J. Plant Prot. and Path., Mansoura Univ., Vol. 8 (1), 7– 13, 2017

Semiochemicals and Tritrophic Interaction Among Leguminous Plants, Aphids and Coccinellid Predators

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ABSTRACT

Chemical communication between the leguminous plants (cowpea, white bean and broad bean), aphids (*Aphis gossypii*, *Aphis. fabae* and *Myzus persicae*) and the coccinellid species (*Coccinella. undecimpunctata L., Coccinella. Septempunctata L.* and *Cydonia. vicina isis L.*) was evaluated under laboratory conditions(at 26 ± 2.5 ◦C and 68 ± 4.5 RH%). Lady beetles exhibited different degrees of preference to volatile oil extracts of the different tested host plants. However, volatile oils emitted from broad bean attracted the highest percent of both *Cyd. vicina isis* and *C. undecimpunctata*, while, *C. septempunctata* showed preference to white bean oil. On the other hand, all tested predators showed no response to oil extracts from cowpea plants. Broad bean and white bean plants damaged by feeding activity of *A. gossypii* produced volatile chemicals (synomones) that attracted all tested predators, While, *C. septempunctata* and *Cyd. vicina isis* adults only elicited positive response to damaged cowpea plants. Also, feeding by *M. persicae* or *A. fabae* on broad bean and white bean seedlings was sufficient to elicit emission of volatiles that attract all predator species in comparison with undamaged leaves. On contrary, all tested predators showed similar response to both damaged and undamaged cowpea seedling. Hexane approved to be the best solvents for kairomone extraction from *A. gossypii, Myzus persicae* and *A. fabae* for Cyd. *Vicina isis*, while acetone was the best one to extract kairomone of all aphid species for *C. undecimpunctata.* Meanwhile, *C. septempunctata* adults exhibited positivel response to hexane extract of both, *Myzus persicae* and *A. fabae,* and to acetone extracts from *A. gossypii*

INTRODUCTION

Leguminous plants are attacked by different insect pests throughout their different growth stages. Piercing-sucking insect pests including aphids, are very injurious and cause serious damage to the yield in both quantity and quality (Ward *et al*., 2002). All parts of plants that are attacked by an aphid, either above or below ground. Aphid feeding significantly reduced cowpea plant dry weights, mean relative growth rates and the mean unit leaf within 10 days (Kusi 2010 and Hawkins *et al*., (2011).

Prey location in an environment, filled with different plants and animal species, is a complex task. Na1tural enemies have specialized sensory nervous systems that allow them to use a variety of cues to find and identify target organisms. Chemical cues can be used by aphid predators to detect their prey. Knowledge concerning the chemical ecology of aphid-natural enemy interactions and on info- chemicals cues would be useful (Hatano, *et al*, 2008). Comprehension of the chemical ecology of plant–insect relations is a key factor in determining the way entomophagous beneficial insects localize host plants or prey. The semiochemicals emitted by plants can explain the orientation and distribution of aphids, and these chemicals play an infochemical role for the aphidophagous natural enemies. In the first steps of prey searching, predators localize prey habitat (Tumlinson *et al*., 1992).

Chemicals from plants and pests are important cues that elicit foraging behavior in many pest natural enemies. Currently, there is increasing evidence that volatile blends from aphid damaged plants play a pivotal role in habitat location by predators. More studies are needed that submit a particular predator species to different aphid-plant complexes to investigate whether natural enemy responses differ among complexes. The differential response of a polyphagous aphid predator to several potential preys demonstrates that biological control cannot be generalized. Each pest and cultivated plant species must be considered as a unique situation (Francis, *et al*, 2004). The impact of allelochemicals from plants and aphids in relation to biological control efficacy must be taken into account in programs of integrated pest management (Francis,2000). Therefore, the present study aims to study the influence of olfactory stimulants emitted by leguminous plants and preys on host location behavior of the aphidophagous coccinellid predators. Also, to evaluate the behavior response of the coccinellid predators to odor emitted by damaged and undamaged host plants by feeding activity with various aphid species.

MATERIALS AND METHODS

Influence of host smell plant on the behavior of insect predators.

Laboratory experiments were carried out to study the behavior response of the coccinellid predators (*Coccinella undecimpunctata* L, *Coccinella septempunctata* L.and *Cydoina vicina Isis L.*) to volatile oils extracted from healthy leguminous plant leaves, cowpea (*Vigna unguiculata* L.), white bean, (*Phaseolus vulgaris* L.) and broad bean (*vichia faba* L.).

Plant and insect sources:

- The leguminous plants (cowpea, white bean, and broad bean were gowning in 15 cm diameter plastic pots under laboratory conditions.
- The tested insect predators (*Coccinella undecimpunctata*, *Coccinella septempunctata* and *Cydonia vicina Isis*) were collected from vegetable fields (broad bean, white bean and cowpea), by using an aspirator, and kept in the laboratory for bioassay. Collected beetle females were starved for 24 hours before bioassay.

Plant oil extraction:

To have oil extraction from the host plants (cowpea, white bean and broad bean), fresh leaves of each plants were collected. Cowpea, white bean and broad bean dried herb were grounded and 50 gm from each was used for oil extraction by steam-distillation. The distillation was repeated to obtain the required oil quantity for research purposes. Such technique of steam distillation was used based on the methods of (Guenther,1949).

The response of adult predator females to volatile oil extracts of the tested host plants was evaluated by using an experimental Y-tube (Abdel-Kareim *et al.*, 2008). The internal wall of each cover was coated by Tangle foot as a sticky material, and one tube cover was coated with 0.2 ml of the extract and the other two covers with similar quantity of distilled water (control). The tested predators were introduced inside the exposure chamber which was closed immediately. Each treatment was repeated four times by using five individuals of predators /time. Counts were done one hour after exposure of predators.

The data obtained were subjected to statistical analysis (F- Test one way ANOVA) and mean comparison were carried out using L.S.D. at 5%.

Influence of feeding activity by aphids on plant synomones induction:

The behavior response of the coccinellid predators (*C. undecimpunctata*, *C. septempunctata* and *Cyd. vicina Isis* to the odors emitted from damaged and undamaged leguminous plants by feeding activity of aphids was estimated under laboratory conditions.

Plant and insect sources:

- The leguminous plants and the tested insect predators were obtained as previously mentioned.

-The green peach aphid, *Myzus persicae* Sultzer, the melon aphid, *Aphis gossypii* Glover, and the black broad bean*, Aphis faba*. Scop. were collected from vegetable fields (broad bean, white bean and cowpea). These insects were used to establish colonies on each host plant species in the laboratory

A set of each host plant seedling were exposed to high number of one of the aphid species (at the 3–4 true leaf stage), and another set was free from aphid infestation. Each combination of aphid and plant was isolated in separated conditioned room (at 26 ± 2.5 ◦C and 68 ± 4.5 RH%).

Bioassay:

The response of insect predators to damaged and undamaged leguminous plant leaves by feeding activity of each aphid species was evaluated by using the transparent Y-tube. (Abdei-Kareim et . al. 2007)

Damaged and undamaged seedlings by feeding activity of each tested aphid species were offered in two odor arms to test predators, while the third arm of the Y-tube was odorless (control). Roots of tested seedlings were immersed in glass tube of water through a pore in the plastic tube cover. The insect predators were introduced within the exposure chamber of the olfactometer, for a period of one hour after exposure of predators. Each treatment was repeated five by using five individuals of predators /time. Counts were done one hour after exposure of predators. The exposure chamber was covered immediately after predator release. Apredator, which showed searching behavior on the seedling leaves was registred as positive.

The data obtained were subjected to statistical analysis (F- Test one way ANOVA) and mean comparison were carried out using L.S.D. at 5%**.**

Influence of aphid body extractions on the behavior response of the insect predators:

To investigate if aphid-induced volatiles that give reliable information about their presence to the coccinellid females, aphid bodies of each species (*M.persicae*, *A. gossypii* and *A. faba*) were extracted by immersing a mixture of nymphal instar (50 individuals / 1 m solvent) during 24 hrs. in three different solvents, (diethyl ether, acetone and hexane). All extracts were stored at -4 °C for laboratory.

To study the orientation responses of the coccinellid females (*C. undecimpunctata*, *C. septempunctata* and *Cyd.vicina Isis)* to volatiles produced directly by aphids give reliable information about their presence, arena tests were carried out in Petri dishes containing one filter paper disc under laboratory conditions. Five individual's equivalents (9c_m diameter) (0.1ml extract) of the kairomone extracts were dispensed on a small part of one half of the disc and the same quantity of pure solvent (control) was placed on the other half. The lady beetle females were placed at the center of the disc. A predator, which entered and showed searching inside the treated disc- half was registered as positive. A test was repeated five times (for each extract) by using five predators each time.

The data obtained were subjected to statistical analysis (F- Test one way ANOVA) and mean comparison were carried out using L.S.D. at 5%**.**

RESULTS

Influence of host smell plant on the behavior of insect predators

Attractiveness of volatile oil extracts of healthy plants (cowpea, white bean and broad bean) to the coccinellid predators in the experimental olfactometer covers were estimated.

As seen in Figure (1), tube tests indicated that the lady bird beetles *C. undecimpunctata* adults showed different degrees of preference for the different volatile oils. However, oil extract of broad bean attracted the highest percentage of predators (70±11.6%), followed by white bean oil (55±19.2%) of tested predator with significantly different between them. On contrary, oil extracts of white bean significantly attracted the highest percent of *C. septempunctata* adult females (70±11.6%) followed by broad bean oil (55±10.0%). While, *Cyd. Vicina isis* adults exhibited the highest attractants to broad bean oil (80±16.3%), followed by white bean (50±11.6%) with significant differences between them.

Data in Figure (1), indicated that volatile oil extracted from cowpea leaves significantly lured the lowest percent of *C. undecimpunctata* (40 %), *septempunctata* (30%) and *Cyd. Vicina isis* (35%) adult femaless.

According to the previously data, it revealed that white bean and broad bean approved to be more favorable host plant for the lady beetles than cowpea.

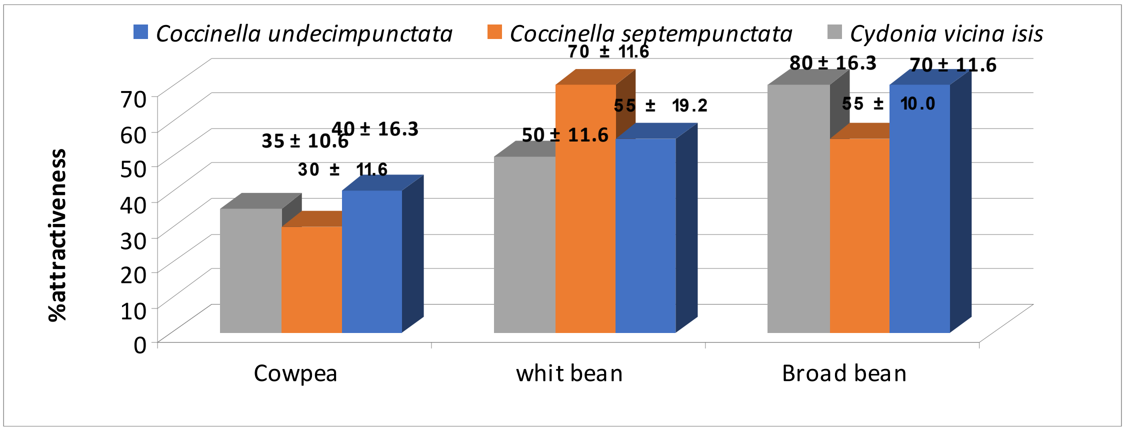

Figure 1. The percentage of attracted *Coccinella. undecimpunctata L.,Coccinella septumpunctata L. and Cydonia vicina isisL.* adults to oil extraction of different host plants (cowpea, white bean, and broad bean). (LS.D. =12.29 (p=5%)

Host plant synomones mediated prey location behavior of insect predators:

Attractiveness % of (*C. undecimpunctata, C. septempunctata* and *Cyd. vicina isis*) adults to damaged and undamaged leaves by feeding activity of each aphid species (*A. gossypii*. *M. persicae* and *A. fabae*) in comparison with untreated (control) in the experimental olfactometer covers were calculated.

Attractiveness to damaged leguminous plants with *A.gossypii*:

As shown in Table, (1) damaged broad bean leaves with feeding activity of *A. gossypii*, attracted the highest percentage of *C. undecimpunctata*, *C. septempunctata* and *Cyd. Vicina isis* (68, 68, and 64%, respectively) in comparison with undamged and untreated (control) in the experimental olfactometer covers. However, feeding by aphid on tested seedlings was sufficient to elicit emission of volatiles that attract the predators in the test odor field of the olfactometer.

With respect to response of eleven-spotted lady beetles to white bean leaves damaged by feeding activity of *A. gossypii*, catches of experimental olfactometer covers demonstrated that damaged leaves attracted the highest percentage of *C. septempunctata* (72.0±10.9%) followed by *C. undecimpunctata* (56.0±8.9%) and *Cyd. vicina isis* (52.0±10.9**)** with significant difference between them. On contrary, undamaged one as well as untreated (control) did not represent effective info-chemical sources to the tested predators.

Data in Table (1) indicated that *C. septempunctata* and *Cyd. vicina isis* adults exhibited positive response to damaged cowpea leaves by feeding activity of *A. gossypii*. However, damaged leaves attracted 56.0±8.9 % and 52.0±10.9% of *Cyd. vicina isis* and *C. septempunctata* with no significant differences between them. While, *C. undecimpunctata* showed similar response to damaged (36.0±10.94) and undamaged leaves (22.0±10.9) as well as control (30.0±14.14 %).

Generally, it could be concluded that legumes plants damaged by feeding activity of *A. gossypii* produced volatile chemicals (synomones) that attracted the tested ladybeetles.

Table 1. Response of *Coccinella undecimpunctata* L., *Coccinella septempunctata* L. and *Cydonia vicina isis* L.adults to damaged and undamaged host plant (cowpea, white bean and broad bean) leaves with *Aphis gossypii* as well as to untreated arms of the experimental tube.

Predators	Treatments	Host plant: Bored bean	White bean	Cowpea
	Damaged	68.0±10.9 a	56.0±8.9 b	36.0±10.9 b
Coccinella undecimpunctata L.	Undamaged	16.0±8.9 b	18.0±10.9 c	22.0±10.9 b
	Control	16.0±13.4 b	26.0±10.7 c	30.0±14.14 b
	Damaged	68.0 ± 10.9 a	72.0 ± 10.9 a	52.0±10.9 a
Coccinella septempunctata L.	Undamaged	24.0 ±11.4 b	14.0 ± 11.4 c	18.0±10.9 b
	Control	8.0 ±13.0 b	14.0 ± 11.4 c	30.0±20.0 b
	Damaged	64.0 ± 8.9. a	52.0±10.9 b	56.0±8.9 a
Cydonia vicina isis L.	Undamaged	18.0 ±10.9. b	26.0±10.7 c	28.0±10.9 b
	Control	18.0±10.9 b	22.0±10.9 c	16.0±13.4 b
L.S.D		14.3	14.1	16.8

Attractiveness to damaged leguminous plants with *M. persicae*:

As shown in Table, (2) damaged broad bean leaves with *M. persicae*, significantly attracted the highest percent of C. *septempunctata*, *C. undecimpunctata* , *C.* and *Cyd. Vicina isis*, it represented by 88.0±10.9, 84.0±8.9 and 68.0±10.9 % of the total exposed predator, respectively, in comparison with undamaged and untreated (control) in the experimental olfactometer covers..

According to the obtained data (Table,2) lady beetles exhibited similar response to white bean leaves damaged by feeding activity of *M. persicae* as those damaged by *A. gossypii*, where, damaged leaves by *M.*

persicae attracted the highest percentage of *C. septempunctata* (72.0±10.9%) followed by *C. undecimpunctata* (56.0±8.9%) and *Cyd. vicina isi*s (52.0±10.9) with significant difference between them. On the other hand, undamaged white bean as well as untreated (control) did not represent effective odor sources to the tested predators.

Statistical analysis revealed that the attractiveness percent of damages cowpea leaves to *C. undecimpunctata, C. septempunctata* and *Cyd. vicina isis* adults were (48.0±10.9, 44.0±8.9 and 32.0 ±10.9 %, respectively) approximately equal to proportion (32.0±10.9, 38.0±14.8 and 32.0 ±10.9 %, respectively) attracted to undamaged leaves.

Generally, it could be concluded that feeding by *M. persicae* on broad bean and white bean seedlings was sufficient to elicit emission of volatiles that attract the predators in comparison with undamaged leaves. While, all coccinellid predators showed similar response to damaged and undamaged cowpea seedling. So, this work shows that all predators only reacts to semiochemical cues from damaged broad bean and white bean leaves by feeding activity of *M. persicae*

Table 2. Response of *Coccinella undecimpunctata* L., *Coccinella septempunctata* L.and *Cydonia vicina isis* L.adults to damaged and undamaged host plant (cowpea, white bean and broad bean) leaves with *Myzus persica*e as well as to untreated arms of the experimental tube.

Predators	Treatments	Host plant Bored bean	White bean	Cowpea
	Damaged	84 ± 8.9 a	56.0 ± 8.9 b	48 ± 10.9. a
Coccinella undecimpunctata L.	Undamaged	12 ± 8.7 c	22.0 ± 4.5 c	32 ± 10.9. a
	Control	4 ± 5.5 cd	22.0 ± 4.5 c	20 ± 10.0 b
	Damaged	88 ± 10.9 a	72.0 ± 10.9 a	44 ± 8.9 a
Coccinella septempunctata L.	Undamaged	8 ± 8.4 c	22.0 ± 10.9 c	38 ± 14.8. a
	Control	4 ± 5.5 cd	6.0 ± 5.5 cd	18 ± 10.9 b
	Damaged	68 ± 10.9 b	52.0±10.9 b	32 ± 10.9 a
Cydonia vicina isis L.	Undamaged	20 ± 10.0. c	28.0±10.9 c	42 ± 10.9 a
	Control	12 ± 4.5 c	20.0 ±14.1 c	26 ± 8.9 b
L.S.D		11.5	10.3	16.3

Attractiveness to damaged leguminous plants with *A. fabae*:

As shown in Table, (3) damaged broad bean leaves with *A. fabae*, significantly attracted the highest percent of *Cyd. Vicina isis* (88.0±10.9 %) followed by C. *septempunctata* (76.0±16.7%) and *C. undecimpunctata* (72.0±10.9%), in comparison with undamaged and untreated (control) in the experimental olfactometer covers.

Data in Table,3, cleared that both ladybird's, *C. undecimpunctata* and *C. septempunctata* adults exhibited the highest response to white bean leaves damaged by feeding activity of *A. fabae* in comparsion with undamaged one, where, the percentage of attractiveness was 84.0±16.7 and 72.0±10.9 %, respectively. On contrary, *Cyd. vicina isi*s showed similar response to damaged and undamaged white bean leaves with non-significant difference between them.

All tested predators exhibited similar response to damaged and undamaged cowpea leaves by feeding activity of *A. fabae*. However, statistical analysis revealed that there were insignificantly differences between the attractiveness % of damages (44.0±8.9, 42.0 ±10.9, and 32.0±10.9) and undamaged cowpea leaves (34.0±8.9, 34.0±8.9 and 42.0 ±10.9%) to *C. undecimpunctata, C. septempunctata* and *Cyd. vicina isis* adults, respectively (Table, 3).

Table 3. Response of *Coccinella. Undecimpunctata* L., *Coccinella. septempunctata* L., and *Cyd. vicina isis* L., adults to damaged and undamaged host plant (cowpea, white bean and broad bean) leaves with *Aphis. fabae* as well as to untreated (control) arms of the experimental tube.

Predators	Treatments	Host plant Bored bean	White bean	Cowpea
Coccinella undecimpunctata L.	Damaged	72.0±10.9 a	84.0±16.7 a	44.0±8.9 a
	Undamaged	18.0±4.5 b	8.0±8.4 c	34.0±8.9 a
	Control	10.0±7.1 b	8.0±8.4 c	22.0±4.5 b
Coccinella septempunctata L.	Damaged	76.0±16.7 a	72.0±10.9 a	42.0 ±10.9 a
	Undamaged	14.0±8.9 b	16.0±8.9 c	34.0±8.9 a
	Control	10.0±7.1 b	12±10.9 c	18.0±4.5 b
	Damaged	88.0±10.9 a	42.0 ±10.9 b	32.0±10.9 a
Cydonia vicina isis L.	Undamaged	12±10.9 b	38.0±4.5 b	42.0 ±10.9 a
	Control	0.0±0.0 bc	20.0±10.0. c	26 ±8.9 b
L.S.D		14.1	13.6	12.3

Generally, it could be concluded that feeding by *A. fabae* on broad bean and white bean seedlings was sufficient to elicit emission of volatiles that attract the predators (*C. undecimpunctata* and *C. septempunctata*) in the test odor field of the olfactometer. While, the coccinellid predators showed similar response to damaged and undamaged cowpea seedling by feeding activity of *A. fabae.*

Prey seeking stimulant (Kairomone) for the ladybeetle:

The behavior reactions of the coccinellid predators (*C. undecimpunctata*, *C. septempunctata* and *Cyd. Vicina isis*) to extracts of aphid (*A. gossypii, M.*

persica and *A faba*e) bodies by using three different solvents (acetone, hexane and diethyl ether) were investigated in the three arm olfactometer tube.

A. gossypii

Data in Table (4) show the percentage of the predators attracted to the different extraction of *A. gossypii* bodies*,* Acetone extract of *A. gossypii* bodies significantly attracted the highest percent of *C. septempunctata* (84.0 ± 16.7 %) and *C. undecimpunctata* (76.0 ± 8.9 %) adults in comparison with hexane and diethyl ether. On contrary, *Cyd. Vicina isis* showed a significantly positive response to hexane extract. However, hexane extract attracted (56.0±16.7 %) of exposed predators, while acetone (44± 16.7%) and diethyl ether (28±10.95 **%)** extracts were less attractive to *Cyd. Vicina isis* with non significant differences between the two solvent extracts.

Generally, Acetone approved to be the best solvents for kairomone extraction from *A. gossypii* for (*C. septempunctata* and *C. undecimpunctata*), while hexane was the best one for Cyd. *Vicina isis* .

Table 4. percent of attracted coccinellid predator adults(*Coccinella undecimpunctata* L.(A), *Coccinella septumpunctata* L.(B) and *Cydonia vicina isis* L. (C) to different extracts of *Aphis gossypii*, Myzua persicae *and Aphis fabae* bodies by using different solvents.

Solvent	*Aphis gossypii* extract A	B	*C*
Acetone	76.0 ± 8.9 a	84.0 ± 16.7 a	44± 16.7 a
Hexane	48.0±11.0 b	48.0± 11.0 b	56.0±16.7a
Diethyl ether	28.0± 11.0 c	32.0±11.0 b	32 ±11.0 ab
L.S.D.	14.23	18.14	18.14
Solvent	*Myzus persicae* extract A	B	*C*
Acetone	88.0 ±17.9 a	44.0 ± 8.9 b	28.0 ±10.9 b
Hexane	80.0 ±14.1 b	64.0 ± 8.9 a	64.0 ±16.7 a
Diethyl ether	64.0 ±16.7 c	36.0 ± 10.9 b	36.0 ±8.9 b
L.S.D.	18.83	13.31	17.43
Solvent	*Aphis faba* extract A	B	C
Acetone	92.0±10.9 a	56.0±16.7 b	48±10.9 b
Hexane	48.0±10.9 b	80.0± 14.1 a	76.0±8.9 a
Diethyl ether	36.0± 16.7 b	36.0± 8.9 c	40±14.1 b
L.S.D.	18.14	20.82	15.91

***M. persica*.**

In case of M. *persica*e extracts, *C. undecimpunctata* exhibited the highest percent of attractiveness to acetone extract (88.0±17.9 %) . As shown in Table (4), the obtained data cleared that hexane extract of *M. persica*e bodies significantly attracted the highest percent of *C. septempunctata* (64±8.94 %) and, *Cyd. Vicina isis* (64±16.73) adults in comparison with acetone and diethyl ether extracts.

Generally, acetone approved to be the best solvent for kairomone extraction from M. *persica*e for *C. undecimpunctata*, while for *C. septempunctata* and *Cyd. Vicina isis* hexane was the best one. *C. septempunctata* and *Cyd. Vicina* showed different in their response to aphid insect extract, depending on aphid species and the solvent used.

***A. fabae*.**

With respect to *A. fabae*, acetone extracts of *A. fabae* bodies elicited a good response in *C. undecimpunctata* (92.0±10.95), *C. septempunctata* (80.0± 14.14) and *Cyd. Vicina isis* (76.0±8.94) in comparison with hexane and diethyl ether extracts.

Generally, it could be concluded that *C. septempunctata* and *Cyd. Vicina* showed different in their response to aphid insect extract, depending on aphid species and the solvent used.

DISCUSSION

Host plant seeking stimulant (Kairomone) for the ladybeetle:

The present investigation demonstrated that ladybirds (*C. undecimpunctata* , *C. septempunctata* and *Cyd. vicina isis*) exhibited different degrees of preferability for volatile oil extracts of the different tested host plants. These results support those obtained by Abdel-Mageed (2005), who stated that *R. cardinalis* females showed different degrees of preferability for the leave extracts of different tested host plants. Cardosa, (1990) came to similar conclusion when he stated that *R. cardinalis* and *C. montrouzieri* exhibited different response to different host plants. Several predatory insects have been demonstrated to use semiochemicals associated with the host plant habitat to locate their prey (Turling *et al*. 2002; Vet and Dicke 1992 and Zhu, 2011).

Emission of auditory stimuli from the host plant is important in tritrophic interaction [Vinson 1984]. Its play an infochemical role for the aphidophagous natural enemies, by using chemical cues emitted by plants (Tumlinson *et al*., 1992).

The ladybird, dalia*A. bipunctata* L.adults were not attracted by the volatiles released from the three-plant species (*vicia. faba*, *Brassica. napus*, and *Sinapis. alba*) (Francis *et al*,2004). Also, *C.septempunctata* does not react to volatiles from uninfected plants in olfactometer bioassays (Ninkovic *et al*., 2001). The obtained results during the course of this study are different from those obtained by the latter authors which may be attributed to the host plant species.

Host plant synomones mediated prey location behavior of insect predators:

The present study revealed that feeding by aphids (*A.gossypii, M. persicse* and *A. fabae)* on broad bean or white bean was sufficient to elicit emission of volatiles that attract the tested ladybirds. Han and Chen (2002a) reported that *Toxoptera aurantii* -damaged tea plants have also been shown attractant for the predator *C. septempunctata*. Also, *C. septempunctata* was attracted to odors from barley plants (*Hordeum volgare*) previously infested by the aphid, *Rhopalosiphum padi* (Ninkovic *et al*., 2001). According to Abdel-Kareim *et al*. (2007) feeding by *A. gossypii* on chamomile seedlings was sufficient to elicit emission of volatiles that attract *C. undecimpunctata*. Also, results in the present study coupled with those by Meiners and Hilker (2000), Ahmad *et al*. (2004), Hulcr *et al*. (2005) and Hatano *et al*. (2008), which suggest that predators were significantly attracted to odor from leaves of the host plant which were systematically induced by feeding of insect pests. According to Francis and haubruge (2002) predatory ladybird (*A. bipunctata*) responded positively to the emitted chemical cues from crushed *M. persicae* and *A. pisum* reared on several host plant species.

The obtained data cleared that feeding by *A. fabae* on white bean seedlings was sufficient to elicit emission of volatiles that attract *C. undecimpunctata* and *C. septempunctata* in the test odor field of the olfactometer, while, adults of Cyd. *vicina isis* were not attracted by the volatiles released from white bean leaves. This results coupled with those by Miners *et al*. (2000), Dicke and van Loor (2000) and Hatano et al. (2008) that the attractiveness of such induced volatiles was shown to be specific both for the plant and insect pest species.

In conclusion, The cultivated plant species play a role in the herbivore — predator relationship and the allelochemicals present can significantly influence the efficacy of entomophagous insects (van Emden, 1995). And Francis *et al.,* (2000)

Prey seeking stimulant (Kairomone) for the ladybeetle.

In the present study, *C. undecimpunctata* elicited positive response to acetone extracts *of A. gossypii, M. persica* and *A. fabae*. With respect to, seven -spotted predator, it exhibited positive reaction to acetone extract of *A. gossypii* and hexane extracts of *M. persicae* and *A. fable*. While, *Cyd. Vicina isis,* only react positive response to hexane extracts of both M. persicae and A. fabae. Also, it could be concluded that that *C. septempunctata* and *Cyd. vicina isis* showed different in their response to aphid insect extract, depending on aphid species and the solvent used. This differences may be attributed to that organic solvents vary in their efficiency in extractive kairomone components of aphids. different in their response to aphid extract, depending on aphid species and the solvent used. According to Abdel-kareim (1988) kairomone contains a volatile substance, produced continuously by insect body, who added that the organic solvents differ in their extractable potential of that substance.

In the present study, diethyl ether extract from all aphid species had a lower attractancy to the lady beetles. According to Francis & Haubruge (2002), may be the chemical composition of kairomone in the diethyl ether extract is not presented. Consequentially, the compounds extracted by diethyl ether were not exclusively all kairomone components. The present study cleared that chemical compounds extractable by organic solvents (acetone and hexane) mediate cuticle recognition by aphid predators. According to kairomone identification (Brown *et al*.,1970), the results obtained proved kairomone activity in the bodies of all aphid species. The foraging behavior of the ladybird was not affected by hexane as a chemical cue Francis and haubruge (2002).

All extracts of. the aphid, *A. gossypii* did not provide a signal to foraging predatory the black ladybirds*, Cyd. vicina isis* about the location of their party. These results coupled with those obtained by Francis and haubruge (2002) that when tested whole bodies of aphids (*M. persicae* and *A. pisum*) as potential kairomone cues for *A. bipunctata*, no informative effect was observed. Similar results have been obtained by the aphid species, *B. brassicae* aphid is the only prey that was not attracted to A. bipunctata larvae and adults Francis and haubruge (2004). According to Francis and haubruge (2004) it could be concluded that the differential response of aphid predators to several potential preys demonstrates that biological control cannot be generalized. Each insect and plant species must be considered as a unique situation.

Zhu, (2011) suggested that the manipulation of these predatory insects to be synchronized with the aphid appearance can be achieved by applying insect predator's attractant lures during the earlier season in aphid-infested leguminous fields. Lead to significant increases in number of predators and the suppression of aphid populations in the treated fields.

But in the case of *M. persicae* the kairomone in hexane which elicited foraging behavior attempts may be the hexane itself having good ability as a solvent to the extraction of the necessary chemicals for recognizes behavior. perhaps some secondary stimulating chemicals , produced by aphid bodies, is not volatile enough to be caught during extraction.

The present results are important in integrated pest management control programs to obtain natural enemies adapted to attack the target pest on the target crops. However, particular plant species may exert a strong attraction even though suitable prey are not present on it. Therefore, the predator may ignore suitable preys growing on plants to which it is not attacked.

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الاتصال الكيميائى وعلاقة المستويات الغذائية الثلاثة بين بعض النباتات البقولية وبعض انواع المن ومفترسات ابو العيد

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تم دراسة الاتصال الكيميائى بين نباتات العائلة البقولية (اللوبيا, الفاصوليا و الفول البلدى), انواع المن (من القطن, من الفولالاسود و من الخوخ الاخضر) و بعض انواع ابو العيد (ابو العيد ١١ نقطة, ابو العيد ٧نقطة و ابو العيد الاسود) وذلك تحت ظروف المعمل.ابدت خنافس ابو العيد استجابة مختلفة للانجذاب للزيوت الطياره المنبعثة من العوائل النباتية تحت الدراسة. حيث سجل ابو العيد الاسود وابو العيد ١١ نقطة اعلى نسبةانجذاب للزيوت المنبعثة من نبات الفول. بينما اعلى نسبةانجذاب لابو العيد ٧ نقطة كانت لنبات الفاصوليا. بينما لم تسجل المفترسات تحت الدراسة انجذاب للزيوت الطياره المستخلصة من نبات اللوبيا. اثبتت الدراسة ان كلا من نبات الفول والفاصوليا التى تعرضت للاصابة بالمن انبعث منها بعض المواد الكميائية (سينمون) والتى جذبت المفترسات تحت الدراسة . كما ابدت المفترسات (فيما عدا ابو العيد ١١ نقطة) استجابة موجبة لنباتات اللوبيا المصابة . وكذلك ادت اصابة نباتات الفول والفاصوليا بمن الخوخ الاخضر اومن الفول الى انبعاث مواد طيارة جذبت كل المفترسات تحت الدراسة مقارنة بالنباتات الغير مصابة. فى حين ابدت كل المفترسات تحت الدراسة اقل استجابة لكل من نباتات اللوبيا المصابة والغير مصابة.يعتبر الهكسان من افضل المذيبات للكيرومون المستخلص من من القطن ومن الخوخ الاخضر ومن الفول لابو العيد الاسود. فى حين كان الاسيتون افضل مذيب للكيرومون المستخلص من كل انواع المن تحت الدراسة لمفترس ابو العيد ١١ نقطة. بينما سجل ابو العيد ٧ نقطة استجابة موجبة لمذيب الهكسان لمستخلص كلا من من الخوخ الاخضر ومن الفول الاسود ومذيب الاسيتون لمستخلص من القطن.