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SUSCEPTIBILITY OF SOME SOLANACEOUS PLANT CULTIVARS TO SAP-SUCKING INSECTS INFESTATION AND THEIR ASSOCIATED NATURAL ENEMIES

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ABSTRACT

Susceptibility of six cultivars belonging to three Solanaceous plant species; Pepper (California wonder and Hyb Morad), Eggplant (Hyb Snow f1 and Black Shanta f1) and Potato (Santana and Hermis) was evaluated to infestation with common aphids, whiteflies, leafhoppers and thrips species and their associated predators throughout two early summer seasons, 2012 and 2013. Results showed significant differences between different plant species/cultivars and population density of these insects and also with their associated predators. Photosynthetic pigments (Chlorophyll a, Chlorophyll b and Carotenoids) analysis showed negative relationship with sap sucking insects infestation. Also different leaf biochemical components such as total phenol, total soluble sugars and total free amino acids revealed negative relationship with sap sucking insects infestation, while total flavonoids analysis showed insignificant differences. These results could be concluded the importance of cultivar selection in any integrated pest management program as well as the effective role of different plant biochemical components on plant resistance against insect pests

Keywords: Solanaceous plants; Sap sucking insects; Susceptibility; Predators; Photosynthetic pigments; biochemical components.

INTRODUCTION

The Solanaceae, or nightshades, are an economically important family of flowering plants. The family ranges from annual and perennial herbs to vines, lianas, epiphytes, shrubs, and trees, and includes a number of important agricultural crops, medicinal plants, spices, weeds, and ornamentals (Olmstead *et al*. 1999). The Solanaceae consists of about 98 genera and some 2,700 species, with a great diversity of habitats, morphology and ecology (Olmstead and Bohs, 2007). The family has a worldwide distribution, being present on all continents except Antarctica. The greatest diversity in species is found in South America and Central America. The Solanaceae include a number of commonly collected or cultivated species. The most economically important genus of the family is *Solanum*, which contains the potato (*S. tuberosum*, in fact, another common name of the family is the "potato family"), the tomato (*S. lycopersicum*), and the eggplant or aubergine (*S. melongena*). Another important genus, *Capsicum*, produces both chili peppers and bell peppers (FAO 2007). Sap sucking insects found to infest solanaceous vegetables such as aphids, whiteflies, leafhoppers and thrips (Parker *et al*., 1995; Mound 1996 and CABI 2007). These insects sucking the plant sap and also inject toxic saliva into the plant tissues, which leads to yellowing as well as secreting large quantities of honeydew, which favors the growth of sooty mould on leaf surfaces and reduces the photosynthetic efficiency of the plants as well as some of these insects species have the ability to plant viruses transmitting (Heng-Moss *et al*., 2004 and Khattab, 2007)

Host plant resistance to pests is ubiquitous but there exists a great deal of variation in the levels expressed by plants. The level of resistance will obviously depend on the specific morphological and biochemical defences utilized by the plant, but ultimately the expression and stability of the resistance characters depend on the plant genotype, the pest genotype and the genetic interactions between the plant and the pest (Gallun & Khush, 1980; Han *et al*., 1991 and Nosser, 1996, Xu *et al*., 2002)

The present work aims at determining the effect of different Solanaceous plant species and cultivars leaf chemical components on the susceptibility to sap sucking insects infestation.

MATERIALS & METHODS

Experimental Area and Design:

An area of about 1200 m^2 at Qaha region, Qalyubiya Governorate was chosen to carry out this investigation throughout two successive early summer seasons; 2012 and 2013. six cultivars were cultivated, represent three Solanaceous plants; Pepper cultivars (California wonder and Hyb Morad), Eggplant cultivars (Hyb Snow f1 and Black Shanta f1) and Potato cultivars (Santana and Hermis). Randomized blocks design with three replicates (Each replicate was 7 * 8 m^2) was used in the both successive seasons. Plantation dates were in mid April and seedlings transplantation in the end April in the two successive seasons. All the usual agricultural practices were applied and the whole experimental chemical control measures were entirely avoided during the two studied seasons.

Sampling Procedure:

Sampling started one week after seedlings transportation and continued weekly until the end of each plant species season throughout the both seasons. Different sap sucking insects were counted directly on thirty leaves of each cultivar (10 leaves * 3 replicates). Some specimens were mounted permanently for insect species identification that was carried out using available identification keys.

Biochemical analysis

To determine the effect of photosynthetic pigments and biochemical components on population density of different sap sucking insects, ten leaves of each tested cultivar were picked out during sap sucking insects population density main peak during the second season.

Photosynthetic pigments Determination:

Chlorophyll a, chlorophyll b and total carotenoids were extracted from one gram of longitudinal sections of fresh leaves in 85% acetone and measured spectro-photometrically according to (Metzner *et al*. 1965) and their levels were calculated according to the formula of (Lichtenthaler 1987).

Total Soluble Sugars Determination:

Total soluble sugars were extracted according to the methods described by (Naguib 1963) and determined using anthrone reagent (Fairbairn, 1953).

Free Amino Acid Determination:

Free amino acids were extracted according to the method of (Vartanain *et al*. 1992) and estimated using ninhydrin (Yemm and Cocking, 1955).

Total Phenol Determination:

Total phenols of fresh leaves were extracted and estimated according to (Malik and Singh 1980).

Total Flavonoids Determination:

The total flavonoids were measured according to (Bushra *et al.* 2009).

Statistical analysis:

Statistical analysis was conducted using (SAS program 1997). 'GLM' procedure was used to evaluate the differences significance among cultivars and means were separated using Duncan's multiple range test (Duncan, 1955) to arrange the tested cultivars in groups according to their susceptibility to different sap sucking insects infestation as well as to their associated predators. Also correlation coefficient (r) was estimated to determine the effect of each cultivar leaf chemical components on different sap sucking insects infestation.

RESULTS & DISCUSSION

Survey of Different Sap Sucking Pests and their Associated Predators:

Six sap sucking insect species (*Aphis gossypii* (Glover), *Mysus persicae* (Siilz), *Bemisia tabaci* (Genn.), *Empoasca decipiens* (Paoli), *Empoasca decdens* (Paoli) and *Thrips tabaci* (Lindeman) were found as common pests on the tested six cultivars. Also The most common observed predators found associated with the pests were "Eleven-spot Lady" *Coccinella undecimpunctata* (Linnaeus), "Seven-spot Lady" *Coccinella septempunctata* (Linnaeus), "Thirteen-spot Lady" *Hippodamia tredecimpunctata* (Linnaeus), *Chrysopa vulgaris* and *Orius* sp. throughout two successive early summer seasons, 2012 and 2013 at the experimental area , Qaha region, Qalyubiya Governorate.

Host Plants and Cultivars Susceptibility to Different Sap Sucking Insects:

Statistical analysis showed highly significant differences among the three host plants and different sap sucking pests infestation throughout the two successive seasons, 2012 and 2013 (F= 11.32 and 9 for the two successive seasons, respectively). These pests recorded the highest seasonal mean numbers on Eggplant plants throughout the two successive seasons (92.14 & 123.9 individuals/leaf) followed by Potato plants (55.1 & 68 individuals/leaf) then Pepper plants (34.8 & 43.7 individuals/leaf). Tables, 1 &2 and Figs., 1, 2, 3 & 4.

Aphids species:

The present study investigated that there are two aphid species; *Aphis gossypii* (Glover) and *Mysus persicae* (Siilz) were found to be common aphids on the three host plants; Pepper, eggplant and potato. Mean numbers of *A. gossypii* population density were more abundant than those recorded of

M. persicae in the both successive seasons (t values= 1.82 & 1.76) . Also seasonal mean numbers of population density of these aphids in 2013 season were higher than those recorded on 2012 season, whereas seasonal mean numbers of population density in the first season were 55 and 16.4 individuals/leaf for *A. gossypii* and *M. persicae*, respectively. Also in the second season, seasonal mean numbers of population density were 77.3 and 22.3 individuals/ leaf for *A. gossypii* and *M. persicae*, respectively. (Fujiie *et al*., 2008), reported that the major aphids in Syria as potato pests were considered to be *M. persicae* and *A. gossypii*, and *A. fabae*. (Hegab *et al.* 2014) recorded the same two species on pepper and egg plant. (El-Khawas & El-Khawas, 2008 and Mousa, 2003), mentioned that *Aphis gossypii* was the only recorded aphid species attacking eggplant.

***Aphis gossypii* (Glover):**

As shown in Tables, 1 &2 and Figs., 1, 2, 3 & 4., it appears highly significant differences between the infestation of *A.gossypii* on the three host plants throughout the both successive seasons (F=2.22 and 2.4 during the two seasons). Mean numbers of this insect pest were recorded highly abundant on eggplant (28 and 40.8 individual/leaf for 2012 and 2013 seasons, respectively), followed by pepper plant (23.5 and 32.2 individual/leaf for the two successive seasons). While this pest on potato plants recorded the lowest seasonal mean numbers of population density (3.56 and 4.3 individual/ leaf for the two successive seasons). Also statistical analysis revealed significant differences of this insect pest infestation on different pepper and eggplant cultivars while showed insignificant differences on the studied potato cultivars throughout the two successive seasons. Pepper California wonder cultivar was more susceptible to *A. gossypii* infestation than Hyb Morad cultivar with seasonal mean numbers, 14.4 and 9.1 individual/ leaf for the two cultivars in 2012 season and with seasonal mean numbers, 18.7 and 13.5 individual/ plant for the two cultivars in 2013 season. Also Eggplant Hyb Snow f1 was more susceptible to *A. gossypii* infestation than Black Shanta f1 cultivar with seasonal mean numbers, 19.4 and 8.6 individual/ leaf for the two cultivars in 2012 season and with seasonal mean numbers, 27.1 and 13.7 individual/leaf for the two cultivars in 2013 season. These results are in agreement with those obtained by (Hegab *et al*. 2014).

***Mysus persicae* (Siilz):**

Data analysis revealed that there are insignificant differences among *M. persicae* infestations on three host plants (F = 0.55 and 0.39 for the both seasons, respectively). Also insignificant differences detected among *M. persicae* infestation and different tested plant cultivars throughout the two successive seasons. Tables, 1 &2 and Figs., 1, 2, 3 & 4.

***Bemisia tabaci* (Genn.):**

Statistical analysis revealed highly significant differences between infestation on three hosts during two seasons where F values= 3.4 and 2.9 for the both seasons, respectively. Mean numbers of *B. tabaci* population density showed highly abundance on potato plants followed by eggplant, while the abundance of this pest on pepper plants recorded the lowest density during the two seasons. Mean numbers of *B. tabaci* population density were 9.7, 8.3, 2.6 and 21, 10.8, 3.07 individual/leaf on potato, eggplant and pepper during two successive seasons, respectively., Tables, 1 &2 and Figs., 1, 2, 3 & 4. These results are confirmed by (Lee *et al*. 2012). Also statistical analysis revealed significant differences between *B. tabaci* infestation on the two tested potato cultivars throughout the two successive seasons (F= 2.13& 7.15) whereas potato Santana cultivar was more susceptible than Hermis cultivar throughout the two seasons with seasonal mean numbers of 6.5 and 3.2 nymphs/ leaf on Santana and Hermis cultivars, respectively in the first season, while seasonal mean numbers in the second season were 13.14 and 7.9 nymphs/leaf on Santana and Hermis potato cultivars, respectively. Insignificant differences detected between *B. tabaci* infestation on neither pepper nor eggplant cultivars during the two seasons. (Amna *et al.* 2014) stated that population of whitefly was the most severity compared with other pests attacking pepper plant, but population of aphid was moderately severity and population of spider mites was less severity.

Leafhoppers species:

There are two leafhoppers species are observed as common on the three host plants; these species are *Empoasca decipiens* (Paoli) and *Empoasca decedens* (Paoli). Statistical analysis showed highly significant differences between mean numbers of the two species on studied plants where *E. decipiens* was more abundant than *E. decedens* throughout the two successive seasons .Seasonal mean numbers of *E. decipiens* were 47.8 and 61.2 individuals/plant for the two seasons, respectively. While seasonal mean numbers of *E. decedens* were 14.2 and 19.2 individuals/plant for the two seasons, respectively. Insignificant differences detected among the both leafhopper species mean numbers and different plant cultivars. These results are supported with (Ebadah, 2002 and Der, *et al*. 2003) who stated that *Empoasca decipiens* infested pepper plant with highly abundant. Tables, 1 &2 and Figs., 1, 2, 3 & 4.

***Empoasca decipiens* (Paoli):**

As shown in Tables (1 and 2) and Figs. (1, 2, 3 & 4), statistical analysis indicated highly significant differences between the infestation of *E. decipiens* on three host plants, where F values were 14.18 and 14.6 during the two seasons. Data revealed that the highest population density was observed on eggplant followed by potato plant, while the lowest density was recorded on pepper plant on the two seasons. Mean numbers of *E. decipiens* on eggplant, potato and pepper were (32.6, 13.14, 2.14 and 42.3, 15.8, 3.1 individuals/laef) during the two seasons, respectively.

***Empoasca decedens* (Paoli):**

Statistical analysis showed highly significant differences between this pest on the three evaluated host pants (F values = 9.6 and 11.5 during the two seasons). As shown in figs. (1, 2, 3 & 4), the highest recorded abundance was occurred on eggplant followed by potato and then pepper plant with mean numbers of 8.7, 4.8, 0.7and 12, 5.14, 0.6 individuals/ leaf on eggplant, potato and pepper during the two seasons, respectively. (Hegab *et al*. 2014) recorded four leafhopper species on pepper plants; *Empoasca decipiens,* *Empoasca decedens, B. hortensis* and *C. chinae.* The most abundant were *Empoasca decipien* and *Empoasca decedens.*

***Thrips tabaci* (Lindeman):**

Data in Tables (1 & 2) and figs. (1, 2, 3 & 4) showed the differences between *Thrips tabaci* infestations on the three host pants. Statistical analysis revealed that there are significant differences among this pest infestation on the three host plants (F = 6.2and 3.08 during two seasons). The highest population density of *T. tabaci* was recorded on eggplant followed by potato plants then pepper plant with seasonal mean numbers of 14.7, 8.14, 0.6 and 17.7, 10, 0.65 individuals/leaf for the three plants during two seasons, respectively. (Alam *et al*., 2003) found that the major pests include eggplant shoot borer, leafhopper, whitefly, thrips, aphid, , stem borer, blister beetle, red spider mite.

Predators Associated with sap sucking insects:

The most common observed predators found to be associated with these sap sucking pests infesting the three Solanaceous plants were "Eleven-spot Lady" *Coccinella undecimpunctata* Linnaeus, "Seven-spot Lady" *Coccinella septempunctata* (Linnaeus), "Thirteen-spot Lady" *Hippodamia tredecimpunctata* (Linnaeus), *Chrysopa vulgaris* and *Orius* sp. (Table, 3 & 4) (Fig., 5 & 6). Statistical analysis showed highly significant differences between the population densities of total predators throughout the two successive seasons (F values= 17 and 10.9 for the two seasons, respectively). The highest seasonal mean numbers of predator's density was recorded on eggplant cultivars throughout the two successive seasons.

Table (1): Seasonal mean numbers of six sap sucking pests per leaf counted on three Solanaceous plants at Qalyubiya governorate during 2012 season.

Plant	Cultivar	Mean No. of insects						Total mean number
		A. gossypii	*M. persicae*	*B. tabaci*	*E. decipiens*	*E. decedens*	*T. tabaci*	
Pepper	California wonder	14.4 [a]	2.21 [a]	1.85 [a]	1.07 [a]	0.28 [a]	0.35 [a]	20.19
	Hyb Morad	9.1 [b]	2.07 [a]	0.78 [a]	1.07 [a]	0.42 [a]	0.28 [a]	14.59
	Total	23.5	4.28	3.8	2.14	1.6	0.63	34.8
Eggplant	Hyb snow f1	19.4 [a]	2.64 [a]	6.14 [a]	15.0 [a]	4.21 [a]	8.57 [a]	50.74
	Black shantaf1	8.6 [b]	1.07 [a]	2.21 [a]	17.64 [a]	4.50 [a]	6.14 [a]	41.40
	Total	28.0	4.01	8.35	32.6	8.71	14.81	92.14
Potato	Santana	2.14 [a]	4 [a]	6.5 [a]	6.50 [a]	2.50 [a]	5.57 [a]	30.50
	Hermis	1.42 [a]	4.21 [a]	3.2 [b]	6.57 [a]	2.35 [a]	2.57 [a]	24.60
	Total	3.56	8.21	9.7	13.14	4.85	8.14	55.1

F value among different plant species and sap sacking insects infestation= 11.32***
Means within the same columns in each cultivar carrying different litters are insignificant at (P ≤0.05)

Table (2): Seasonal mean numbers of six sap sucking pests per leaf counted on three Solanaceous plants at Qalyubiya governorate during 2013 season

Plant	Cultivar	Mean No. of insects						Total mean number
		A. Gossypii	*M. persicae*	*B. tabaci*	*E. decipiens*	*E. decedens*	*T. tabaci*	
Pepper	California wonder	18.7 [a]	3.7 [a]	1.8 [a]	1.3 [a]	0.28 [a]	0.35 [a]	23.5
	Orli improfed f1	13.5 [b]	2.7 [a]	1.2 [a]	1.8 [a]	0.35 [a]	0.3 [a]	20.2
	Total	32.2	6.4	3.0	3.1	0.63	0.65	43.7
Eggplant	Hyb snow f1	27.1 [a]	3.3 [a]	7.7 [a]	18.6 [a]	6.14 [a]	10.8 [a]	68.4
	Black shantaf1	13.7 [b]	1.6 [a]	3.1 [a]	23.7 [a]	6.35 [a]	6.9 [a]	55.5
	Total	40.8	4.9	10.8	42.3	12.49	17.7	123.9
Potato	Santana	2.7 [a]	5.5 [a]	13.1 [a]	8.4 [a]	3.00 [a]	6.6 [a]	37.8
	Hermis	1.6 [a]	5.5 [a]	7.9 [b]	7.4 [a]	3.14 [a]	3.35 [a]	30.2
	Total	4.3	11.0	21.0	15.8	6.14	9.95	68.0

F value among different plant species and sap sacking insects infestation= 9***
Means within the same columns in each cultivar carrying different litters are insignificant at (P ≤0.05)

Also there were highly significant differences among the different five recorded predators throughout the two seasons (F= 14.09 & 12.7), where *C. undecimpunctata* was the most dominant predator species during the two successive seasons with seasonal mean numbers 34.8 and 42.74 adults/plant for the two seasons, respectively followed by *Ch. vulgaris* with seasonal mean numbers 14.5 and 17.4 adults/plant for the two seasons, respectively followed by *C. septempunctata* with seasonal mean numbers 11.5 and 13.4 adults/plant for the two seasons, respectively, then *H. tredecimpunctata* with seasonal mean numbers 7.4 and 10.8 adults/plant for the two seasons, respectively, while *Orius* sp. was recorded in few mean numbers 0.8 and 1.3 adults/plant for the two seasons, respectively. (Table, 3 & 4) (Fig., 5 & 6).

This type of predators abundance may be due to the association between the predator and its prey abundance whereas different sap sucking pests were found in highly abundant on eggplant cultivars throughout the two successive seasons. These results are in agreement with those obtained by (Dicke *et al*., 2003; Sabelis *et al*., 2005 and Arimura *et al*., 2009) who reported that many arthropod Predators and parasitoids are known to use volatiles from plants infested with their prey/hosts while foraging. (Amaral *et al*., 2013) stated that coccinellids were the most abundant aphidophagous predator in chili pepper fields in Brazil, coccinellids were more abundant when aphids were present. Also Dixon, 2000 and Soares *et al*. 2003 cited that Aphidophagous ladybird beetles are important predators of aphids in agricultural crops, and have been receiving attention as biological control agents due to some of their characteristics, such as: ability to feed on a wide range of prey As well as (Alvarado *et al*., 1997 and Montserrat *et al*., 2000 and Gerling *et al*., 2001). mentioned that several species of *Orius* have been found to feed on *B. tabaci*. While (El-Khawas and El-Khawas 2008) found the two predators; *C. carnea* and *Scymnus* sp., were the most abundant species among other all surveyed predators on eggplant in Sharkia Governorate.

1-2

3-4

Table (3): Seasonal mean numbers of five predators associated with the common sap sucking pests on the three Solanaceous plants at Qalyubiya Governorate during 2012 season.

Plant	Cultivar	Predators					Total mean number
		C. undecimpunctata	*C. septempunctata*	*H. tredecimpunctata*	*Ch. vulgaris*	*Orius* sp.	
Pepper	California wonder	4.57^{c}	1.5b	2.35^{a}	0.85^{e}	0^{d}	9.15
	Hyb Morad	2.3^{e}	0.78c	2.6^{a}	2.71^{c}	0^{d}	8.39
	Total	6.8	2.28	4.95	3.56	0	
Eggplant	Hyb snow f1	11.3^{a}	3.9a	0.35^{c}	2.07^{a}	0.21^{b}	17.83
	Black shantaf1	10.6^{b}	3.8a	0.71^{b}	2.07^{a}	0^{d}	17.18
	Total	22.3	7.71	1.06	4.14	0.21	
Potato	Santana	3.07^{d}	0.85c	0.78^{b}	3^{b}	0.28^{a}	8.43
	Hermis	2.57^{d}	0.71c	0.6^{bc}	3.7^{a}	0.35^{a}	7.9
	Total	5.64	1.56	1.38	6.7	0.63	
	L.S.D	**0.34**	**1.5**	**0.25**	**0.12**	**0.03**	

Means within the same columns carrying different litters are insignificant at ($P \leq 0.05$)

Table (4): Seasonal mean numbers of five predators associated with the common sap sucking pests on the three Solanaceous plants at Qalyubiya Governorate during 2013 season

Plant	Cultivar	Predators					Total mean number
		C. undecimpunctata	*C. septempunctata*	*H. punctata*	*Ch. vulgaris*	*Orius* sp.	
Pepper	California wonder	5.0^{c}	1.5^{c}	4.1^{a}	0.8^{e}	0^{d}	11.4
	Orli improfed f1	2.0^{f}	0.9^{d}	3.0^{b}	3.1^{c}	0^{d}	9.0
	Total	7	2.4	7.1	3.85	0	
Eggplant	Hyb snowf1	15.9^{a}	4.61^{a}	0.4^{d}	3.07^{c}	0.21^{c}	24.18
	Black shantaf1	13.7^{b}	4.4^{b}	1.1^{c}	2.57^{d}	0^{d}	21.7
	Total	$29.^{6}$	9.01	1.5	5.64	0.21	
Potato	Santana	3.64^{d}	1.0^{d}	1.1^{c}	3.7^{b}	0.6^{a}	10
	Hermis	3.10^{e}	0.9^{d}	1.1^{c}	4.2^{a}	0.5^{b}	9.8
	Total	6.74	1.9	2.2	7.9	1.1	
	L.S.D	**1.7**	**1.5**	**0.26**	**0.28**	**0.16**	

Means within the same columns carrying different litters are insignificant at ($P \leq 0.05$)

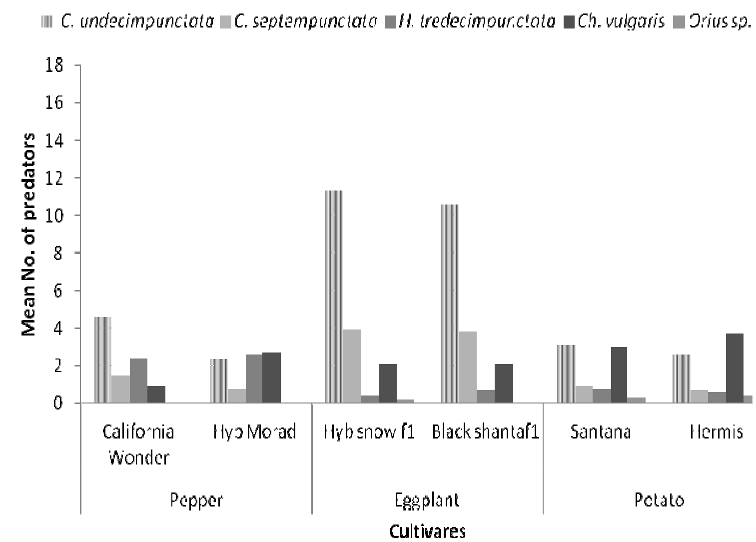

Fig. (5): Seasonal mean number of predators associated with sap sucking insects infesting three plants on Qalyubiya Governorate during 2012 seasons

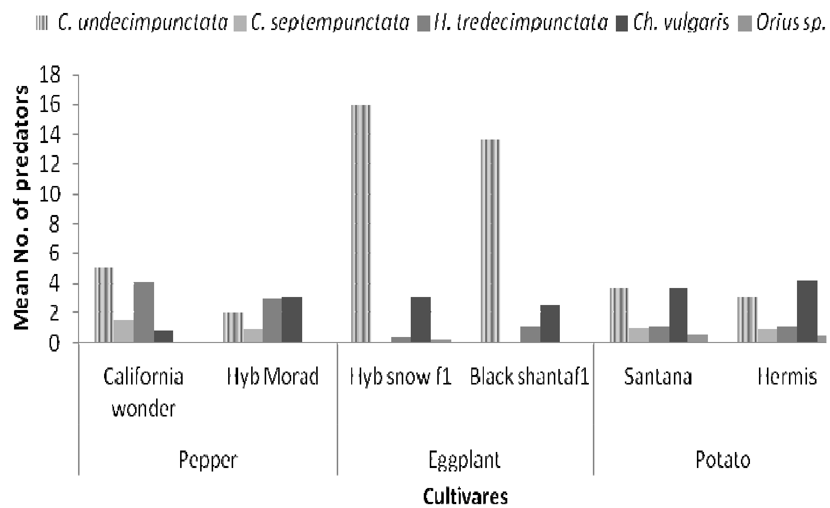

Fig. (5): Seasonal mean number of predators associated with sap sucking insects infesting three plants on Qalyubiya Governorate during 2013 seasons

Effect of Different Leaf Chemical Components on Pests Infestation:
Photosynthetic pigments:

Results of different leaf photosynthetic pigments components were tabulated in Table (5) whereas three photosynthetic pigments components; Chlorophyll (a & b) and Carotenoids were analyzed in the three tested plants leaf as well as their cultivars to detect the effect of the sap sucking pests infestation on total photosynthetic pigments content. statistical analysis revealed that there are significant differences among total chlorophyll (a + b) contents in the different three host plants (F=18.9**) where the highest contain was found in pepper leaf followed by both eggplant and potato. Also chlorophyll a contents showed highly significant differences among the three plants (F=12.6***) where pepper leaf was contained the highest content followed by both eggplant and potato. While results of chlorophyll b analysis showed insignificant differences among the three plants (F= 0.06). Leaf carotenoids analysis showed significant differences among the three plants (F= 3.7*), the highest carotenoids found in pepper and eggplant cultivars while potato leaf showed the lowest carotenoids contents.

Table (5):. Effect of infestation with certain sap sucking insects on photosynthetic pigments in leaves of six different Solanaceous plants cultivars..

Cultivars	Mean No. insects	Chl a mg^{-1} g FW	Chl b mg^{-1} g FW	Car mg^{-1} g FW	Total chlorophyll mg^{-1} g FW
California wonder	2019	9.1a	6.9b	1.9a	16.0ab
Hyb Morad	14.59	10.1a	8.4a	2.2a	18.5a
Hyb snow f1	50.74	5.8b	5.0c	2.0a	10.8cd
Black shantaf1	41.40	5.4b	6.6b	2.1a	12.0c
Santana	30.50	3.9b	4.8c	1.5ab	8.7d
Hermis	24.60	3.4b	5.7b	0.8b	9.1cd
L.S.D 5%		2.79	3.2	0.06	4.4
r		-0.9518	-0.79491	-0.84152	-0.91109

Also photosynthetic pigments analysis showed significant differences among different tested cultivars, F values were 21.8***, 3.2** and 5.5** for chlorophyll a, b and carotenoids, respectively. The highest seasonal mean numbers of sap sucking insects recorded on hyb snow eggplant cultivar, california wonder pepper cultivar and Santana potato cultivar, these cultivars found to have the lower content of these three photosynthetic pigments as compared with the other cultivar of the same plant species (Table 5). These results may be reflect the effect of sap sucking insects infestation and the decrease of these photosynthetic pigments. these results are in agreement with those obtained by (Kruger and Hewitt1984, Riedell 1989, Burd and Todd 1992, Miller *et al*. 1994, van der Westhusizen and Pretorius 1995, Burd and Elliott 1996, Ni *et al*. 2002, Macedo *et al*. 2003, Heng-Moss *et al*. 2003, Heng-Moss *et al*.,2004 and Wang et al., 2004) who detected a significant reduction of chlorophyll a/b ratio in Russian wheat aphid, *Diuraphis noxia*-infested susceptible wheat cultivars. Also (Khatab, 2007) cited that Chlorosis is the most obvious plant injury symptom on cabbage leaves after cabbage aphid, *Brevicoryne brassicae* feeding and is indicative of chlorophyll loss and reported that such effect may be cleared in Hermis by the significant reduction in chlorophyll a and b contents as well as carotenoids determined in the infested cabbage leaves. As will as Golawska et al. 2008 determined a significant reduction of chlorophyll a and b in four Fabaceae plant species as a result of pea aphid, *Acyrthosiphon pisum* feeding.

Different leaf biochemical components:

Four biochemical components (Total phenol, Total free amino acids, Total soluble sugar and Flavonoids) were analyzed (Table 6).

Leaf total phenols:

Statistical analysis of leaf total phenols component data showed highly significant differences among different plant species and different plant cultivars (F= 8.8* & 31.5** for plant species and cultivars, respectively). Results revealed negative relationship among phenol content and infestation with sap sucking insects whereas resistant cultivar in each plant species (Hyb Morad pepper cultivar ; Hermis potato cultivar and Black shanta eggplant cultivar) found to have phenols content higher than that determined in the susceptible cultivar in each plant species to sap sucking insects infestation.

Table (6): Effect of certain sap sucking insects infestation on biochemical components in leaves of different of six different Solanaceous plants cultivars.

Cultivars	**Mean No. insects**	**Total phenol mg tannic acid/g**	**Total free amino acids mg/g fresh weight**	**Total soluble sugars mg glucose/g**	**Flavonoids mg quercetine /g**
California wonder	23.5	3.14b	17.6c	86.6ab	5.03
Hyb Morad	20.2	5.5a	19.1c	94.54a	3.61
Hyb snow f1	68.4	0.98c	37.01b	69.2bc	4.1
Black shantaf1	55.5	1.01c	55.6a	70.3bc	3.6
Santana	37.8	2.9b	16.51c	66.3c	3.4
Hermis	30.2	3.6b	23.65c	85.5ab	3.3
L.S.D 5%		1.4	12.8	18.4	Insig.
r		-0.92827	-0.85913	-0.93773	-

Also, the highest amount of phenols determined in pepper plant cultivars those had the lowest seasonal mean numbers of sap sucking insects throughout the two seasons in comparison with potato and eggplant cultivars. So leaf phenol content may be play an effective role against sap sucking insects infestation. these results are in agreement with those obtained by (Lowe, 1981; Bennett & Wallsgrove, 1994; Leszczynski, 2001 and Cipollini *et al*. 2008) who mentioned that phenols are one of the most active groups of allelochemicals that unfavourably affect aphid growth, development and/or feeding behavior. Also (Golawska *et al*. 2008) suggested that phenolics have negative effect on pea aphid, *Acyrthosiphon pisum* and they are good for control of the insect pests. As well as (Wójcicka 2010) reported that the triticale hybrids containing higher phenolic levels were less attractive for cereal aphids than standard, non-transgenic cultivars.

Total free amino acids:

Statistical analysis showed highly significant differences between leaf free amino acids amount and sap sucking insects infestation in both different plants and cultivars (F= 46.8*** & 34.5*** for plants and cultivars, respectively). Results indicated that the content of free amino acids increased in the highly infested plants and cultivars (Table 6). These results in harmony with (Sandstrom & Moran, 1999) who mentioned that phloem sap as a main source of nutrients for many of hemipterous species (i.e. aphids) is characterized by 0.8 – 4.5% amino acid content. It is not an efficient amount, thus sucking-piercing insects collect high quantities of phloem sap and induce plant metabolism to more intensive biosynthesis of biomolecules necessary to their growth and development. Therefore, the content of free amino acids increases within tissues of different plant species infested by *Elatobium abietinum* and *Aphis fabae*. (Blackmer & Byrne 1999) reported that an aggregation of *Bemisia tabaci* nymphs on *Cucumis melo* L. significantly raised the total amino acid concentration as well as the content of 10 out of the 22 identified amino acids. Also, (Sandatrom *et al*., 2000) detected that cereal aphids *Schizaphis graminum* and *Diuraphis noxia* caused strong increase of amino acids (especially essential) within phloem sap of wheat and barley and these changes affected various parts of infested leaves. (Sempruch *et al*. 2011) reported that the level of amino acids within triticale ears infested by a grain aphid at peak population density was generally raised. While these results were in disagreement with (Khatab 2007) who reported that the levels of free amino acids and total soluble proteins of infested cabbage leaves were lower than those of the healthy ones. Such effect might be due to the drain of the assimilates towards the aphids and/or decrease in their biosynthetic pathways induced by aphids. Also (Lokeshwari *et al*. 2014) who found reduction of free amino acids in Mango shoots due to aphid infestation.

Total soluble sugars:

Results of analysis of total soluble sugars content in different cultivars and plants showed moderate significant differences (F=8.92** & 8.8* for cultivars and plants, respectively) Also negative relationship with sap sucking insects infestation was detected whereas susceptible cultivars possessed low total soluble sugars content when compared with resistant cultivars. This relationship may be due to the effect of sap sucking insects infestation on photosynthetic pigments components. This result is in harmony with (Kamel *et al*. 2009) who found that total soluble sugar content was decreased with increasing cotton aphid’s infestation in cucumber. And reported that cotton aphids and green stink bugs didn’t prefer soluble sugars in high concentration. Also (Lokeshwari *et al*. 2014) who detected a significant reduction in the amount of total soluble sugar content in infested Mango shoots due to aphid feeding.

Flavonoids:

Results of flavonoids content analysis revealed insignificant differences among different cultivars or plant species (F= 0.6 & 0.51 for cultivars and plants, respectively). (Kamel *et al*. 2009) cited that total flavonoids group that is considered as a secondary plant metabolite had no biological activity either as anti-feedant or as repellant to different cucumber sap sucking insects.

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حساسية بعض أصناف نباتات العائلة الباذنجانية للاصابة بالحشرات الماصة والاعداء الطبيعية المصاحبة لها

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تم دراسة قابلية ستة أصناف تنتمي إلى ثلاثة أنواع نباتية تابعة للعائلة الباذنجانية حيث تم تقييم الفلفل صنف California wonder، Hyb Morad والباذنجان صنف Hyb Snow F1 ، Black والبطاطس صنف Santana، Hermis للإصابة بكلا من المن والذباب الأبيض و نطاطات الاوراق والتربس والاعداء الطبيعية المرتبطة بها طوال موسمين أوائل الصيف ٢٠١٢/٢٠١٣ وقد اظهرت النتائج فروق معنوية بين مختلف الاصناف النباتية والكثافة العددية لهذه الحشرات، وكذلك مع الاعداء الطبيعية المرتبطة بها .وأظهرت نتائج تحليل الصبغات الضوئية (الكلوروفيل لذلك، الكلوروفيل ب والكاروتينات) العلاقة السلبية مع الاصابة بالحشرات الماصة ، وكذلك المكونات البيوكيميائية مثل الفينول الكلي، السكريات الكلية الذائبة ومجموع الأحماض الأمينية الحرة حيث وجدت علاقة سلبية مع الاصابة بالحشرات الماصة ، في حين أظهر تحليل إجمالي الفلافونويد اختلافات ضئيلة .هذه النتائج يمكن أن تنتهي على أهمية اختيار الصنف في أي برنامج متكامل لإدارة الآفات فضلا عن الدور الفعال للمكونات الكيميائية الحيوية النباتية المختلفة على مقاومة النبات ضد الآفات الحشرية.

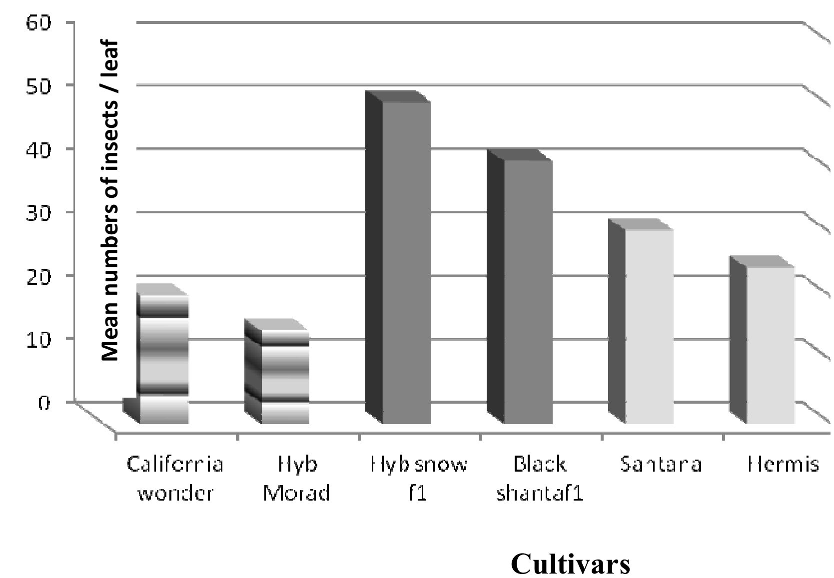


Fig. (1): Population densities of common sap sucking insects infesting Solanaceous cultivars at Qalyubiya Governorate during 2012 season.

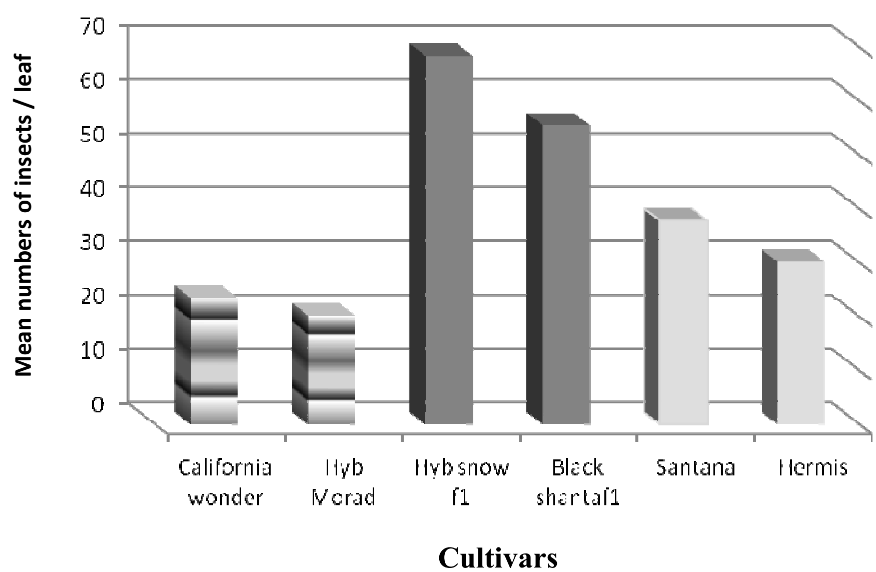
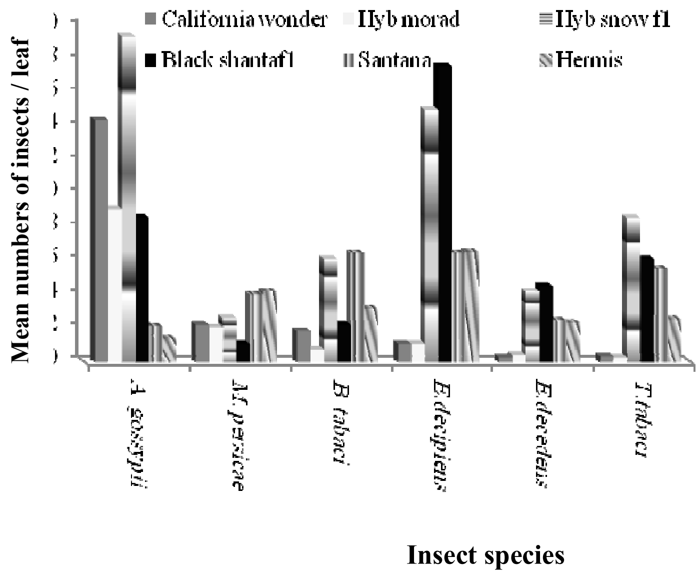


Fig. (2): Population densities of common sap sucking insects infesting Solanaceous cultivars at Qalyubiya Governorate during 2013 season.

Fig. (3): Seasonal mean numbers of different sap sucking insect species on different cultivars during 2012 season at Qalyubiya Governorate.



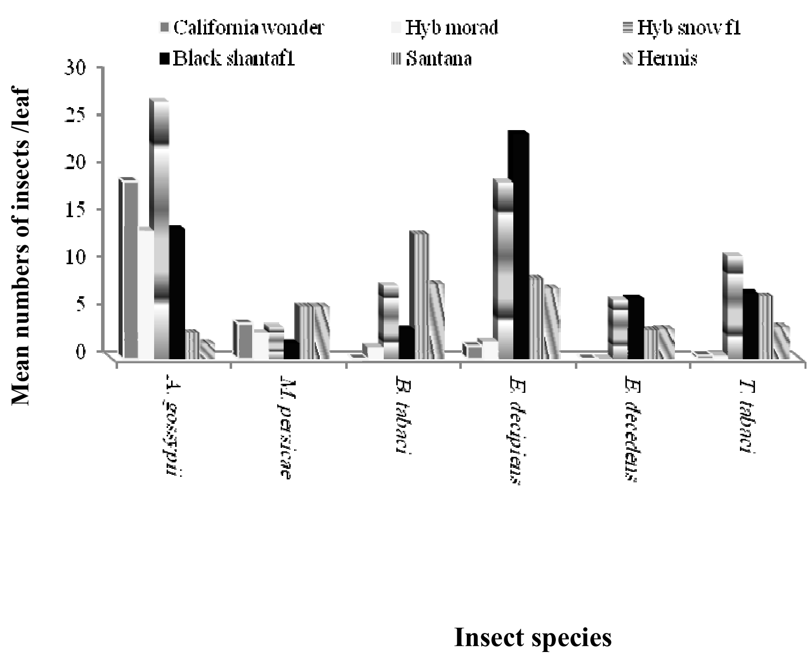


Fig. (4): Seasonal mean numbers of different sap sucking insect species on different cultivars during 2013 season at Qalyubiya Governorate.