.), due to attack by the lepidopteran stem borers, *Sesamia cretica* Led. (Noctuidae), *Ostrinia nubilalis* (Hb.) (Pyraustidae) and *Chilo agamemnon* (Bles.) (Crambidae).

Maize plants were treated with the recommended doses of five insecticides:- Chloropyriphose (Pyreban ® 48%), the novel insecticide Spintoram (Radiant® 12%SC), Indoxacarb (Avaunt® 15% EC), Chlorantranliprole (Coragen® 20% SC) and the natural biological agent Azadirachtin (Achook® 0.15 EC). Obtained data revealed that loss percentages were 0.00, 11.23, 24.60, 28.34, 39.04 and 39.25 for Cholorotraniliprol, Indoxacarb, Spintoram, Chloropyrephose, Azadirachtin and control, respectively in 2014.

In 2015 the corresponding percentages were as follows: Azadirachtin (36.57), Chloropyrephose (30.69) Spintoram (9.97), Indoxacarb (1.10) and 53.62% for the control.

As a general observation, the larval number of each species increased maize grain yield loss. Loss percentages are a prerequisite step for the determination of the economic injury level for each borer, according to the procedure indicated by Pedigo and Higley (1996). Econmice injury levels (EILs) due to infestation with *S. cretica* were (1.51) for Cholorotraniliprol, (0.93) Indoxacarb, (1.75) Spintoram, (0.83) Chloropyrephose, and (1.31) for Azadirachtin

These levels due to infestation by *O. nubilalis* were 2.42, 1.57, 2.68, 1.38 and 1.75; while they were 0.60, 0.39, 0.66, 0.31 and 0.32 due to infestation with *C. Agamemnon* when treated with the forementioned insecticides respectively, in 2014. In season 2015 the corresponding respective EILs values were 2.08, 1.40, 2.25, 1.26 and 1.87 for Chlorotraniliprol, Indoxacarb, Spintoram, Chloropyrephose and Azadirachtin, respectively, for *S. cretica* ; 1.00, 0.69, 1.48, 0.85 and 0.70 for *C. agamemnon* and 2.33, 1.60, 3.13, 1.57 and 1.75 for *O. nubilalis* as represented by number of larvae / 10 plant.

Keywords:-Maize stem borers - Insecticidal control-Yield loss assessment - Economic injury levels

INTRODUCTION

Maize (*Zea mays* L.)*,* is a major cereal crop in Egypt. About 750000 hectares were cultivated with maize in 2012 (FAO, 2012). Maize occupies a crucial economic importance since it is used for human and livestock's consumption and as a source of industrial raw material for the production of bio products such as oil, alcohol and starch.

In Egypt, maize plants are subjecte to infestation with a varity of insect pests. Most important of which is the lepidopteran stem borers, *Sesamia cretica* Led. (Noctuidae), *Ostrinia nubilalis* (Hb.) (Pyraustidae) and *Chilo agamemnon* (Bles.) (Crambidae) , that attack the maize plants throughtout the different stages of their growth causing the characteristic symptoms of dead hearts, elongate tunnels and circular holes., respectively, which subsequently affect the grain yield. (Berry and Campbell., 1978; Edwards *et al*., 1992. Mesbah *et al*., 2002; Sabbour, 2002 and Idraw and Al-Jouri, 2007).

Attention should be paid for assessing yield loss due to these stem borers because yield loss is a prerequisite step for the determination of economic injury levels (EILs) that represent a salient tool for a decision – making program and /or for initiating integrated pest management (IPM) programs in maize field.

As mentioned by Stern *et al*., (1959) (EIL) is defined as: "the lowest population density of a pest that will cause economic damage; or the amount of pest injury which will justify the cost of control."

Therefore, the current investigation aims at the evaluation of some insecticides against the three stem borers under field conditions and assesses grain yield loss and determine the (EILs) for each of the above-mentioned maize borers.

MATERIALS AND METHODS

1- Experimental site and design

Field trials were conducted by cultivating the maize hybrid (SC 10) during the two successive summer seasons of 2014 and 2015 at the Research Experimental Farm of the Faculty of Agriculture, Saba Bacha , Alexandria University, situated at the 10th village,

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Abees, Alexandria, Egypt. An experimental area was divided into plots, each of which was 12 m^2 (3 x 4 m). The plants were grown along a distance of 30 cm apart and of 70 cm. between rows. All experimental plots received the recommended agricultural practices.

2- Insecticide treatments

Used chemicals

Two groups of insecticides were used; namely, Chloropyriphose (Pyreban ® 48%), as well as the novel insecticides Spintoram (Radiant® 12%SC), Indoxacarb (Avaunt® 15% EC), Chlorantranliprole (Coragen® 20% SC) in addition to the natural biological agent Azadirachtin (Achook® 0.15 EC).

Maize plants were treated with insecticides twice, after 25 and 45 days from sowing which took place on the first week of the June in both seasons for the control of the three concerned stem borers. Treatments were arranged in a complete randomized block design (CRBD) with 3 replicates for each treatment plus other 3 replicates without any treatment as check (control).To create a range of stem borer population densities and crop damage, larval numbers before and after each insecticidal application were recorded.

Reduction percentage calculation

The control efficacy of the chemicals was estimated as percentages of infestation reduction calculated according to the equation of Henderson and Tilton (1955):

Reduction % = [1- (A/B x C/D) x 100],

Where:-

A = Mean no. of larvae in treatment after spraying, B = Mean no. of larvae in treatment before spraying, C = Mean no. of larvae in untreated check (control) before spraying and D = Mean no. of larvae in check after spraying.

At harvest all maize ears of each plot were collected, weighed and adjusted to find out the yield per feddan expressed as (ardab/feddan). (One ardab is equal to 150 kg).

3- Maize grain yield loss assessment

Once again, different insecticides at recommended doses were used for the purpose of creating gradient levels of infestation. Hence it was possible to study the relationship between the mean number of each stem borer larvae and mean percentage of loss. Appraisal of maize grain loss percentages was calculated according to the following formula modified for the formula described by Zahid *et al*., (2008):

% loss percent = $[(Y_{op} – Y_{t2...5} / Y_{op})$ x 100],

Where :-

Y_{op} = optimal yield, which is corresponding to T_1 where the maize plants were sprayed with Chlorantranliprole.

$Y_{t2...5}$ = yield for each insecticidal treatment

4- Determination of the multiple economic injury levels of the stem borer complex

The following steps, in order, represent the approach to determine EIL for each key insect pest of the stem borers:

a. Regression of insect population three considered on yield loss.
b. calculating the values of (EILs) by applying the following formula:

EIL = C/VIDK

Where:

C = the management cost per production unit (*e.g.*, L.E./fed.).

V = market value per production unit (*e.g.*, L.E./kg).

I = injury unit per pest equivalent.

D = damage per unit injury (*e.g.*, kg reduction/fed./ injury unit).

K = proportional reduction in injury due to management.

For both 2014 and 2015 seasons the management costs were estimated by calculating costs of insecticide, sprayers and labour. Such data were obtained from the department of Plant Protection, Ministry of Agriculture operation and farmers' inquiry. The price of yield unit (ardab/ fed.) was estimated as 300L.E/ardab according to the information provided by the Department of Economics and Statistics Ministry of Agriculture. Since, "I × D" is equivalent to the "b" index, *i.e*, the slope of the regression line y=a+bx formula (Pedigo *et al*., 1986) the equation and regression relation between the number of larvae/ plant and damage to grain yield were estimated and considered as $D \times I = D'$ *e.g.* and the amount of yield loss was obtained from the slope of the regression equations (Peterson, 1996 and Warabieda, 2015).

The correlation coefficient 'r' among the variables, hence population level of the pest and reduction in grain yield per plant were worked out using the following formula:

$$r = \frac{N\sum XY - \sum X \sum Y}{\sqrt{\left(N\sum X^2 - (\sum X)^2\right)\left(N\sum Y^2 - (\sum Y)^2\right)}}$$

Where:

r = correlation coefficient between variables.

N = total number of observations

X = population levels of larvae/plant

Y = reduction in grain yield.

All statistical calculations were made by the computer program CO-STAT

RESULTS AND DISCUSSION

A. Mean grain yield loss assessment

A. 1. (2014) season:

The mean numbers of *S. cretica* larvae /10 plants were 3.00, 4.00, 5.00, 6.00. 11.00 and 11.25 after treatments with Cholorotraniliprol, Indoxacarb, Spintoram, Chloropyrephose, Azadirachtin and control respectively. The corresponding mean numbers of O. *nubilalis* larvae/10 plants were 3.65, 5.37, 9.00, 12.33, 16 and 17 /10 plants while for, the *C. agamemnon* were 0.89, 1.03, 2.68, 3.32, 3.41 and 4.00 (Table1).

The mean grain weigh /10 plants were adjusted as the number of plants / feddan were about 24000 and expressed as mean grain yield / feddan. Thes values were 29.92, 26.56, 22.56, 21.44, 18.44 and 18.17 ardab/ fed. for the abovementioned insecticides and control, respectively during 2014 season.

Percentages of grain yield loss were appraised estimated by to the previously mentioned formula indicated that the losses were 0.00, 11.23, 24.60, 28.34, 39.04 and 39.25 for the tested insecticides as well as the control, in respect (Table 1).

Result refer that insecticidal treatments with Cholorotraniliprol and Indoxacarb followed by Spintoram and then Chloropyrephose and Azadirachtin led to subsequent increases in the mean yield of maize grains which have no significant difference between them or the control

A. 2. (2015) season:

Data in Table (2) indicates that the mean numbers of of *S. cretica* larvae were 4.09, 4.55, 5.65, 7.73, 12.53 and 12.67 /10 plants for the treatments (T_1) Cholorotraniliprol, (T_2) Indoxacarb, (T_3) Spintoram, (T_4) Chloropyrephose, (T_5) Azadirachtin and control, respectively . As for O. *nubilalis*, the mean numbers of larvae were7.91, 8.80, 11.59, 13.35, 17.01 and 18.67 /10 plants, while for *C. agamemnon* the corresponding numbers were 1.68, 2.61, 4.49, 5.35, 5.65 and 6.92 larva /10 plants.

Table 1. Efficacy of 5 tested insecticides (treatments) on larval densities of 3 stem borers and on yield loss in maize field during 2014

Insecticide (treatment)	Mean no. of larvae /10 plants			Mean weight of Grains	Mean weight of Grains yield (Ardab/Fed)	% Loss
	Sc	On	Ca			
Cholorotraniliprol (T_1)	3.00	3.65	0.89	1.87 ^{a}	29.92 ^{a}	0.00
Indoxacarb (T_2)	4.00	5.37	1.03	1.66 ^{a*}	26.56 ^{a}	11.23
Spintoram (T_3)	5.00	9.00	2.68	1.41 ^{b}	22.56 ^{b}	24.60
Chloropyrephose (T_4)	6.33	12.33	3.32	1.34 ^{c}	21.44 ^{c}	28.34
Azadirachtin (T_5)	11.00	16.00	3.41	1.14 ^{c}	18.24 ^{c}	39.04
Control (check)	11.25	17.00	4.00	1.136 ^{c}	18.17 ^{c}	39.25

* Numbers followed by the same letter(s) in each column are not significantly different.

Sc :- *Sesamia cretica* led. , On:- *Ostrinia nubilalis* (Hb.) Ca:- *Chilo agamemnon* (Bles.)

Plant stand was 24000 plants/ feddan

Table 2. Efficacy of 5 tested insecticides (treatments) on larval densities of 3 stem borers and on yield loss in maize field during 2015

Insecticide (treatment)	Mean no. of larvae /10 plants			Mean weight of Grains (kg / 10 plants/plot) s/10plant	Mean weight of Grains yield (Ardab/Fed.)	% Loss
	Sc	On	Ca			
Cholorotraniliprol (T_1)	4.09	7.91	1.68	1.466 ^{a*}	23.46 ^{a}	0.00
Indoxacarb (T_2)	4.55	8.80	2.61	1.45 ^{a}	23.20 ^{a}	1.11
Spintoram (T_3)	5.65	11.59	4.49	1.32 ^{a}	21.12 ^{a}	9.97
Chloropyrephose(T_4)	7.73	13.35	5.35	1.016 ^{a}	16.26 ^{a}	30.69
Azadirachtin (T_5)	12.53	17.01	5.65	0.93 ^{a}	14.88 ^{a}	36.57
Control (check)	12.67	18.67	6.92	0.68 ^{b}	10.88 ^{b}	53.62

* Numbers followed by the same letter(s) in each column are not significantly different.

Sc :- *Sesamia cretica* led. , On:- *Ostrinia nubilalis* (Hb.) Ca:- *Chilo agamemnon* (Bles.)

Plant stand was 24000 plants/ feddan

Mean grain yield / fed. recorded and it was noticed that Cholorotraniliprol (T_1) was the superior treatment that yielded (23.46) ardab/fed. followed by Indoxacarb (23.20), Spintoram (21.12), Chloropyrephose (16.26) and Azadirachtin (14.88) whereas the control yilded (10.88) ardab/ feddan. Yield loss percents could be arranged in a descending order as follows: Control (53.62), Azadirachtin (36.57), Chloropyrephose (30.69), Spintoram (9.97), Indoxacarb (1.10) and Cholorotraniliprol (0.00).

Previous results infer that the mean weight of maize grains / feddan were higher during the first season than those recorded for the second season. This phenomenon was definitely related to the comparatively low numbers of stem borers larvae that infested maize plants rather than in the first season as well as to the expected differences in environmental factors. Thereby, yield losses in (2014) were relatively lower.

Furthermore, used insecticides acted differently on the larval population of each species. In the sense, that larval numbers as a result of spraying the chemicals indicated reflected differences in the susceptibility of the different species to them. In this regard, it was clear that *C. agamemnon* larvae were the most susceptible to tested insecticides rather than *S. cretica*.

Several authors refered to the deleterious damage of maize borers to maize plants including the works of Jepson, (1954), El- sherif (1965), Hosny and El-saadany (1970); Isa and Awadallah (1975) and Rokaia (2013).

B. Determination of multiple economic injury levels (EILs) of the maize stem borers under syudy:

B. 1. (2014) season

Assessment of crop loss is a prerequisite step for the determination of the economic injury level. In that respect the parameter of % mean loss against the mean number of larvae for each insect pest was essential to get the EILs values (larvae /10 plants).

The total control costs including insecticides price + labour differed for the different used insecticides being L.E 480, 300,440,230 and 240 for Cholorotraniliprol, Indoxacarb, Spintoram, Chloropyrephose and Azadirachtin , respectively (Table 3).

The respective efficacy of control (insect reduction) for *S. cretica* according to the formula of Henderson & Tilton (1955) was 0.81, 0.81, 0.64, 0.70 and 0.46 for the same tested insecticides, respectively.

Regression of yield loss on larval population was calculated by applaying the following formula:-

$Y= -1.53 + 1.31X$ with $r^2 = 0.810$

Therefore, the EIL values of *S. cretica* for the different tested chemicals were as follows:

- (Cholorotraniliprol) = 480/ (300*1.31*0.81) = 1.51 larva
- (Indoxacarb) = 300/ (300*1.31*0.81) = 0.93 larva
- (Spintoram) = 440/ (300*1.31*0.64) = 1.75 larva
- (Chloropyrephose) = 230/ (300*1.31*0.70) = 0.83 larva
- (Azadirachtin) = 240/(300*1.31*0.46) = 1.31 larva

Similarly, the EIL values for O. *nubilalis* were:

The obtained regression equation was:

$Y = -1.99 + 0.881 X$, $r^2 = 0.948$.

EIL values were 2.42, 1.57, 2.68, 1.38 and 1.75 larvae for Cholorotraniliprol, Indoxacarb, Spintoram, Chloropyrephose and Azadirachtin, in succession.

Likewise, for *C. agamemnon* the obtained regression equation was:

$Y= -1.80 + 3.522 X$, $r^2 = 0.898$

EIL values were 0.60, 0.39, 0.66, 0.31and 0.32 for Cholorotraniliprol, Indoxacarb, Spintoram, Chloropyrephose and Azadirachtin, in respect, (Table, 3 & Figs.1,2 and 3).

2. (2015) season

regression equation for *S. cretica* was:-

$Y= -3.70 + 1.07 X$ with $r^2 = 0.851$ and

EIL values for the different tested chemicals were 2.08, 1.40, 2.25, 1.26 and 1.87 larva for Cholorotraniliprol, Indoxacarb, Spintoram, Chloropyrephose and Azadirachtin, respectively.

For O. *nubilalis* regression equation was:-

$Y= -8.53 + 1.040 X$ with $r^2 = 0.915$

EIL values were 2.33, 1.60, 3.13, 1.57and 1.75 larva for Cholorotraniliprol, Indoxacarb, Spintoram, Chloropyrephose and Azadirachtin , respectively.

For *C. agamemnon* regression equation was:

$Y= -4.66 + 2.11 X$ with $r^2 = 0.84$ with EIL values of 1.00, 0.69, 1.48, 0.85 and 0.70 larva for Cholorotraniliprol, Indoxacarb, Spintoram, Chloropyrephose and Azadirachtin, subsequently (Table, 4 & Figs.4,5 and 6).

It is worthmentioning that EIL is an important and salient factor in initiating a proper and sound integrated pest management program (IPM) for the studied pests.

The economic injury level is not representing a permanent constant value, but it differs according locality, product price and insecticide cost. In other words it is a dynamic value.

Table 3. Multiple economic injury levels (EILs) of 3 stem borers complex in 2014 season

Insecticide (treatment)	Mean no. of larvae / plant			Mean grain yield (Ardab/Fed)	Mean yield loss (Ardab/Fed.)	Total control costs in L.E.	Efficacy of control (Reduction)			Regression equations			EIL values Larvae/10 plants		
	Sc	On	Ca				Sc	On	Ca	Sc	On	Ca	Sc	On	Ca
Cholorotraniliprol (T_1)	3.00	3.65	0.89	29.92	0	480	0.81	0.75	0.75	Y = -1.53+ 1.31 X R^2 = 0.810	Y = -1.99 + 0.881 X R^2 = 0.948	Y = -1.80+ 3.52 X R^2 = 0.898	1.51	2.42	0.60
Indoxacarb (T_2)	4.00	5.37	1.03	26.56	3.36	300	0.81	0.72	0.72				0.93	1.57	0.39
Spintoram (T_3)	5.00	9.00	2.68	22.56	7.36	440	0.64	0.62	0.64				1.75	2.68	0.66
Chloropyrephose (T_4)	6.33	12.33	3.32	21.44	8.48	230	0.70	0.63	0.70				0.83	1.38	0.31
Azadirachtin (T_5)	11.00	16.00	3.41	18.24	11.68	240	0.46	0.63	0.71				1.31	1.75	0.32

Sc :- *Sesamia cretica* led. , On:- *Ostrinia nubilalis* (Hb.) Ca:- *Chilo agamemnon* (Bles.)
Plant stand was 24000 plants/ feddan

Table 4. Multiple economic injury levels (EILs) of 3stem borers complex in 2015 season

Insecticides (treatments)	Mean no. of larvae / plant			Mean grain yield (Ardab/fed.)	Mean yield loss(Ardab/ Fed.)	Total control costs in L.E.	Efficacy of control (Reduction)			Regression equations			EIL values Larvae/ 10plants		
	Sc	On	Ca				Sc	On	Ca	Sc	On	Ca	Sc	On	Ca
Cholorotraniliprol (T_1)	4.09	7.91	1.68	23.46	0	480	0.72	0.66	0.76	Y = -3.70+ 1.07 X R^2 = 0.851	Y = -8.53 + 1.040 X R^2 = 0.915	Y = -4.66+ 2.11 X R^2 = 0.846	2.08	2.33	1.00
Indoxacarb (T_2)	4.55	8.80	2.61	23.20	0.26	300	0.67	0.60	0.69				1.40	1.60	0.69
Spintoram (T_3)	5.65	11.59	4.49	21.12	2.34	440	0.61	0.45	0.47				2.25	3.13	1.48
Chloropyrephose (T_4)	7.73	13.35	5.35	16.26	7.20	230	0.57	0.47	0.43				1.26	1.57	0.85
Azadirachtin (T_5)	12.53	17.01	5.65	14.88	8.58	240	0.40	0.44	0.54				1.87	1.75	0.70

Sc :- *Sesamia cretica* led. , On:- *Ostrinia nubilalis* (Hb.) Ca:- *Chilo agamemnon* (Bles.)
The total number of plants /feddan was calculated according to 24000 plants/ feddan

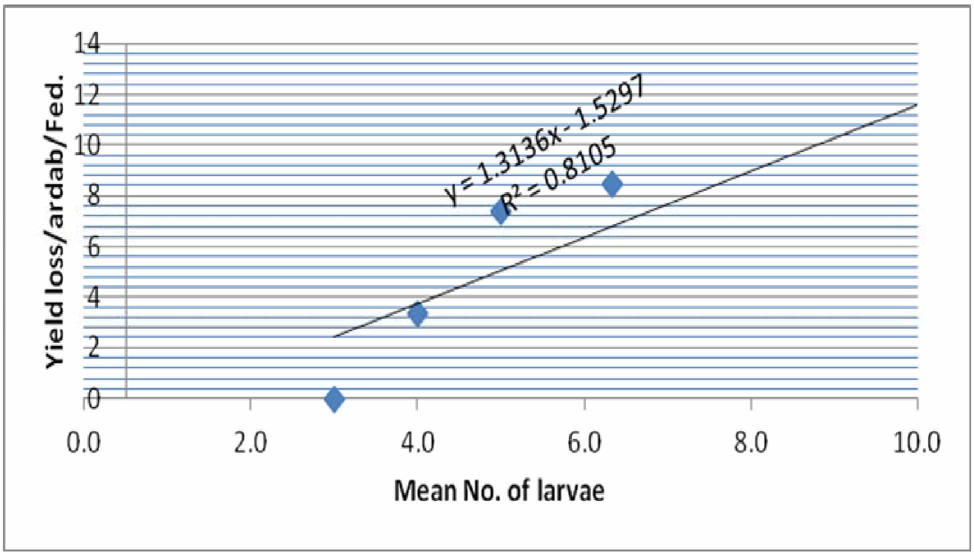

Fig.1. Regression yield loss against mean number of *S. cretica* during 2014 season

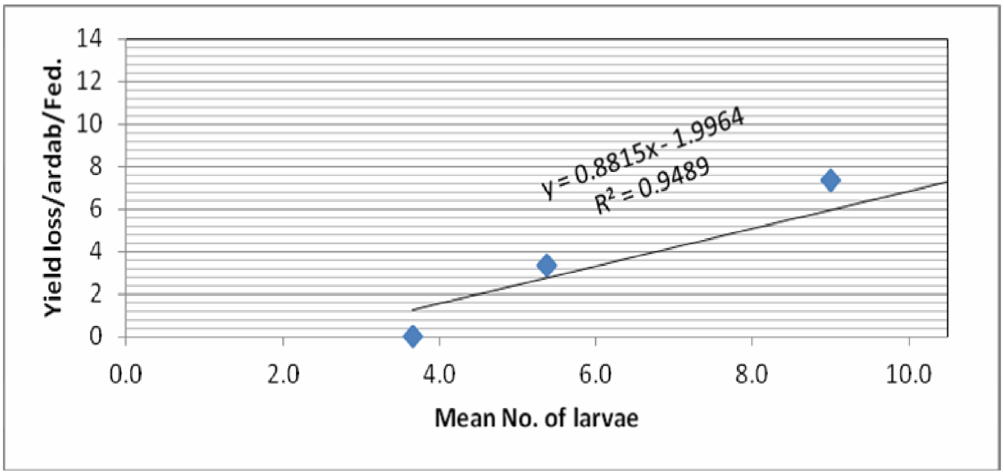

Fig.2. Regression yield loss against mean number of *O. nubilalis* during 2014 season

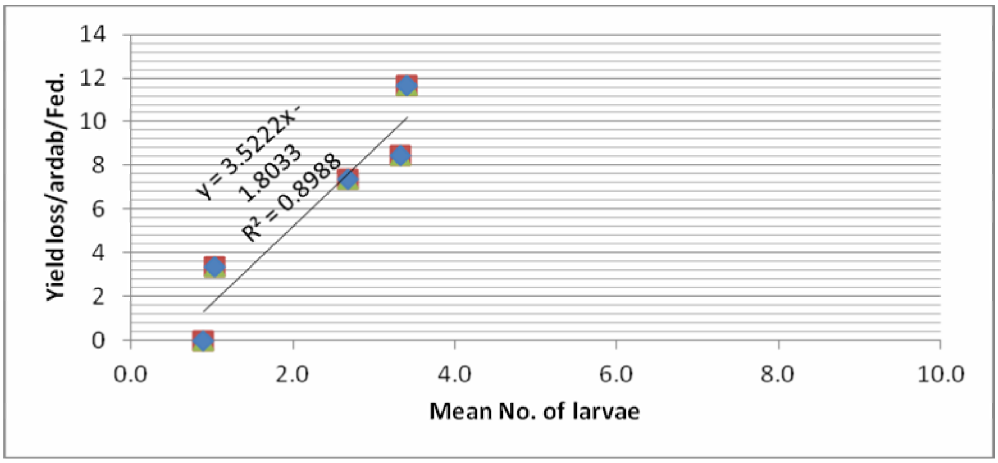

Fig.3. Regression yield loss against mean number of *C. agamemnon* during 2014 season

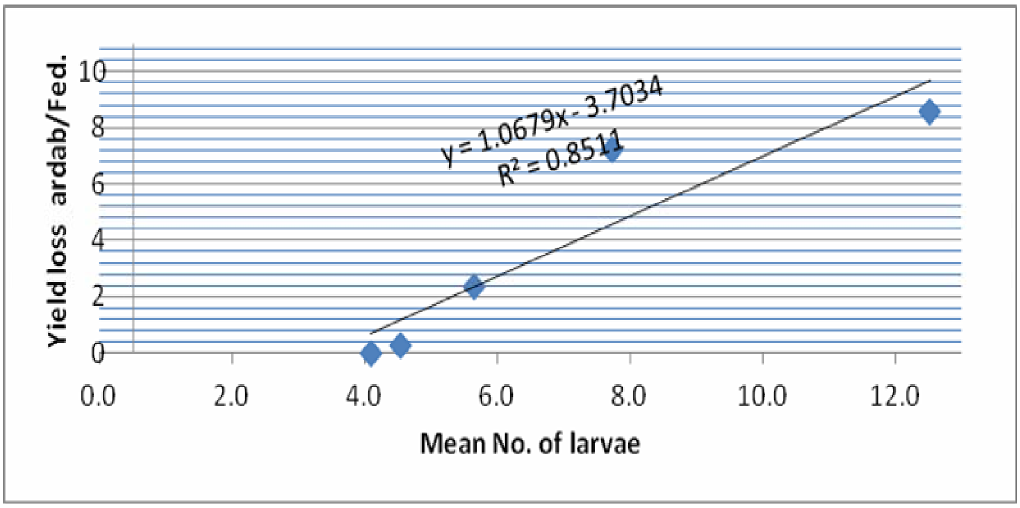

Fig.4. Regression yield loss against mean number of *S. cretica* during 2015 season

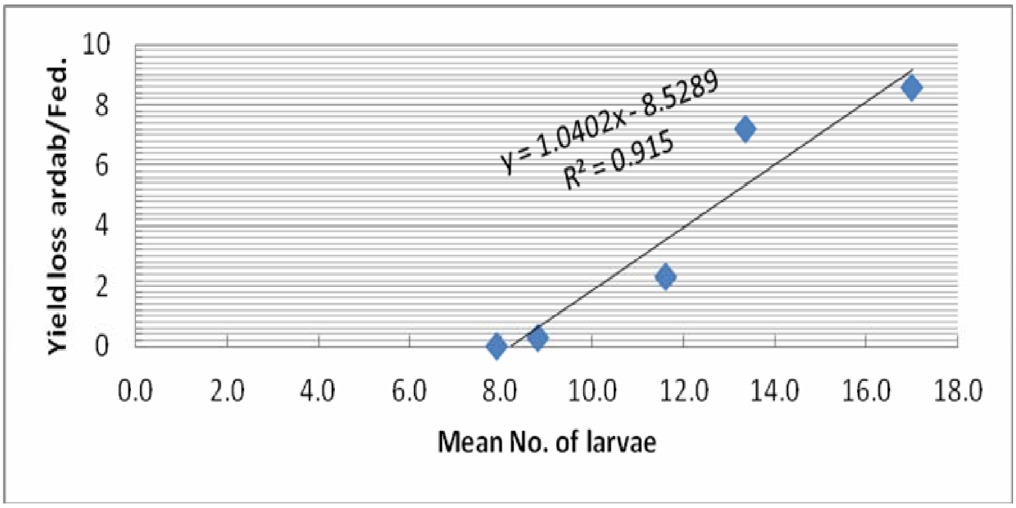

Fig.5. Regression yield loss against mean number of *O. nubilalis* during 2015 season

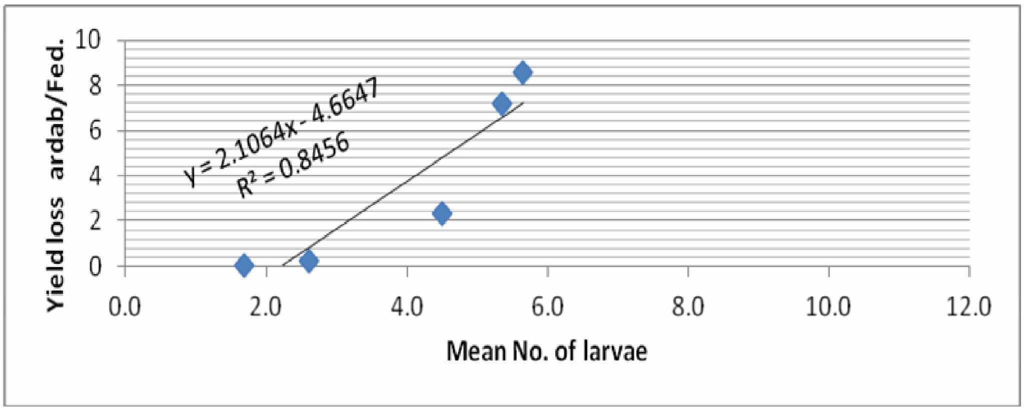

Fig.6. Regression yield loss against mean number of *C. agamemnon* during 2015 season

Perusing precisely the data included in Tables (3 &4), it has been noticed that the EILs values varied among the applied insecticides. Such variations might be due to the interaction between chemicals and corn plants, which surely affect the physiological processes and pathways of plants.

The low EIL values in this study validated the recommended schedule of spraying insecticides twice throughout the season as recommended by the Egyptian ministry of Agriculture control officers

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الملخص العربي

تقييم الفاقد في محصول الذرة لتقدير مستويات الضرر الإقتصادية نتيجة الإصابة بالثاقبات مع المكافحة بالمبيدات تحت الظروف المصرية

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يعتبر محصول الذرة ثالث أهم محاصيل الحبوب من ناحية الإقتصاد الزراعي بعد محصولى القمح والأرز على مستوى العالم حيث انه مصدرا لغذاء الإنسان والحيوان وكذلك مصدرا من مصادر انتاج الزيت والكحول والنشا.

وفي الحقيقة فإن محصول الذرة دائما أبدا يتعرض للإصابة بثاقبات الذرة وهى دودة القصب الكبيرة ودودة القصب الصغرى وحفار ساق الذرة الأوربي والتى تحفر داخل سيقان النباتات.

ولقد أجرى هذا البحث خلال الموسميين الصيفيين ٢٠١٤ و٢٠١٥ بغرض تقدير الفاقد فى محصول حبوب الذرة نتيجة للإصابة بالآفات الحشرية السابق ذكرها بواسطة إستخدام خمسة مبيدات وهى كلوروترانيليبرول (كوراجين®)، اندوكساكارب(آفانت®)، سبينتورام (رادينت®)،كلوروبيروفوس(بيربان®)وأزاداراختين(أشوك®). بالجرعات الموصى بها وكانت نتائج الفواقد فى محصول الحبوب كالتالى:- صفر،

١١,٢٣، ٢٤,٦٤، ٢٨,٣٤، ٣٩,٠٤ و٣٩,٢٥ بالنسبة للمبيدات وهى كلوروترانيليبرول(كوراجين®)، اندوكساكارب(آفانت®)، سبينتورام(رادينت®)، كلوروبيروفوس(بيربان®)،أزاداراختين(أشوك®) والكونترول على التوالى خلال موسم ٢٠١٤ أما بالنسبة للموسم التالى ٢٠١٥ كانت النتائج المحصل عليها هي صفر، ١,١٠، ٩,٩٧، ٣٠,٦٩، ٣٦,٧٥ و٥٣,٦٢ للمعاملات كلوروترانيليبرول(كوراجين®)، اندوكساكارب (آفانت®)، سبينتورام(رادينت®)، كلوروبيروفوس(بيربان®)، أزاداراختين (أشوك®) والكونترول عى الترتيب.

وبتقدير قيم مستوى الضرر الإقتصادى خلال الموسميين لحشرات ثاقبات الذرة مجتمعة أظهرت النتائج القيم التالية كلوروترانيليبرول(١,٥١)، اندوكساكارب(٠,٩٣)، سبينتورام (١,٧٥)، كلوروبيروفوس(٠,٨٣) و أزاداراختين (١,٣١) يرقة/ ١٠ نباتات بالنسبة لدودة القصب الكبيرة وبالنسبة لثاقبات ساق الذرة الاوربية كانت انتائج٢,٤٢، ١,٥٧، ٢,٦٨، ١,٣٨ و١,٧٥ لنفس المركبات على الترتيب.

وبالنسبة لدودة القصب الصغيرة كانت النتائج ٠,٦٠ ل الكلوروترانيليبرول، ٠,٣٩ اندوكساكارب، ٠,٦٦ اسبينتورام، ٠,٣١ كلوروبيرفوس و٠,٣٢ أزادراختين وذلك خلال موسم ٢٠١٤.

أما بالنسبة لموسم ٢٠١٥ فقد أظهرت المعاملات قيم مستوى الضرر الاقتصادى التالية:

٢,٠٨، ١,٤٠، ٢,٢٥، ١,٢٦ و١,٨٧ للمبيدات كلوروترانيليبرول(كوراجين®)، اندوكساكارب(آفانت®)، سبينتورام(رادينت®)، كلوروبيروفوس (بيربان®) وأزاداراختين(أشوك®) وذلك ل دودة القصب الكبيرة و١,٠٠، ٠,٦٩، ١,٤٨، ٠,٨٥ و٠,٧٠ لدودة القصب الصغرى بينما لحفار ساق الذرة الاوربية أوضحت النتائج القيم التالية ٢,٣٣ ، ١,٦٠، ٣,١٣ ، ١,٥٧ و١٧٥ للمبيدات سالفة الذكر على الترتيب.