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Ecological Studies of Certain Piercing-Sucking Insects Infesting Squash Plants and Relation with Their Chemical Constituents

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ABSTRACT

The homopterous insects are considered polyphagous pests on some cucurbitaceous crops. The objective of aim study was to survey the aphids, leafhoppers and whitefly insect species infesting certain varieties of squash plants i.e.(hybrid Otto, hybrid Daphne and hybrid Aziad) and also to study the seasonal abundance of the dominant species as well as to evaluate the effect of different varieties and their chemical constituents on the population density of the aforementioned homopterous insects during the studying period. The present experiments were carried out at the experimental farm belonging to the faculty of agriculture , zagazig university during 2016 and2017 seasons. The least susceptible variety of squash was Aziad hybrid variety, while the highest susceptible variety was Daphne hybrid variety and the certain chemical constituents in all tested varieties were associated with the insects infestation. The resistance variety should be used as an effective factor in integrated pest management programs which played an important role in depressing the population of the tested insects.

INTRODUCTION

Squash (*Cucurbita pepo* L.) is one of the important cucurbitaceous vegetable crops which used as human food in many counties of the world, which infested by a lot of insect pests throughout the growing seasons. Homopterous insects i.e.(Aphid insects, Leafhopper insects and Whitefly insect) which caused extensive damage not only by sucking plant juice but also by transmission of phytopathogenic (Feres and Moreno , 2009;Abd-El-Kariem *et al.*, 2015 ;Al- Saleh *et al.*, 2015 and Garzon *et al.*,2016). Cucurbit crops are preferable for these pests which decreased its yield. Therefore, This work was designed to assess the relationships between plant varieties, their chemical constituents and the rates of infestation with the aforementioned homopterous insects. So the resistant squash variety is essential components of integrated pest management (IPM) for different insects pests.

MATERIALS AND METHODS

This investigation was conducted at the experimental farm belonging to the faculty of agriculture , zagazig university during the two successive seasons 2016 and 2017.The different varieties of squash were hybrid Otto, hybrid Daphne and

hybrid Aziad. An area was about 600 m² which divided into nine replicates. Each variety was sown in three replicates. The experimental design used was completely randomized blocks. The varieties were sown in the second week of May for each season. All recommended agriculture practices were applied during the growing season without insecticides applications. Samples started after sowing dates one month for each season to evaluate the effect of different varieties on the population density of the main homopterous insect pests.

The following two methods of sampling were used:

Plant Samples:

Weekly samples of twenty leaves from each replicate were taken randomly until the end of each growing season. The collected leaves were transferred to the laboratory into plastic bags for identification and counting the number of individuals of aphids and whitefly species.

The Sweeping Net:

Sweeping was conducted weekly and each sample had consisted of 50 double strokes. These samples were taken by walking diagonally across the experimental area. Caught insect species were transferred to plastic sacs containing pieces of cotton saturated with ether for anesthetizing the collected insects. The plastic sacs were well tied by rubber bands and taken to the laboratory for inspection and identification according to the work of Nielson (1968) and Hegab *et al.*, (1989).

The relationship between different squash varieties and the population density of the aforementioned homopterous insects were statistically analyzed. Daily records of both means of temperature along with relative humidity were obtained from the Meteorological Central Laboratory of Agriculture Climate, Agriculture Research Center during the period of this investigation. To estimate the effect of each factor on the population density of these insects, the values of Correlation coefficient (r) and total explained variances (E.V%) values were calculated.

Chemical analyses of different varieties of the aforementioned cucurbitaceous plants were carried out in the Central Laboratory, Faculty of Agriculture, Zagazig University. leaves were taken at random from each replicate at the start of flowering-stage of different squash plant varieties in the second to determine the total protein and carbohydrate contents according to (Bremner and Mulvaney 1982 and Dubois *et al.*, 1956) and estimated pH values in the plants sap by using pH meter according to the method of AOAC(1970).

Statistical analysis

All data were analyzed by using LSD 5% and 1 % according to COSTAT(2005) computer program.

RESULTS AND DISCUSSION

1-Survey of the main piercing-sucking insect pests infesting squash Plants

Data in Table(1), showed that the total numbers and percentages of the main homopterous insect pests attacking squash plants during the two successive seasons 2016 and 2017. The tomato whitefly, *Bemisia tabaci* (Genn.) was recorded the highest numbers and percentages during the two seasons 2016 and 2017 and presented by 11632 (41.391%) and 13889 (41.55%), respectively. El-Nagger *et al.*, (2014), who mentioned that the whitefly, *B. tabaci* is one of the serious pests of squash cultivations. On the other hand, the cotton aphid, *Aphis gossypii* (Glov.) came in the second rank and presented by 7317 (26.04%) and represented by 8690 (26.00%), successively. These results agree with Webb (2007), recorded that the

onion aphid, *A. gossypii*, and the green peach aphid, *Myzus persicae* (Sulzer) are the dominant aphid insect species on squash plants. Mohamad (2011), found that the rates of infestation in squash plants with *A. gossypii* were highly during the investigation period. Meanwhile, the leafhopper insects exhibited the lowest numbers and percentages during the two investigated seasons. These results are also in agreement with the findings of Abou-El-Saad (2015) and El-Mesawy (2018), mentioned that the squash plants attracted the highest number of the whitefly, *B. tabaci* followed by the cotton aphid, *A. gossypii* and *Empoasca* spp.

Table1. Total numbers and percentages of the main homopterous insect species infesting some different squash plant varieties at Ghazala Farm, Sharkia governorate during 2016 and 2017 seasons

seasons	Insects species	Total numbers and percentages of insect pests on Squash varieties						General total	General percentage %
		V1		V2		V3			
		No.	%	No.	%	No.	%		
2016	<i>A. gossypii</i>	2969	26.84	2433	25.78	1915	25.18	7317	26.04
	<i>M. persicae</i>	2298	20.78	1867	19.78	1398	18.38	5563	19.79
	<i>E. decipiens</i>	407	3.68	376	3.98	278	3.66	1061	3.78
	<i>E. decedens</i>	611	5.52	521	5.52	452	5.94	1584	5.64
	<i>C. chinai</i>	190	1.72	167	1.77	141	1.85	498	1.77
	<i>B. hortensis</i>	169	1.53	149	1.58	133	1.75	449	1.59
	<i>B. tabaci</i> (Ad. and Ny.)	4417	39.93	3926	41.59	3287	43.23	11632	41.39
Total	11061	100.00	9439	100.00	7604	100.00	28104	100.00	
2017	<i>A. gossypii</i>	3503	26.77	2873	25.33	2314	25.46	8690	26.00
	<i>M. persicae</i>	2773	21.19	2363	21.00	1684	18.53	6820	20.40
	<i>E. decipiens</i>	458	3.50	403	3.58	313	3.44	1174	3.51
	<i>E. decedens</i>	693	5.30	598	5.31	483	5.32	1774	5.31
	<i>C. chinai</i>	210	1.61	192	1.71	167	1.84	569	1.70
	<i>B. hortensis</i>	191	1.46	171	1.52	149	1.64	511	1.53
	<i>B. tabaci</i> (Ad. and Ny.)	5256	40.17	4654	41.35	3979	43.78	13889	41.55
Total	13.084	100.00	11.254	100.00	9.089	100.00	33.427	100.00	

V₁= hybrid Daphne.

V₂= hybrid Otto.

V₃= hybrid Aziad.

Ad.=Adult.

Ny.= Nymphs.

No.= Number

2- The Seasonal Activity of the Dominant Homopterous Insect Pests:

The seasonal abundance studies of the dominant homopterous insect pests concerned on the Daphne squash plant variety because it sown commonly in Sharkia Governorate.

Aphid Insects:

Data in Figs. (1 and 2), illustrated that the population density of Aphid insects, *A. gossypii* and *M. persicae* had one peak. The peak occurred on the fourth week of July with a total numbers of 758 and 879 individuals (for *A. gossypii*) and 590 and 689 individual insects (for *M. persicae*) at means of 29.30°C and 28.75°C with 66.00% and 68.30% R.H. for 2016 and 2017 seasons, respectively. Similar results were obtained by El-Mesawy (2018), in Egypt, who indicated that the aphid, *A. gossypii* had one peak on squash plants.

The Leafhopper Insects:

The seasonal abundance of *Empoasca decipiens* (Paoli) and *Empoasca decedens* (Paoli) on squash plants were represented in Figs. (1 and 2) during the two studying seasons. One peak was observed on the second week of August with the total numbers of 128 and 133 insects (for *E. decipiens*) and 152 and 165 insects (for *E. decedens*) at means of 26.40 °C and 27.50 °C with 63.10% and 66.00% R.H. for

the two seasons, successively.

The Whitefly Insect Species:

The data in Figs. (1 and 2) cleared that there were two peaks of the total weekly numbers of *B.tabaci* (adult and nymph stages) during 2016 and 2017 seasons. The first one was happened during the third week of July and represented by 949 and 1078 individuals at 27.9°C and 28.00°C with 67.11% and 69.00% R.H. for the experimental seasons, respectively. The second peak occurred during the first week of August with total numbers of 847 and 951 insects at means of temperature 28.10°C and 28.50°C with 65.60% and 67.00% R.H. during the two studying seasons, accordingly. These results partially agree with the findings of Kamel *et al.*, (2000), who indicated that the peak of whitefly, *B. tabaci* occurred during the third week of July on some cucurbitaceous vegetable plants under field conditions. Pan *et al.*, (2015), evaluated the ecological information for *B.tabaci* and concluded that the population density increased in early autumn compared with in spring season.

As a conclusion, the total numbers of the aforementioned tested insects in the second season were greater than that recorded in the first one, this may be due to the moderate values of temperatures and the highest values of the relative humidity.

3- Effect of Means Temperature and Relative Humidity on the Population

Density of Some Dominant Piercing-Sucking Insect Pests:

The values of correlation coefficients between the population density of tested insects and means temperature and relative humidity were recorded in Table(2) during the studying seasons. The correlation coefficients between population density of *A.gossypii* and *M. persicae* and means of relative humidity were positively significant ($r = 0.559^*$ and $r = 0.568^*$, respectively) only in the second season of study. Also, the relative humidity had a positive significant effect with *B.tabaci* in the first and second seasons ($r = 0.378^*$ and $r = 0.598^*$, successively). While, the correlation coefficients between means of temperature and the total numbers of insects were not significant in both seasons of study.

The explained variance values indicated that the total effect of the two above mentioned weather factors on the population activity of aphids, leafhoppers and whitefly insect species were greater in the second season than in the first one. These results agree with the findings of Hegab (2017), who indicated that the temperature and humidity had effects on the insects population density under study on certain cucurbitaceous plants.

4-Effect of Different Varieties of Squash Plants on the Main Homopterous

Insects Infestation and the Yield Quantity:

The susceptibility of certain varieties of squash plants to some homopterous insects infestation was studied under field conditions at the farm belonging to the faculty of agriculture, Zagazig University during the two successive seasons of 2016 and 2017.

Data in Table (3), showed that the Daphne hybrid variety was the most susceptible for the aphid species. The mean numbers were 76.128, 89.821 individuals /sample for *A. gossypii* and 58.923, 71.103 individuals /sample for *M. persicae* during the two experimental seasons, respectively. While the lowest population of aphid species infestation was recorded on Aziad hybrid variety (49.103, 59.333 individuals /sample for *A. gossypii* and 35.846, 43.179 individuals /sample for *M. persicae*) for 2016 and 2017 seasons, successively.

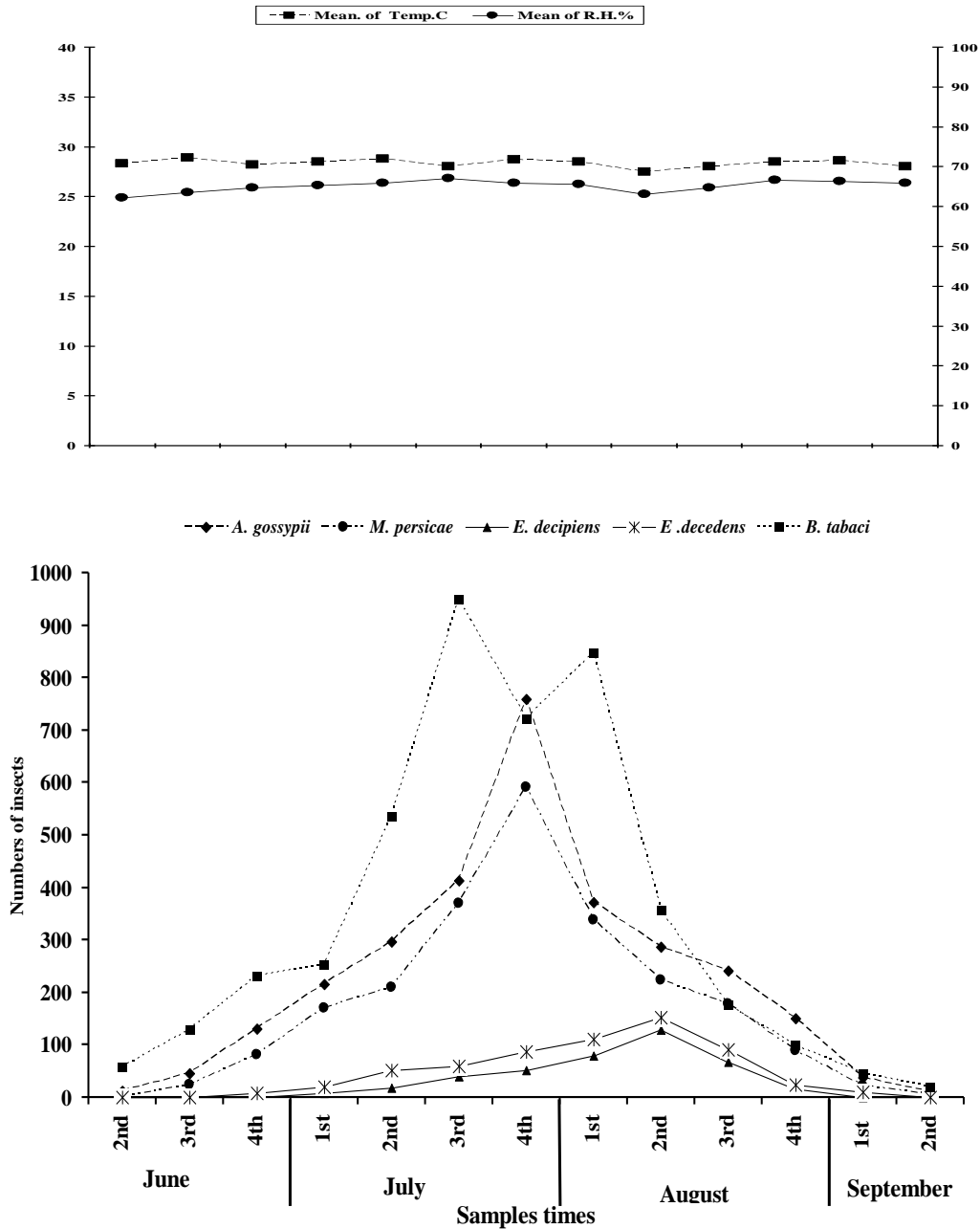


Fig.(1) Seasonal abundance of aphids *A.gossypii* (Glov.), *M. persicae* (Sulzer) , leafhoppers *Empoasca decipiens* (Paoli), *E.decedens* (Paoli) and whitefly *Bemisia tabaci* (Genn.) infesting squash plants at Ghazala district, Sharkia Governorate , Egypt during 2016 season.

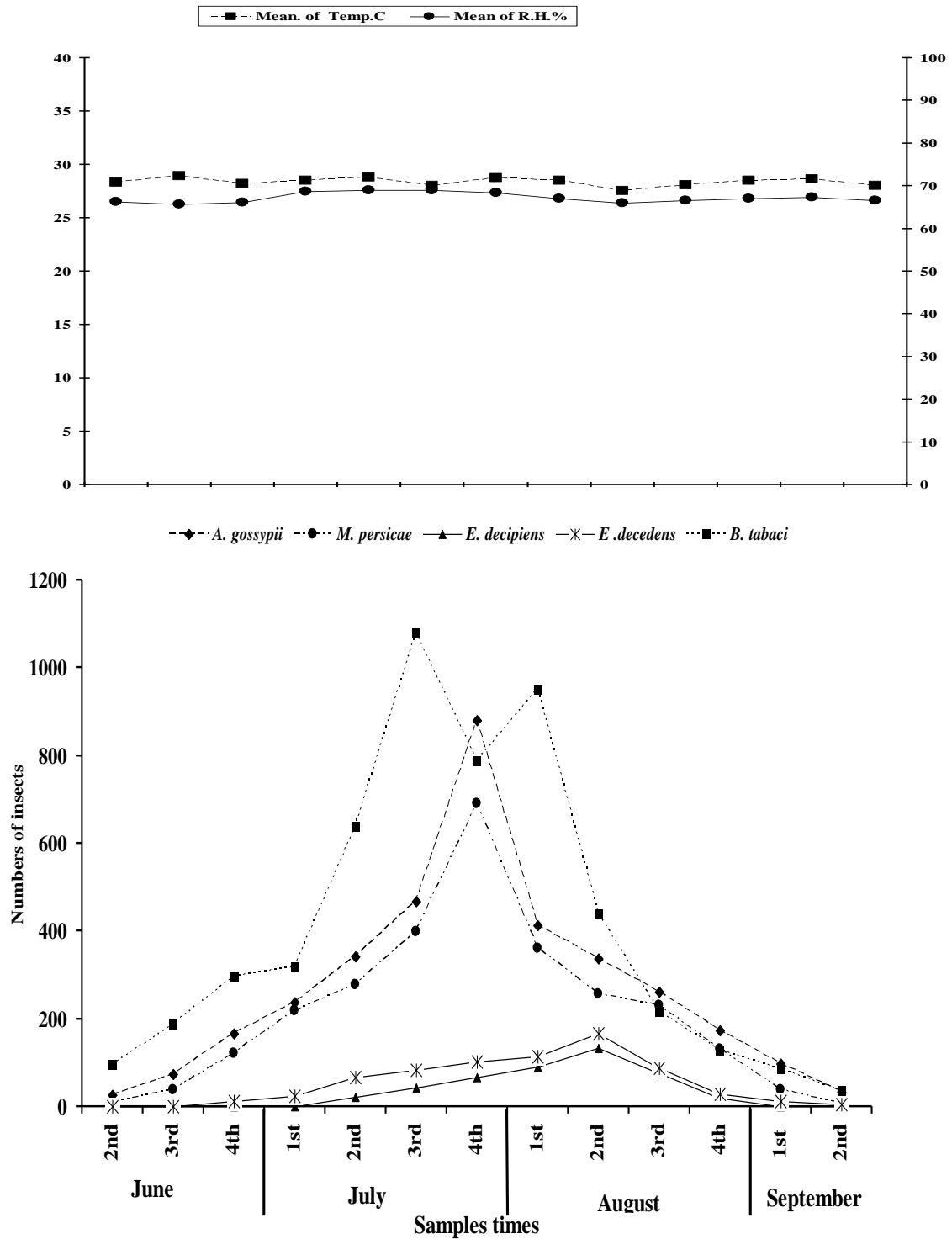


Fig.(2) Seasonal abundance of aphids *A.gossypii* (Glov.), *M. persicae* (Sulzer) , leafhoppers *Empoasca decipiens* (Paoli), *E.decedens* (Paoli) and whitefly *Bemisia tabaci* (Genn.) infesting squash plants at Ghazala district, Sharkia Governorate , Egypt during 2017 season.

As shown in Table (3), the significant differences could be noticed between three varieties of squash plants and the infestation of the leafhopper insects, *E. decipiens* and *E. decedens*. The most susceptible variety was Daphne hybrid variety followed by Otto, whereas Aziad hybrid variety was the least susceptible to infestation.

As seen in Table (3), The highest population whitefly, *B. tabaci* was observed on Daphne hybrid variety with mean numbers of 113.256 and 134.769 individuals /sample for both seasons, respectively. On the other hand, the least population was recorded on Aziad hybrid variety (84.282 and 102.026 individual insects/sample) during 2016 and 2017 seasons, accordingly.

Table 2. Simple correlation coefficients (r) and explained variance (EV%) between each of means temperatures, means relative humidity as well the total numbers of certain piercing-sucking insects infesting squash plants at Ghazala Farm, Sharkia Governorate during 2016 and 2017 seasons

Insect species	Simple correlation coefficients				Explained Variance (%)	
	2016		2017		2016	2017
	r ₁	r ₂	r ₁	r ₂	R ²	R ²
<i>A. gossypii</i>	0.322	0.335	0.105	0.559*	14	32
<i>M. persicae</i>	0.319	0.351	0.051	0.568*	15	34
<i>E. decipiens</i>	-0.334	-0.157	-0.482	-0.530	11	24
<i>E. decedens</i>	-0.280	-0.490	-0.410	-0.174	8	27
<i>B. tabaci</i>	0.209	0.378*	0.025	0.598*	15	39

r₁ = Simple correlation coefficients between means of temperatures and the total numbers of insects .

r₂ = Simple correlation coefficients between means of relative humidity and the total numbers of insects .

E.V. (%) = Explained variance. * = significant at 0.05 level of probability.

Table 3. Mean numbers of aphids, *A.gossypii* , *M. persicae* , leafhoppers, *E. decipiens* , *E .decedens* and whitefly insect *B. tabaci* infesting different varieties of squash plants at Ghazal Farm, Sharkia Governorate during 2016 and 2017 seasons

Varieties	Mean numbers of insects / sample											
	Aphid insects				Leafhopper insects				Whitefly insect <i>B. tabaci</i> (Ad. and Ny.)		Mean of yield kg/plot	
	<i>A.gossypii</i>		<i>M.persicae</i>		<i>E. decipiens</i>		<i>E. decedens</i>		2016	2017	2016	2017
	2016	2017	2016	2017	2016	2017	2016	2017				
V1	76.128	89.821	58.923	71.103	10.346	11.744	15.666	17.769	113.256	134.769	39.83	36.33
V2	62.385	73.666	47.872	60.590	9.641	10.333	13.359	15.333	100.666	119.333	46.66	44.66
V3	49.103	59.333	35.846	43.179	7.128	8.026	11.590	12.385	84.282	102.026	64.33	59.33
L.S.D 0.05	4.012**	3.865**	3.410**	3.260**	2.226*	2.686*	2.997*	3.205*	4.935**	8.687**	12.51**	9.58**

** = Highly significant at 0.01 level of probability.

* = significant at 0.05 level of probability .

V₁ = hybrid Daphne.

V₂ = hybrid Otto.

V₃ = hybrid Aziad

Ny. = Nymphs.

Ad. = Adult.

Concerning the effect of squash varieties on the quantity of yields, data in Table(3), showed that Aziad hybrid variety yielded the highest mean of yield 64.33 and 59.33 kg/ plot in 2016 and 2017 seasons, respectively. While the Daphne hybrid variety yielded the lowest mean of yield (39.83 kg /plot in 2016 season and 36.33 kg/ plot in 2017 season). The Otto hybrid variety yielded the moderate quantity of yield .

The obtained results were statistically analyzed and revealed that the differences between the mean numbers of leafhopper insects and the different varieties of squash plants were significantly , but it was highly significant with the other tested insects during the studying period.

Concerning , it could be noticed that the whitefly, *B. tabaci* and aphid insects, *A. gossypii* recorded the highest numbers of the test insect species followed by *M. persicae* and finally the leafhopper insects during the successive seasons 2016 and 2017.

Finally, it could be concluded that Aziad hybrid variety was less susceptible to aforementioned homopterous insects and produced the highest quantity of yield. Meanwhile, Daphne hybrid variety recorded the highest mean numbers of tested insects and produced the least quantity of yield. The moderate favourable variety to infestation with all tested insects was Otto hybrid variety during the two studying seasons ,successively.

These results are similar with those obtained by Hegab-ola and Hegab (2009), El-Naggar *et al.*,(2014) and El-Mesawy (2018) ,who indicated that there are significantly differences between the average numbers of aphids and whitefly, *B.tabaci* and the different cucurbit crops.

5-Effect of Some Chemical Constituents of Certain Squash Plant Varieties and Their Relation with the Population Density of Certain Piercing–Sucking Insect Pests

The chemical contents of squash plant leaves were chemically analyzed and the results obtained are recorded in Table(4).

Total Protein , Carbohydrate Rates and pH Values :

The effect of protein and pH values were highly significant in squash plants during the second season. While the carbohydrate values in all tested varieties on the population density of all tested insects are significantly.

As a conclusion , the highest rates of infestation with aphids, leafhoppers and whitefly, *B. tabaci* were related with the greatest levels of protein and carbohydrate values and the smallest levels of pH values in sap plants.

Table 4. Effect of certain chemical constituents of certain squash plant varieties on the population density of the main homopterous insects pests during 2017 season.

varieties	Total protein (%)	Total Carbohydrate (%)	pH	Mean number of aphids		Mean number of leafhoppers		Mean number of whitefly <i>B. tabaci</i>
				<i>A.gossypii</i>	<i>M. persicae</i>	<i>E. decipiens</i>	<i>E. decedens</i>	
V ₁	28.06	33.66	6.01	89.821	71.103	11.744	17.769	134.769
V ₂	27.20	31.00	6.85	73.666	60.590	10.333	15.333	119.333
V ₃	26.30	28.33	6.94	59.333	43.179	8.026	12.385	102.026
L.S.D 0.05	0.613 **	3.395 *	0.314**	3.865**	3.260**	2.686*	3.205*	8.687**

** = Highly significant at 0.01 level of probability.

* = significant at 0.05 level of probability .

V₁= hybrid Daphne. V₂= hybrid Otto. V₃= hybrid Aziad

Similar results were conducted by Saleh and Al-Shareef (2010), who mentioned that the infestation with whitefly, *B.tabaci* was correlated with the amino acids and pH values in some vegetable plants. Hegab(2017) and Bayoumy *et al.*(2017), revealed that the cotton aphid, *A. gossypii* was positively correlated with the higher ratios of total protein ,carbohydrates and nitrogen of squash leaves

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ARABIC SUMMERY

دراسات ايكولوجية على بعض الحشرات الثاقبة الماصة التي تصيب نباتات الكوسة وعلاقتها بمكوناتها الكيميائية

محمد على مرسى حجاب

قسم وقاية النبات- كلية الزراعة - جامعة الزقازيق - الزقازيق - مصر

تعتبر الحشرات متشابهة الإجنحة من الآفات متعددة التغذية على بعض المحاصيل القرعية. هدفت خطة الدراسة إلى حصر بعض أنواع حشرات المن ، نطاطات الاوراق والذبابة البيضاء التي تصيب بعض أصناف نباتات الكوسة مثل (صنف هجين اوتو، صنف هجين دافني وصنف هجين ازياد) وأيضا دراسة الوفرة الموسمية للأنواع السائدة من تلك الحشرات وذلك لتقييم تأثير الاصناف المختلفة ومكوناتها الكيميائية على كثافة المجموع للحشرات متشابهة الأجنحة سابقة الذكر أثناء فترة الدراسة. تم إجراء التجربة في مزرعة كلية الزراعة - جامعة الزقازيق خلال موسمين 2016 و2017 م . كانت اقل الاصناف حساسية للإصابة هو صنف هجين ازياد بينما اكثر الاصناف حساسية هو صنف هجين دافني ، كما ارتبطت بعض المكونات الكيميائية في الأصناف المختلفة مع الإصابة الحشرية . لذلك ينصح بإستخدام الصنف المقاوم كمعامل مؤثر في برامج المكافحة المتكاملة للآفات حيث يلعب دور هام في خفض تعداد تلك الحشرات المختبرة.