Bol. San. Veg. Plagas, 31: 503-507, 2005

Myzus persicae (Homoptera: Aphididae) and *Capsicum annuum* (Solanaceae) volatiles: their effect on predators attraction

M. V. CIARLA, G. MAREGGIANI, G. HEIT, L. PUHL

The behaviour of predators and their efficacy as biological pest control agents can be affected by the volatile infochemicals emitted by their preys and host plants. To test this hypothesis, the response of three ladybirds, the Coccinellidae *Eriopis connexa*, *Cycloneda sanguinea* and *Harmonia axyridis*, in presence of the aphid *Myzus persicae* and the host plant *Capsicum annuum*, was here analyzed using an air static olfactometer. Data showed that, in presence of the prey or the host plant alone, no significant differences in the time required for the three ladybird species to choose the volatiles source chamber ($p \leq 0.05$) were found. However, when the effect of the association aphid-host plant on the predators foraging behaviour was analyzed, *C. sanguinea* required significantly lower time to select the odour source. These variations are attributed to the higher attraction exerted by induced volatiles emissions, which act as sinomones in *C. sanguinea* case.

M. V. CIARLA, G. MAREGGIANI, G. HEIT. Cátedra de Zoología Agrícola. Facultad de Agronomía. Av. San Martín 4453 (1417) Bs. As. Argentina. ciarla@agro.uba.ar. mareggia@agro.uba.ar
L. PUHL. Cátedra de Estadística. Facultad de Agronomía. Av. San Martín 4453 (1417) Bs. As. Argentina.

Key words: *Myzus persicae*, *Capsicum annuum*, infochemicals, *Eriopis connexa*, *Cycloneda sanguinea*, *Harmonia axyridis*.

INTRODUCTION

The generalist aphid *Myzus persicae* is a cosmopolitan pest of horticultural crops. Its management is generally based upon the use of synthetic insecticides. However, in integrated pest management, biological control using natural predators such us the ladybirds (Coleoptera: Coccinellidae) is an interesting strategy.

The introduction of these natural enemies is particularly useful in greenhouses destined for organic production, because the predators can maintain the aphid populations below the economic threshold.

To achieve good results in the natural enemy mass rearing and also in its introduction, it is necessary to understand the behaviour of the Coccinellidae when they are in contact not only with the pest but also with the host.

Natural enemies frequently use volatile infochemicals emitted by the pest or by their host plants as olfactory cues in order to find their preys. A better knowledge of this interaction can help to optimize the processes related to predators rearing and introduction.

Behaviour can be analyzed with different types of olfactometers such us those described by SCHOONHOVEN *et al.* (1998), EIGENBRODE and BERNAYS (1997), TAKÁCS *et al.* (1997), ROMERIS *et al.* (1998), GEERVLIET *et al.* (1997 y 1998), FRANCIS *et al.* (2004), etc. Here, an air static olfactometer, based on the design of VET and DICKE (1992) was used to

Figure 1: Green peach aphids, *Myzus persicae*.

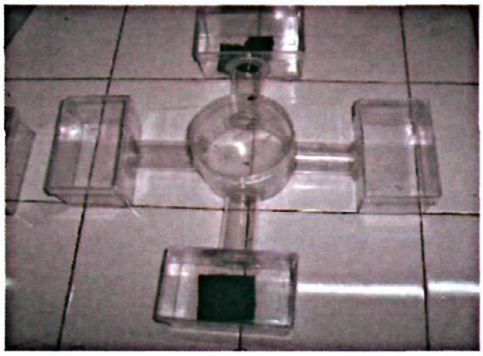

Figure 2: Air static olfactometer.

study the olfactory response of three ladybeetles in presence of different odour or volatiles sources.

MATERIALS AND METHODS

Predators

Mass rearing of the generalist ladybirds *Eriopis connexa*, *Harmonia axyridis* and *Cycloneda sanguinea* (Coleoptera: Coccinellidae) was started with adults collected in the field near the Cát. Zoología Agrícola FAUBA laboratory. They were fed on green peach aphids, *Myzus persicae* (Homoptera: Aphididae), in standardized environmental conditions (24 ± 2 °C, 65 ± 10 % RH, and 16:8 L:D) to obtain egg masses. Leaves infested with aphids were offered to neonatae larvae until the emergence of the adults, which were used in the tests.

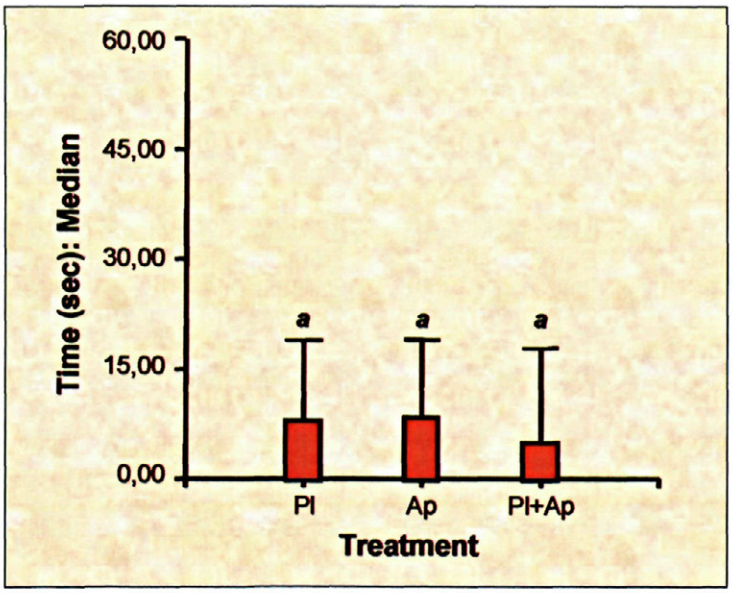

Figure 3: Time required for *E. connexa* to choose among the three treatments (Plant, Aphid and Plant+Aphid).

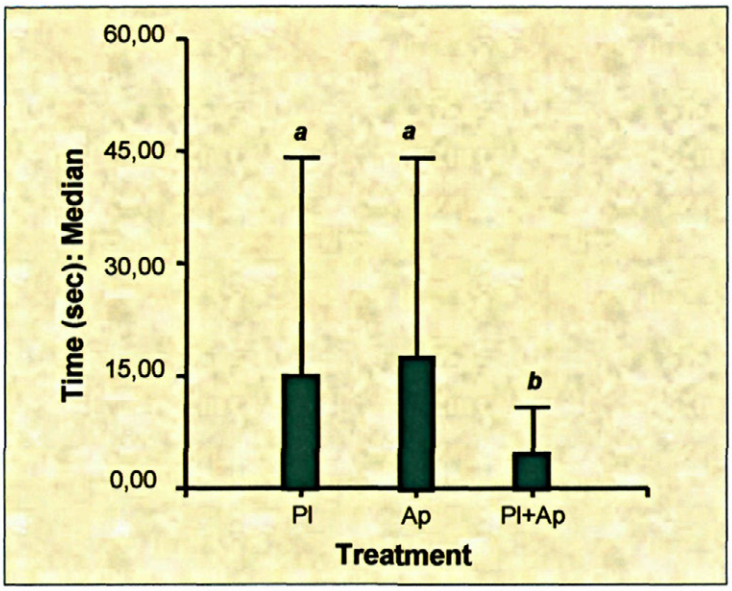

Figure 4: Time required for *C. sanguinea* to choose among the three treatments (Plant, Aphid and Plant+Aphid).

Prey

Green peach aphids, *Myzus persicae* (Homoptera, Aphididae) (Figure 1) were reared on pepper seedlings, *Capsicum annuum* (Solanaceae) in standardized environmental conditions (24 ± 2 ºC, 65 ± 10 % RH, and 16:8 L:D) to obtain the adults for the tests.

Olfactometer tests

An air static olfactometer (HEIT *et al.*, 2004) with a central *arena* and four arms, each one with a chamber at the end (Figure 2), was used. Three of the chambers contained different odour's sources, while the last one was empty. The odour source was represented by three treatments: **Ap**) The prey alone (18 aphids/chamber), **Pl**) the host plant, *Capsicum annuum* alone and **Pl+Ap**) *M. persicae* (18 aphids/chamber) and *C. annuum* together. The three coccinellid species used in the different trials were randomly selected. An adult ladybeetle, 24 hours starved, was introduced in the central *arena*. The time required to make the chamber election was recorded during ninety minutes. Ten replicates of each treatment were done in standardized environmental conditions (24±2°C, 65±10% and continuous light from two 40 Watts daylight lamps). Data were analyzed with a Mann-Whitney-Wilcoxon test ($p \leq 0.05$) respectively.

RESULTS AND DISCUSSION

The election time to enter into the chambers with each odour or volatiles source is shown in Figures 3, 4 and 5. When *Eriopis connexa* foraging behaviour is analyzed (Figure 3), no significant differences among the time required to enter to the chambers containing only host plants (**Pl**), only aphids (**Ap**) or the combination aphid-host plants (**Pl + Ap**) ($p \leq 0.05$) was observed. In the case of *Cycloneda sanguinea* (Figure 4), there were significant differences among the treatments ($p \leq 0.05$) with a clear preference for the **Pl+Ap** treatment which was chosen in just a few seconds. In the case of *Harmonia axyri-*

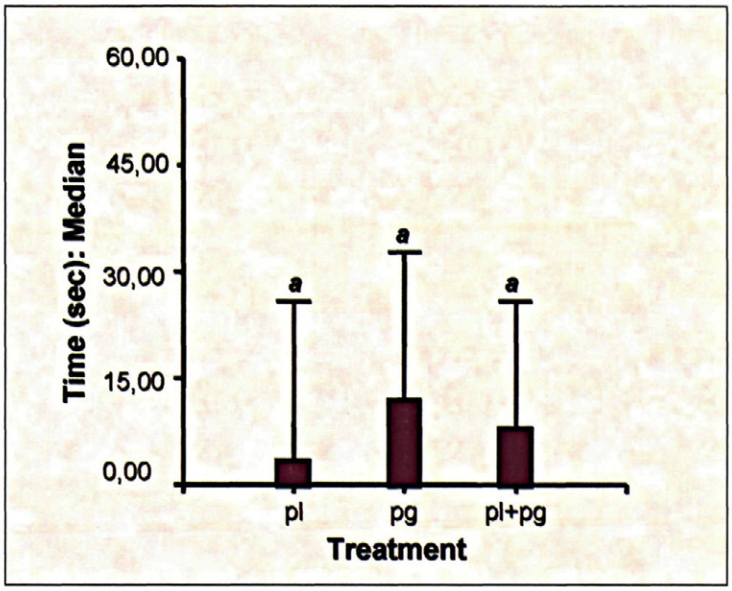

Figure 5: Time required for *H. axyridis* to choose among the three treatments (Plant, Aphid and Plant+Aphid).

dis no significant differences ($p \leq 0.05$) among treatments were found (Figure 5).

These results indicate variations in the foraging behaviour of the three coccinellids assayed. The different response here observed could be analyzed taking into account the evolution of herbivores and predators in relation to plants. *C.sanguinea* is a south-american species with the same geographical origin of Solanaceae, while the two other predators are exotic ones for South American plant species. Then, as the coevolution was different, it is possible that the secondary metabolism of the host could have induced the production of volatile infochemicals after aphid attacks, to attract natural enemies as a defense (FRANCIS *et al.*, 2004). This kind of infochemicals could act as sinomones because they benefit the host and the predator (HUNTER, 2002) .

It is possible that the elicitors in the aphid saliva may induce a response in *C. annuum*, so that the infested host synthesize metabolites *de novo* which make them more attractive to the predator than the non infested one (RÖSSE *et al.*, 1998).

A better knowledge of the mechanisms involved in these tritrophic interactions, including the study of the volatiles emitted, could be useful to develop baits to attract predators to infested crops.

CONCLUSIONS

The association *Myzus persicae-Capsicum annuum*, as an odour or volatile source, produced more efficient foraging behaviour in *C. sanguinea*, species which required significantly lower time than the two other predators to select the odour source. These variations are possible due to the higher attraction exerted by the emission of induced volatile sinomones.

RESUMEN

CIARLA M. V. , G. MAREGGIANI, G. HEIT, L. PUHL. 2005. Volátiles de *Myzus persicae* (Homoptera: Aphididae) y *Capsicum annuum* (Solanaceae): su efecto sobre la atracción de los predadores. *Bol. San. Veg. Plagas*, **31**: 503-507.

El comportamiento de los predadores y su eficacia como herramientas de control biológico de plagas puede resultar afectado por los infoquímicos volátiles emitidos por sus presas y por sus plantas huéspedes. Para probar esta hipótesis, se analizó la respuesta de tres vaquitas o mariquitas, los Coccinellidae *Eriopis connexa*, *Cycloneda sanguinea* y *Harmonia axyridis*, en presencia del áfido *Myzus persicae* y del hospedante *Capsicum annuum*, utilizando un olfatómetro de aire estático. Los resultados mostraron que, en presencia de la presa o del hospedante solamente, no hubo diferencias significativas en el tiempo que insumió a cada una de las tres especies de Coccinellidae, para elegir la cámara con la fuente de volátiles ($p \leq 0.05$). Sin embargo, cuando se analizó el efecto de la asociación áfido-hospedante, *C. sanguinea* requirió un tiempo significativamente menor para seleccionar la fuente de olores. Estas variaciones se atribuyen a la mayor atracción ejercida por emisiones de volátiles inducidos, que actúan como sinomonas en el caso de *C. sanguinea*.

Palabras clave: *Myzus persicae*, *Capsicum annuum*, infoquímicos, *Eriopis connexa*, *Cycloneda sanguinea*, *Harmonia axyridis*.

REFERENCES

EIGENBRODE, S. D.; BERNAYS, E. A. 1997. Evaluation of Factors Affecting Host Plant Selection, with an Emphasis on Studying Behaviour.pp. 147-169 *In*: Methods in Ecological & Agricultural Entomology. Edited by Dent, D. R. and Walton, M. P., U. K.

FRANCIS, F.; LOGNAY, G.; HAUBRUGE, E. 2004. Olfactory responses of the aphid and host plant volatile releases: (E)-β-farnesene an effective kairomone for the predator *Adalia bipunctata*. *Journal of Chemical Ecology*, **30** (4): 741-755.

GEERVLIET, J. B. F; ARIËNS, S.; DICKE, M.; VET, L. E. M. 1997. Long-Distance assessment of patch profitability through volatile infochemicals by the parasitoids *Cotesia glomerata* and *C. rubecula* (Hymenoptera: Braconidae). *Biological Control*, **11**: 113-121.

GEERVLIET, J. B. F.; VREUGDENIL, A. I.; DICKE, M.; VET, L. E. M. 1998. Learning to discriminate between infochemicals from different plant-host complexes by the parasitoids *Cotesia glomerata* and *C. rubecula*. *Entomologia Experimentalis et Applicata*, **86**: 241-252.

HEIT, G., MA. V. CIARLA y G. MAREGGIANI. 2004. Olfatómetro de Aire Estático: Una Herramienta de Estudio Comportamental de Artrópodos Frente a Distintos Genomas Vegetales. Simposio Internacional de Biotecnología. Aplicación en Alimentos, Salud y Medio Ambiente. p.120. San Miguel de Tucumán. Tucumán.

HUNTER, M. D. 2002. A breath of fresh air: beyond laboratory studies of plant volatile-natural enemy interactions. *Agricultural and Forest Entomology*, **4**: 81-86.

ROMERIS, J.; SHANOWER, T. G.; ZEBITZ, C. P. W. 1998. Physical and chemical plant characters inhibiting the searching behaviour of *Trichogramma chilonis*. *Entomologia Experimentalis et Applicata*, **87**: 275-284.

RÖSSE, U. S. R.; LEWIS, W. J.; TUMLINSON, J. H. 1998. Specificity of Systemically Released Cotton Volatiles as Attractants for Specialist and Generalist Parasitic Wasps. *Journal of Chemical Ecology* , **24** (2):303-319.

SCHOONHOVEN, L. M.; JERMY, T.; VAN LOON, J. J. A. 1998. Insect-Plant Biology. From physiology to evolution. 377 pp. London.

TÁKACS, S; GRIES, G.; GRIES, R. 1997. Semiochemical-mediated location of host habitat by *Apanteles carpus* (Say) (Hymenoptera:Braconidae), a parasitoid of clothes moth larvae. *Journal of Chemical Ecology*, **23** (2): 459-472.

VET, L. E.; DICKE, M. 1992. Ecology of infochemical use by natural enemies in a tritrophic context. *Annual Review of Entomology*, **37**:141-172.

(Recepción: 9 junio 2005)
(Aceptación: 3 noviembre 2005)