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The relative susceptibility of certain recommended maize (*Zea maize* L.) cultivars to infestation with the Pink Stem Borer, *Sesamia cretica* Led. (Lepidoptera: Noctuidae) under natural infestation conditions at two different ecosystems in Egypt

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ABSTRACT

The Pink Stem Borer, *Sesamia cretica* Led. (Lepidoptera: Noctuidae) is a serious pest threatening maize (*Zea mays* L.) plants in Egypt. The relative susceptibility of 18 recommended maize cultivars to infestation with this pest under natural infestation condition was investigated at two different ecosystems; "Wadi El-Natroon", Beheira Governorate and "Giza" Giza Governorate throughout two successive maize growing seasons (2011& 2012). Criteria used for comparing susceptibility to infestation were the percentage of "Total Infested Plants" (% TIP), percentage of "Dead Hearts" (% DH) and "Infestation Rate" (IR) which is based on an arbitrary rating system. The percentage of "Yield Loss" (% YL) was also considered in the classification process. At Wadi El- Natroon, where a harsh agro ecosystem existed, maize plantations were subject to relatively higher insect populations than at Giza where a relatively milder agro ecosystem prevailed. The correlations between infestation criteria on one hand and % YL on the other were also determined. According to % TIP at Wadi El-Natroon region during 2011 maize growing season (where and when the highest levels of infestation were recorded) tested maize cultivars could be classified into significantly different susceptibility groups. None of the tested cultivars showed immunity or high resistance while 5 cultivars were resistant (SC101, SC 128, SC166, SC173 and TWC329), 5 were relatively resistant (SC162, SC163, SC164, SC30K9 and Cairo 1,), 4 were susceptible (SC168, SC2055, SC3062 and SC30N-11) and 4 were highly susceptible (SC125, SC167, SC2031, and SC30K8).

Keywords: *Sesamia cretica, relative susceptibility of maize cultivars to infestation, relationship between infestation criteria and yield loss.*

INTRODUCTION

Maize (*Zea mays* L.) is an important economic cereal crop. Its grain-flour is essential for making bread particularly in developing countries. Green maize plants, silage and maize grains are also a significant source for livestock fodder worldwide. Moreover, several food industries stand on processing maize grains and their byproducts. In Egypt, the area cultivated with maize in 2013 reached about 2 million feddans (feddan 4200 m^2), which produced about 7 million tons of grain yield (Anonymous, 2013). Multiple efforts are made by the Egyptian government to increase the local production of maize through both horizontal expansion in the newly reclaimed lands and vertical expansion depending on improvement of agricultural practices including – of course – breeding for pest-resistant high-yielding cultivars and disseminating them to maize growers (Saad El-Deen, 2008).

In Egypt, maize plantations are usually subject to the attacks of a variety of pests most economically important of which are a group of insects, commonly and collectively known as “Corn Borers”. A corn borer that represents a real threat to maize plantations, particularly at the early stages of plant growth, is “the Pink Stem Borer” *Sesamia cretica* Led. (Noctuidae: Lepidoptera). Infested plants often show dead-heart symptoms, tillering and severe yield losses (Ahmed and Kira, 1960). Nowadays, the cultivation of insect-resistant plants has become an acceptable strategy for the control of major insect pests. Thus, the highly qualified scientific teams working for most extension authorities, research institutes, universities and seed production companies are in hard competition to develop new maize germplasm that posses the trait of resistance to *S. cretica* in addition to as much as possible other desired traits. Painter (1951) mentioned that insect-resistant plants provide an economic and effective control method that does not require special equipment or user expertise and, in the meantime, eliminates environmental pollution.

Literature refers to few investigations on the evaluation of the commonly grown maize cultivars in Egypt with respect to their relative susceptibility to infestation with *S. cretica* under both natural and artificial infestations. In an endeavor to contribute to the knowledge in that respect, the present investigation was aimed. It concentrated, therefore, on a comparative study of the relative susceptibility of 18 maize cultivars currently recommended for distribution to Egyptian growers by ARC, MOA authorities to *S. cretica* under natural infestation conditions at two different eco systems.

MATERIALS AND METHODS

Eighteen maize cultivars were evaluated for their relative susceptibility to infestation with *S. cretica* under natural infestation conditions at 2 different ecosystems during the 2 successive maize growing seasons of 2011 and 2012. Selected study locations for both seasons were the Agricultural Experimental Farms of the Faculty of Agriculture, Cairo University at Wadi El-Natroon region, Beheira Governorate (30°30'22.6"N & 30°05'41.3"E) and Giza region, Giza Governorate (30°01'32.5"N & 31°11'33.0"E). Evaluated germplasm (cultivars) was obtained from different sources (ARC and commercial seed companies). Selected cultivars were recommended for distribution to farmers by the official authorities of the Ministry of Agriculture of Egypt (ARC).

Experimental design was exactly similar at both experimentation locations during both years of investigation. For each considered maize growing season, an area of about 1/2 feddan was divided into 108 plots, each measuring 2.8 x 3.0 meters (*i.e.* 1/500 feddan) separated by ridges and irrigation canals of suitable size. Every plot consisted of 4 rows 3 meters long and 70 cm. apart. Plots were seeded with evaluated cultivars in hills 25 cm. apart at a rate of 3 seeds / hill then thinned to 1 seedling / hill at thinning due time 3 weeks after seeding (a mean stand of 6.67 plants/ square meter, equivalent to about 28 thousand plants/ feddan). Sowing was practiced during the 2nd week of April in 2011 and the 3rd week of the same month in 2012. To assure maximum natural infestation with *S. cretica,* sowing dates were approximated to fit – as much as possible – with the time of peak prevalence of the emerging moths of the 1st. (hibernation) brood of the pest as reported in the available literature (Khalifa *et al*., 2013) as well as to coincide with the time at which maize plants reach the most preferred growth stage for infestation (the age of 30- 45 days and the extended height of 40 – 45 cm.) as mentioned by Ahmed and Kira (1960).

Tested cultivars were the single crosses 101, 125, 128, 162, 163, 164, 166, 167, 168, 173, 30k8, 30k9, 3062, 30N-11, 2031 and 2055, the 3-way cross 329 and the open-pollinated variety Cairo 1. Cultivars were randomly distributed all over the experimental areas in a Randomized Complete Blocks Design (RCBD) with 3 replicates / treatment (cultivar).

Three evaluation criteria were used for comparing the relative susceptibility of tested cultivars to infestation with *S. cretica;* “% Total Infested Plants” (% TIP), “% Dead Hearts” (% DH) and “Infestation Rate” (IR). Weekly records of these criteria were made for all plants of every tested cultivar between the 2nd. and 7th. weeks after planting (6 recording times) by applying the following formulae: % TIP = no. of infested plants / total no. of plants / plot ×100, % DH = no. of plants showing dead hearts / total no. of plants / plot ×100 and IR = (Ir1+ Ir2 +Ir3…………… + Irn) / n where: Ir = infestation rate for every individual plant, and n = total no. of examined plants.

A 5-class arbitrary visual infestation rating system, nearly similar to the rating systems suggested by Mostafa (1981) and Semeada (1985), was followed. These classes were: (IR = 0) for plants with no visible injury, (IR = 1) for plants with holes less than 0.5 mm. in diameter across the partially or fully unfolded whorl leaves, (IR = 2) for plants with several irregular relatively-wide rounded or elongated holes on the folded whorl leaves accompanied by the presence of few small yellowish-green pellets of larval frass aggregated among the whorl leaves, (IR = 3) for plants with larger rounded and /or elongated irregular holes, evident distortion and withering of most of whorl leaves and accumulation of plenty of comparatively large sized pellets of frass inside the whorl as well as scattered on the ground around the stem, and (IR = 4) for plants with infestation-characteristic dead-hearts. By the end of each field experiment, tested cultivars were classified into 5 groups as “Highly Resistant” (HR), “Resistant”

(R), "Relatively Resistant" (RR), "Susceptible" (S) and "Highly Susceptible" (HS) by applying the classification system and mathematical equations proposed by Semeada (1985).

At harvest time, a sample of 10 plants was randomly taken from every experimental plot and data on grain yield in Ardabs/feddan (adjusted to the standard of 15.5% moisture content) and % yield loss were calculated for every evaluated maize cultivar. Data were statistically analyzed as described by Gomez and Gomez (1984) using M-STAT-C computer program (Freed *et al.*, 1989). For both years of investigation, data were tested for homogeneity using F test and combined for analysis according to Steel *et al.* (1997). Means of measured traits were compared using L.S.D. at 0.05% level of probability. The correlation coefficients for the relationship between infestation assessment criteria and yield loss were calculated by the computer program SPSS 17.0.0 (2008).

RESULTS AND DISCUSSION

RESULTS

Infestation assessment

The mean percentages of total infested plants (% TIP), dead hearts (% DH) and infestation rating (IR) of S. cretica under natural infestation conditions for the 18 tested maize cultivars at Wadi El-Natroon and Giza regions during 2011 and 2012 maize growing seasons are shown in Table (1).

Table 1. Mean percentages of total infested plants (% TIP) and dead hearts (% DH) as well as infestation rate (IR) with S. cretica under natural infestation conditions at Wadi El-Natroon (Beheira Governorate) and Giza (Giza Governorate) ecosystems on tested maize cultivars during 2011 and 2012 maize growing seasons

	REGION (GOVERNORATE)											
Cultivar	Wadi El- Natroon (BEHEIRA)						Giza (GIZA)					
	% TIP		% DH		IR		% TIP		% DH		IR	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
SC101	3.6	3.8	2.4	2.4	1.0	1.8	6.4	2.1	1.7	0.7	2.6	2.2
TWC329	4.6	3.7	1.1	1.2	1.1	1.5	3.7	1.6	1.7	0.0	2.4	1.7
SC173	5.6	3.4	2.2	1.1	2.2	1.8	2.0	2.1	1.4	0.0	0.8	1.3
SC166	5.7	4.5	3.4	1.1	2.0	1.7	8.3	3.0	4.6	1.5	3.3*	2.0
SC164	6.2	6.1	3.4	2.3	1.1	3.0	3.8	2.1	1.6	0.7	3.0	1.8
SC2055	6.7	7.6	6.7	5.0	2.3	3.5	5.6	3.6	2.6	2.9	3.2	3.7
SC3062	6.8	10.8	4.5	8.5	3.3	3.5	4.9	4.4	2.3	2.9	2.6	3.4
SC128	7.1	4.0	5.9	1.4	2.3	1.5	7.1	2.8	2.9	1.4	2.9	1.7
Cairo1	10.1	7.3	5.6	3.7	3.2	2.0	4.7	3.4	3.0	2.1	2.3	2.4
SC163	11.2	6.7	3.4	4.4	1.8	2.2	4.9	3.0	2.9	0.8	2.3	1.7
SC162	11.3	3.7	5.8	4.7	2.1	3.7	5.0	3.5	3.8	2.8	0.7*	2.3
SC30K8	12.3	16.7	5.6	11.8	3.0	3.2	8.0	2.8	4.9	0.6	2.5	2.5
SC30K9	12.3	4.7	7.8	3.4	3.3	2.1	5.5	2.8	2.6	1.4	3.1	2.0
SC30N-11	12.8	5.8	8.1	4.7	2.2	3.8	8.0	3.2	1.9	1.6	2.4	2.0
SC168	14.0	8.9	5.8	3.8	1.8	2.2	2.4	2.1	1.7	1.4	1.4	3.7
SC2031	15.3	19.2	9.7	8.2	3.2	3.0	11.2	2.9	4.3	0.7	2.6	1.9
SC167	17.4	6.5	11.6	5.2	3.3	2.1	5.0	2.9	3.2	2.1	3.3	2.3
SC125	20.3	18.6	16.9	12.0	3.0	3.2	12.8	5.0	7.4	3.6	2.8	3.4
LSD 0.05	2.3	1.9	2.0	1.5	0.9	0.9	1.8	1.4	1.3	1.0	1.0	1.2

Infestation assessment parameters presented in that table brought to light the following important preliminary general observations: 1) Regardless of cultivar, infestation levels were comparatively higher at Wadi-El-Natroon than at Giza. 2) Regardless of ecosystem, infestation levels were comparatively higher during 2011 than 2012 maize growing seasons. 3) Regardless of either experimentation ecosystem or maize growing season, there were noticeable discrepancies in the ascending arrangement of the tested cultivars with respect to the different considered infestation assessment criteria. To overcome such discrepancies as far as possible, tested maize cultivars were arranged ascendingly according to % TIP at Wadi El-Natroon region during 2011 maize growing season where and when the highest levels of S. cretica infestation were almost recorded. 4) For both study ecosystems and both seasons of investigation, shading the figures representing the minima and maxima of all considered infestation assessment criteria (the top 3 and 2 bottom lines in Table 1, respectively) primarily revealed that the most resistant cultivars for S. cretica were SC101, TWC329 and SC173, and the most susceptible cultivars for it were SC2031, SC167 and SC125, while the other tested cultivars showed intermediate susceptibility levels.

% Total Infested Plants (%TIP):

For the tested maize cultivars, the means of % TIP ranged 3.6 – 20.3 and 3.4 – 19.2 in 2011 and 2012 maize growing seasons, respectively, at Wadi El-Natroon region whereas at Giza region the corresponding respective ranges were 2.0 – 12.8

and 1.6 – 5.0. On basis of mean % TIP, the relatively least susceptible cultivars in both study regions were SC101, TWC329 and SC173 while the most susceptible cultivar was SC125. The other tested cultivars ranked between these least and most susceptible cultivars.

% Dead Hearts (%DH):

At Wadi El-Natroon region, the means of % DH ranged 1.1 – 16.9 and 1.1 – 12.0 in 2011 and 2012 maize growing seasons, respectively, whereas at Giza region the corresponding respective ranges were 1.4 – 7.4 and 0.0 – 3.6. On basis of mean % DH, the least susceptible cultivar in both study regions was TWC329 and the most susceptible cultivar was SC125. The other tested cultivars ranked between the least and most susceptible cultivars.

Infestation Rate (IR):

At Wadi El-Natroon region, the means of IR ranged 1.0 – 3.3 and 1.5 – 3.8 in 2011 and 2012 maize growing seasons, respectively,. At Giza region, the corresponding respective ranges of IR were 0.7 – 3.3 and 1.3 – 3.7. On basis of mean IR, the least susceptible cultivars in both study regions were SC101, TWC329 and SC173. On the same basis, the most susceptible cultivars were SC3062, SC167 and SC30N-11 at Wadi El-Natroon region (IR = 3.3 – 3.8) and SC166, SC167 and SC168 at Giza region (IR = 3.3 – 3.7) whereas the other tested cultivars recorded intermediate IR values.

Classification of cultivars according to susceptibility to infestation

Due to the noticeable discrepancy in the data on % TIP, % DH and IR as criteria for comparing the 18 tested maize cultivars with respect to their susceptibility to infestation with S. cretica under natural infestation conditions (Table 1) it was felt advisable to squeeze down such large amount of data in a more or less compressed form to facilitate handling it and- subsequently- achieve more reliable conclusions and recommendations. The first step in that direction was classifying tested cultivars according % TIP only, taking into consideration % DH and IR values as aids for the explanation of results. For further data squeeze, the collective grand mean of % TIP in the two seasons of investigation was worked out for every tested maize cultivar at each experimentation region. Classification of tested cultivars depended on calculating a theoretical grand mean value of per cent infested plants (GM % IP) for all tested cultivars, then comparing the grand mean % TIP for every specific cultivar to it after applying the formerly referred to formulae and classification system developed by Semeada (1985). Such calculations revealed the four susceptibility classification groups shown in Table (2).

Table 2. Classification of tested maize cultivars into groups of susceptibility to infestation with S. cretica* under natural infestation conditions at Wadi El-Natroon (Beheira Governorate) and Giza (Giza Governorate) ecosystems according to grand means of % TIP in 2011 and 2012 maize growing seasons

Susceptibility group	Cultivar	R E G I O N Wadi El-Natroon (Beheira Governorate) 2-years grand mean %TIP	Degree of susceptibility	Giza (Giza Governorate) 2-years grand mean %TIP	Degree of susceptibility
Highly resistant to resistant (HR/R)	SC101	3.7	R	4.3	RR
	SC173	4.5	R	2.1	R
	TWC329	4.2	R	2.6	R
Resistant to relatively resistant (R/RR)	SC164	6.1	RR	3.0	RR
	SC162	7.5	RR	4.3	RR
	SC30K9	8.5	RR	4.2	RR
	Cairo 1	8.7	RR	4.1	RR
	SC163	8.9	RR	4.0	RR
Relatively resistant to susceptible (RR/S)	SC166	5.1	RR	5.7	S
	SC128	5.5	RR	4.9	S
	SC2055	7.1	RR	4.6	S
	SC3062	8.8	RR	4.6	S
	SC167	12.0	S	3.9	RR
	SC168	11.4	S	2.2	R
Susceptible to highly susceptible (S/HS)	SC30N-11	9.3	S	5.6	S
	SC30K8	14.5	HS	5.4	S
	SC2031	17.3	HS	7.1	HS
	SC125	19.4	HS	8.9	HS

* Based on the formulae and classification system described by Semeada (1985).
HR: Highly resistant, R: resistant, RR: relatively resistant, S: susceptible, HS: highly susceptible

The latter table indicated that none of the tested maize cultivars was immune or highly resistant to S. cretica infestation. However, SC101, SC173 and TWC329 cultivars showed a noticeable degree of resistance to the pest at both regions of investigation (% TIP = 2.1 - 4.5). Five cultivars appeared as relatively resistant namely: SC164, SC162, SC30K9, Cairo 1 and

SC163 (with % TIP 3.0 – 8.9). Another group of 6 cultivars ranked between relative resistance and susceptibility without showing a consistent susceptibility trend. At Wadi El-Natroon region, SC166, SC128, SC2055 and SC3062 cultivars were relatively resistant (% TIP = 5.1 – 8.8) while SC167 and SC168 cultivars were susceptible (% TIP = 11.4 – 12.0). At Giza region, on the other hand, the opposite occurred where SC166, SC128, SC2055 and SC3062 cultivars turned to susceptible (% TIP = 4.6 – 5.7) while SC167 and SC168 cultivars changed to relatively resistant (% TIP = 3.9) and resistant (% TIP = 2.2), respectively. Such discrepancy of susceptibility classification within this particular group of maize cultivars might be attributed to inherent variations in the response of cultivars to both pest's natural populations and prevailing environmental conditions at two different ecosystems throughout two different maize growing seasons. At both study ecosystems, the cultivar SC30N-11 appeared as consistently susceptible (% TIP = 5.6 – 9.3) while both SC2031 and SC125 were found to be consistently highly susceptible (% TIP = 7.1 – 17.3 and 8.9 – 19.4, respectively). Only one cultivar (SC30K8) ranked as susceptible at Giza region (% TIP = 5.4) whereas it ranked as highly susceptible at Wadi El-Natroon region (% TIP = 14.5).

Nowadays, it is a well-established principle that, in nature, varietal differences in the degree of susceptibility or resistance of a certain plant species to infestation with a particular insect pest depend considerably on the existing field populations of that pest. Therefore, when comparing plant cultivars with respect to their relative susceptibility and / or resistance to insect attacks higher field populations of insects often lead to more accurate results. Taking this principle into consideration, the current classification of the 18 tested maize cultivars was founded on the 2-years grand-means of GM % TIP at Wadi El-Natroon region only being the experimentation site that suffered the highest infestation level with S. cretica. Tested cultivars could be classified into the following groups and arranged ascendingly according to % TIP as follows:

Immune to highly resistant cultivars :None.

Resistant cultivars: SC101 % (TIP = 3.7) < TWC329 (% TIP = 4.2) < SC173 (% TIP = 4.5).

Relatively resistant cultivars: SC166 (% TIP =5.1) < SC128 (% TIP =5.5) < SC164 (% TIP = 6.1) < SC2055 (% TIP = 7.1) < SC162 (% TIP=7.5) < SC30K9 (% TIP= 8.5) < Cairo 1 (% TIP = 8.7) < SC3062 (% TIP = 8.8) < SC163 (% TIP = 8.9).

Susceptible cultivars: SC30N-11 (% TIP = 9.3) < SC168 (% TIP = 11.4) < SC167 (% TIP = 12.0).

Highly susceptible cultivars: SC30K8 (% TIP = 14.5) < SC2031 (% TIP = 17.3) < SC125 (% TIP = 19.4).

A glance to Table (2) , which shows that at Wadi El-Natroon region throughout 2011 maize growing season (the location and season with the highest natural infestation level with S. cretica), statistical analysis revealed a LSD value of 2.4 at 0.05 probability level for the differences between the 18 tested maize cultivars in % TIP means. Based on that value, tested cultivars could be classified into 5 statistically different groups of susceptibility to infestation with S. cretica. Group A included 4 cultivars that represented the level of resistance [R] to the insect pest under investigation (SC101, TWC329, SC173 and SC166, with % TIP = 3.6 – 5.7). Group B included another 4 cultivars that represented the level of relative resistance [RR] (SC164, SC2055, SC3062 and SC128, with % TIP = 6.2 -7.1). Group C included 5 cultivars that oscillated between relative resistance and susceptibility [RR/S] (Cairo 1, SC163, SC162, SC30K8 and SC30K9, with % TIP = 10.1 – 12.3). Group D included 2 cultivars that represented the susceptibility [S] level (SC30N11 and SC168, with % TIP = 12.8 – 14.0). Group E included 3 cultivars that belonged to two significantly different sub –groups representing the level of high susceptibility [HS] (SC2031, SC167 and SC125, with % TIP = 15.3 – 20.3).

Relationship between infestation and yield loss

Table (3) shows the means of corrected grain yield and percentages of yield loss (% YL) due to S. cretica infestation for the 18 tested maize cultivars at both Wadi El- Natroon and Giza regions throughout 2011 and 2012 maize growing seasons.

At Wadi El- Natroon, % YL varied from a minimum of 2.2 % to a maximum of 18.0% whereas, at Giza, the corresponding respective % YL figures were 1.0% and 11.5%. Such percentages confirm the previously mentioned observation that at Wadi El- Natroon region maize plantations were subject to relatively higher levels of infestation with S. cretica than Giza plantations. Nevertheless, statistical analyses indicated that while the differences between all tested cultivars with respect to % YL were insignificant at both Wadi-El-Natroon in 2011 and Giza in 2012 maize growing seasons they were, on the other hand, significant at 0.05 probability level at Wadi El-Natroon in 2012 and Giza in 2011.Therefore, it was sought rather practical to consider the percentages of yield loss at Wadi El-Ntroon region only in 2012 only (significant % YL and relatively greater cultivar % YL values) as basis for classifying tested maize cultivars into significantly different groups. Two cultivars (SC125 and SC30K8) suffered the highest % YL (16.3 – 17.5%) and a single cultivar (SC2031) suffered a moderate yield loss of 14.7%. In the meantime, the remaining 15 tested cultivars were insignificantly different from each other from the statistical point of view and belonged to a group that suffered relatively low percentages of yield loss. The latter group included 4 cultivars with <3 % YL (TWC329, SC173, and SC127 and SC101), 3 cultivars with 3 - <5 % YL (SC166, SC30K9 and SC163), 5 cultivars with 5 - <7 % YL (SC30N-11, SC162, SC163, SC167 and SC2055) and 3 cultivars with 7 – <10 % YL (SC168, Cairo 1 and SC3062).

Table 3. Means of corrected grain yield and percentages of yield loss (% YL) for tested maize cultivars under natural infestation with S. cretica at Wadi El-Natroon (Beheira Governorate) and Giza (Giza Governorate) ecosystems during 2011 and 2012 maize growing seasons

Cultivar	REGION (GOVERNORATE)							
	Wadi El- Natroon (BEHEIRA)				Giza (GIZA)			
	Corrected grain yield*		Yield loss (%YL)		Corrected grain yield*		yield loss (%YL)	
	2011	2012	2011	2012	2011	2012	2011	2012
SC101	15.5	14.2	3.3	2.8	26.4	29.4	4.0	1.6
TWC329	23.8	14.0	3.7	2.2	25.2	21.8	4.0	1.0
SC173	19.5	14.7	4.7	2.5	20.3	22.6	1.9	1.0
SC166	16.1	15.1	5.1	3.4	17.7	26.0	6.6	2.5
SC164	20.2	11.7	5.6	4.5	19.7	26.7	3.8	1.6
SC2055	17.8	14.8	6.7	6.9	26.9	24.9	3.8	3.5
SC3062	19.0	16.1	6.3	10.0	20.3	21.8	4.0	3.8
SC128	24.7	19.4	6.5	2.7	24.8	23.3	6.4	2.1
Cairo1	21.1	13.0	12.3	8.6	15.9	16.5	6.4	3.1
SC163	17.6	12.7	9.0	5.8	22.4	25.4	4.4	2.1
SC162	15.9	14.9	10.2	5.6	15.9	19.8	4.9	3.3
SC30K8	19.4	16.1	10.4	17.5	17.6	20.5	7.6	1.9
SC30K9	12.9	12.7	9.8	4.4	24.2	25.9	5.0	2.3
SC30N-11	16.9	11.0	11.6	5.5	26.6	19.4	6.2	2.6
SC168	24.8	14.1	10.4	7.3	15.7	26.4	2.9	4.0
SC2031	11.4	14.9	13.6	14.7	27.8	24.9	8.9	2.1
SC167	15.8	13.8	16.0	6.5	14.4	23.2	4.5	2.7
SC125	19.3	16.5	18.0	16.3	21.6	23.7	11.5	4.5
LSD 0.05	3.0	2.3	ns	8.1	1.9	1.9	4.7	ns

*Ardabs / feddan.

DISCUSSION

Agro ecosystem influenced the prevalence of S. cretica infestations at the two study regions. At Wadi El- Natroon which is a relatively harsh desert ecosystem, maize plantations were subject to relatively higher levels of infestation with the insect pest under investigation (% TIP = 3.6 – 20.3) than at Giza, which is a mild agro ecosystem (% TIP = 1.6 – 12.8) . Integration of data in Tables (1 and 2) led to the general conclusion that among the 18 tested maize cultivars none of them was “immune” or “highly resistant” to S. cretica infestation while 5 cultivars appeared as “resistant” to it and other 4 cultivars appeared as “highly susceptible”. Between the resistant and highly susceptible cultivars ranked a group of 9 cultivars that varied from “relatively resistant” to “susceptible” to S .cretica infestation. Resistant cultivars were SC101, SC 128, SC166, SC173 and TWC329, and highly susceptible cultivars were SC125, SC167, SC2031, and SC30K8. Five cultivars with relative resistance were determined namely: SC162, SC163, SC164, SC30K9 and Cairo 1, and 4 other cultivars were rated as susceptible namely: SC168, SC2055, SC3062 and SC30N-11.

At both study regions, % TIP, % DH and IR assessment criteria (as independent variates) tended to be obviously related to % YL (as a dependent variate). To statistically explore such tendency, the simple correlation coefficients for the relationships between each of % TIP, % DH and IR and the corresponding % YL were calculated and results were summarized in Table (4).

Table 4. Simple correlation coefficients (r) for the relationship between three assessment criteria of infestation with S. cretica and yield loss under natural infestation conditions at two different eco systems in 2011 and 2012 maize growing seasons

RELATIONSHIP	REGION			
	Wadi El-Natroon (Beheira Governorate)		Giza (Giza Governorate)	
	2011	2012	2011	2012
% TIP / % YL	0.97**	0.96**	0.93**	0.77**
% DH / % YL	0.90**	0.95**	0.88**	0.90**
IR / % YL	0.66**	0.54*	0.33	0.86**

n = 18 DF= (n-1) = 17

At both study regions and for both study maize growing seasons, a highly significant positive relationship existed between either % TIP or % DH on one hand and %YL on the other hand. As for IR value, the positive relationship to % YL still existed at Wadi El-Natroon being highly significant in 2011 and significant in 2012. At Giza, the relationship between IR value and % YL remained positive in both 2011 and 2012 maize growing seasons but insignificant throughout the former season and highly significant throughout the latter one.

As a matter of fact, knowledge on the magnitude of association between plant characters and susceptibility to insect infestations is quite helpful in the process of simultaneous selection for more than one desired plant character (Odiyi, 2007). Literature refers that, in Egypt, % TIP, % DH and IR were frequently regarded as main criteria for the assessment of S. cretica infestations in maize plantations under both natural and artificial conditions (Mostafa, 1981; Semeada, 1985; El-Sherif and Mostafa, 1987; El-Khishen, 2006; El-Hosary et al. 2012 and Khalifa et al., 2013). Several other authors pointed out the need for the sustainability of evaluating the relative susceptibility of the currently-used and / or eventually newly-developed maize germplasm to S. cretica infestation before distributing it to growers. At any rate, the current study, which simultaneously took into consideration several infestation assessment criteria (% TIP, % DH, IR & %YL), verified tested maize cultivars into significantly different groups of susceptibility to infestation with S. cretica (Table 2). In the light of such verification, farmers might be advised to grow the resistant or relatively resistant maize cultivars and avoid the susceptible or highly susceptible ones. However, the above-mentioned conclusion should be taken very cautiously until ascertained by further tests conducted under artificial infestation conditions.

REFERENCES

Ahmed MKA and Kira MT.(1960. Studies on corn borers and their control (in Arabic). Tech. Bull., Egyptian Agricultural Authority. Cairo, Egypt, 44 *pp*.

Anonymous. 2013. Statistics yearbook. Central Agency for Public Mobilization and Statistics, Egypt,

EL-Hosary AA, EL-Badawy M, Saafan TAE and Ismail MRM. 2012. Genetic analysis of agronomic characters and resistance to borers for genotypes in corn. 13th International Conf. Agron., Fac. Agic., Benha Univ., Egypt, 35-48.

El-Khishen AA. 2006. Breeding for corn borers resistance in maize. Ph. D. Thesis, Fac. Agric., Cairo Univ., Egypt, 153 *pp*.

El-Sherif SI and Mostafa FF. 1987. Susceptibility of maize germplasm to infestation with the greater sugarcane borer *Sesamia cretica* Led. (Lepidoptera: Noctuidae). 10. Evaluation of the commercial cultivars Giza 2, D.C. 202 and D.C. 204. (in Arabic) Arab J. Pl. Prot., 5: 8-13. 1.

Freed R, Einensmith SP, Gutez S, Reicosky D, Smail VW and Wolberg P. 1989. Guide to MSTAT-C analysis of agronomic research experiments. Michigan Univ. East Lansing, U.S.A.

Gomez KA and Gomez AA. 1984. Statistical Procedures for Agricultural Research. 2nd ed., New York: John Wiley and Sons, Inc., 108-116 *pp*.

Khalifa KI, Abdallah TAE and Elrawy AME. 2013. Resistance to the pink stem borer in twenty exotic maize populations under natural and artificial infestation conditions. J. of Agric. Sci., 5(8): 117-124.

Mostafa FF. 1981. Biological and ecological studies on the pink borer *Sesamia cretica* Led. (Lepidoptera: Noctuidae). Ph. D. Thesis, Fac. Agric., Cairo Univ., Egypt, 360 *pp*.

Odiyi AC. 2007. Relationships between stem borer resistance traits and grain yield reduction in maize: correlations, path analysis and correlated response to selection, Nigeria. Agric. J., 2(2): 337-342.

Painter RH. 1951. Insect resistance in crop plants. University of Kansas Press, Lawrence, KS, 520 *pp*.

Saad El-Deen EH. 2008. Effect of some maize genotypes on growth and reproduction of *Sesamia cretica* Led. under natural and artificial infestation conditions. M. Sc. Thesis, Fac. Agric., Cairo Univ., Egypt, 112 *pp*.

Semeada AM. 1985. Relative susceptibility of certain maize germplasm to infestation with greater sugar-cane borer *Sesamia cretica* Led. (Lepidoptera: Noctuidae). M. Sc. Thesis, Fac. Agric., Cairo Univ., Egypt, 82 *pp*.

SPSS Statistics 17.0.0. 2008. SPSS for Windows. SPSS Inc.

Steel RGD, Torrie JH and Dickey DA. 1997. Principles and procedures of statistics: A biometrical approach. McGraw Hill Book International Co., New York.