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DAVETS, J., GABARRA, R., and CASTANE', C. (1993). *Frakliniella occidentalis* predation by native natural enemies. IOBC/WPRS,**16**(2): 137-140.
DAVETS, J. and CASTANE', C. (1994). Abudance and host plant preferences for oviposition of *Orius spp*. (Heteroptera: Anthocoridae) along the Mediterranean coast of Spain. Bull. OILB/SROP, **17**(5):230-236.
VELLA, L., ARZONE, A. and ALMA, A. (1991). Researches on *Orius laevigatus* (Fieb), a Predator of *Frankliniella occidentalis* (Perg.) in greenhouses. A preliminary note.Bull. WPRS/SROP, **XIV**/5: 65-72.
RNON R.S. and GILLESPIE D.R. (1990). Spectral respectiveness of *Frankliniella occidentalis* (Thysanoptera: Thripidae) determined by trap catches in greenhouses. Environ. Entomol., **19**(5): 1229-1241.
LEVIELLE, M. and MILLOT, P. (1991). Lutte biologique contre *Frankliniella occidentalis* avec *Orius laevigatus* sur Fraisier. Bull. SROP/WPRS, **XIV**/ 5: 57-61.

RESPONSE OF THE ANTHOCORIDS *Orius laevigatus* AND *Orius albidipennis* AND THE PHYTOSEIID *Amblyseius cucumeris* FOR THE CONTROL OF *Frankliniella occidenatalis* IN COMMERCIAL CROPS OF SWEET PEPPERS IN PLASTIC HOUSES IN MURCIA (SPAIN).

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SUMMARY

Since the first appearance of Tomato Spotted Wilt Virus (TSWV) in Southeast Spain in 1990, the complex of this virus and its vector, *Frankliniella occidentalis* constitutes the most important phytopathological problem in the region. In crops of sweet peppers under plastic, the control of *F.occidentalis* is being achieved by chemical methods. Sometimes these treatments are insufficient to maintain the populations under acceptable economic thresholds, considering the damage caused by this species as a vector of TSWV.

During the 1995/96 season IPM trials were carried out in two commercial plastic houses to test the efficacy of the simultaneous use of *Amblyseius cucumeris*, *Orius laevigatus* and *Orius albidipennis* in the control of *F.occidentalis*. Another plastic house using chemical control was used as a comparison. In each of the three plastic houses, populations of the relevant species were monitored by taking samples of leaves and flowers weekly, from the beginning to the end of the crop.

The use of natural enemies for the control of Thrips gave satisfactory results, comparable with the results achieved with chemical control. In one of the plastic houses where integrated pest management was used, *Amblyseius cucumeris* reached a maximum of 3,8 predatory mites/flower in the middle of March; *F.occidentalis* reached its maximum population in the middle of May with 4,7 individuals/flower, and one month later *Orius spp.* reached a peak level of 3,6 individuals/flower. In the second plastic house a peak of 17,5 *Amblyseius cucumeris*/flower was recorded in the middle of February; *F.occidentalis* reached a maximum of 10,7 individuals/flower in early June, and *Orius spp.* reached a peak of 1 individual/flower one month later. In the plastic house where chemical control was used, 6,6 *F.occidentalis* were present in each flower by the middle of May. A maximum of 20 individuals/flower was recorded at the end of the crop, after the final chemical treatments.

INTRODUCTION

In the Murcia region over 1200 Has. of sweet-peppers are grown in plastic-houses. The complex of *Frankliniella occidentalis* and Tomato Spotted Wilt Virus (TSWV) has constituted the most important phytopathological problem, since 1990, when the presence of TSWV was detected (LACASA, *et al.* 1994). The control of Thrips populations is absolutely vital to reduce or limit the virus incidence. The control of *F.occidentalis* as vector is mainly carried out by chemical methods. When the conditions are optimum for the development, multiplication and movements of thrips, chemical control is insufficient to maintain the level of virus incidence under the economic thresholds (LACASA Y CONTRERAS, 1993). Also, the frequent treatments during spring and summer cause problems of resistance or are incompatibe with programmes of integrated pest management.

Since 1991, different alternative and complementary methods of control have been tested, to reduce the number of chemical interventions: use of dense mesh in the openings of the plastic-houses (LACASA, *et al.* 1994), elimination of infested plants and the use of natural enemies (SANCHEZ, *et al.* 1995). In the sweet-pepper growing areas , the thrips are being multiplied in outside crops, where they remain active throughout the year and produce maximun populations in spring, summer and autumn. A proportion of the alternative host crops are susceptible to TSWV.

The activity and efficacy of some phytoseiids from the *Amblyseius* genus and *Anthocorids* of the genus *Orius* in the control of thrips in the sweet-pepper crops, has been stated by RAMAKERS (1990; 1993), TEILLER and STEINER (1990) and TAVELLA *et al.* (1994). Some of them consider that the most effective control is given by the asocciation of the two types of predators.

The objective of this work was to confirm the response of the predators *A.cucumeris, O. laevigatus* and *O.albidipennis* in commercial sweet-pepper crops for the control of *F.occidentalis*, following the results obtained by SANCHEZ *et al.* (1995) in preliminary trials.

MATERIALS AND METHODS

Three commercial plastic-houses "Tipo capilla" have been used , with drip irrigation and mesh of 14x10 threads/cm in the ventilation opening. The plastic-houses A and C were planted with "Lamuyo Type" peppers while Californian peppers were planted in plastic-house B, with a density of 1x0'4 m. In the three plastic-houses the cultural practices common in the area were used.

Plastic-house A was treated with Lufenuron on 18th December and later with the following natural enemies were released for thrips control: *A.cucumeris* (1 sachet/plant on 13rd Jan and 0'5 sachets/plant on 1st March and 3rd May); *O.laevigatus* (2 adults/m^2 on 2nd Feb. and 8th Feb.) and *O.albidipennis* (1 adults/m^2 the 19th April and 27th April). Also on 20th May the plants from the edges of the plastic-house were treated with acrinatrin. For the control of the other pests *Bacillus thuringiensis* (6 treatments after 24th April) and Piriproxifen (2 treatments, 5th & 18th June) were applied.

Plastic-house B was treated with Lufenuron (27th Dec.) and acrinatrin (5th & 13rd Jan.). Later the following natural enemies were released: *A.cucumeris* (2nd Feb. & 26th April), *O.laevigatus* (16th Feb. & 1st March) and *O. albidipennis* (23rd & 31st May) at the same rates as in the plastic-house A. Also the plastic-house was treated with *Bacillus thuringiensis* (6 times from 28th May), hexitiazox (2nd June) and piriproxifen (21st June). sulphur was applied too (9 times) and specific fungicides.

In the plastic-house C, 19 treatments were used with specific products against thrips making use of metamidofos (14 times), formetanato (4 times), metiocarb (twice), clorpirifos (once) and acrinatrin (once). Other treatment were: *B.thuringiensis* (10 times), lufenuron (3 times), imidacloprid (once), fufenoxuron (once), mtomilo (3 times), priproxifen (3 times), pridafention (once), slphur (19 times) and secific fungicides. In Fig. 5 the dates of the specific applications against thrips are indicated.

A.cucumeris was distributed in sachets; the first release was placed in the fork of the plants while the following releases were placed on the apical branch, near to the flowers. The *Orius* were distributed on the leaves regularly, throughout the plastic-house. *Amblyseius californicus* was released on 30th March, distributing it on the leaves.

To follow the population evolution of the thrips and their natural enemies, 6 samples of 10 flowers and 6 samples of 10 leaves were taken weekly from the third apex of the plants. These samples were placed into plastic bags hermetically seated and carried to the laboratory in a refrigerated container.

The extraction of the thrips and the predators was done in Berlese-Tullgren funnels with incandescent lamps of 25 w. The individuals that remained in the bags were collected with a brush. All the individuals were collected in alcohol at 10%, to which had been added a wetter (Agral ®) at 1 part per 1000. The adults and larvae of *F.occidentalis* and both species of *Orius*. were counted .Separate counting was carried out of the adults of *A.cucumeris* the other *Amblyseius* species spontaneously associated with the crop, or those that had been released for the control of tetranychid mites (*A.californicus*).

RESULTS

In the plastic-house A the first larvae of *F.occidentalis* were recorded on 22ld February, with a 5 weeks delay prior to finding adults in the flowers. The mean density of thrips in the flowers remained low until early May (Fig. 1). The highest numbers were present between the middle of May and the end of June, with a maximum of 10'7 Thrips/flower.

The populations of *A.cucumeris* reached a maximum of 15 - 20 mites/flower between the first week of February and the first of March (Fig. 1), but later the population decreased until it disappeared in early July. The release made in May had no apparent effect on the level of *A.cucumeris* inside the flowers. *Amblyseius barkeri* occurred naturally, although at much lower numbers than *A.cucumeris*.

The first larvae of *Orius laevigatus* were seen two weeks after the release. The total population increased at the same time as those of *A.cucumeris* , were decreasing (Fig. 1), reaching a relative maximum of 0'4/flower on the 7th of March. They later decreased, registering minimum numbers at the begining of April (Fig. 2). The first larvae of *O.albidipennis* were found two weeks after the release; later the population increased as did the number of thrips. After that moment, the population of *Orius* was mainly made up of *O.albidipennis* (Fig. 2), with over 0,4 *Orius* per flower from the begining of June until mid August. Numbers peaked at nearly 1 *Orius*/flower in the middle of July. Thrips populations were kept at low levels from early July.

The number of flowers/plant increased progessively from transplanting until 7th March, when a maximum of 10 flowers/plant was recorded. After that moment the level decreased until values of 1 - 1'5 flowers/plant were reached between the last week of March and the third week of April. Later there were slight oscillations of the flowering level, but it did not fall below 3 flowers/plant (Fig. 7).

In the plastic-house B adults of *F.occidentalis* were found from the start of the crop. With larvae appearing from the middle of February. The total populations were under 0'6 thrips/flower until early May. Later, the thrips density increased quickly (Fig. 3), at the same time as the numbers of flowers/plant, reaching a maximum of 4'7 thrips/flower. After that moment the level decreased drastically due to predation by *Orius spp.* and was maintained under 0'6 thrips/flower until the end of August when it increased slightly (Fig. 3).

The behaviour of *A.cucumeris* was very similar to that in plastic-house A. The populations increased from the time of release (Fig. 3), maintained over 3 predatory

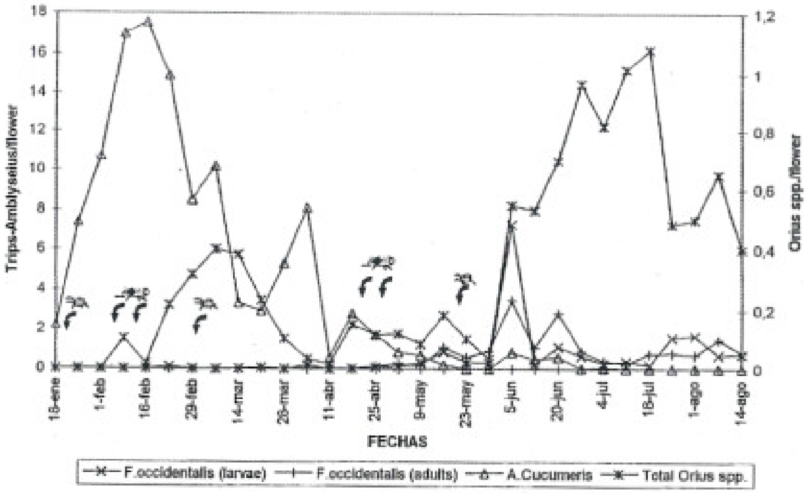

Fig. 1. Plastic-house A. Evolution of *F.occidentalis, Orius spp.* and *A.cucumeris.* Natural enemies release. *Orius spp.* . *Amblyseius cucumeris*.

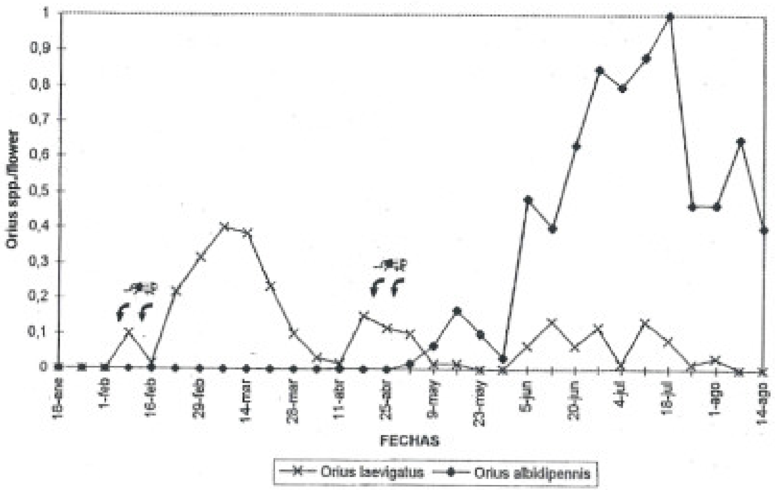

Fig. 2. Plastic-house A. Evolution of *Orius laevigatus* and *Orius albidipennis.*

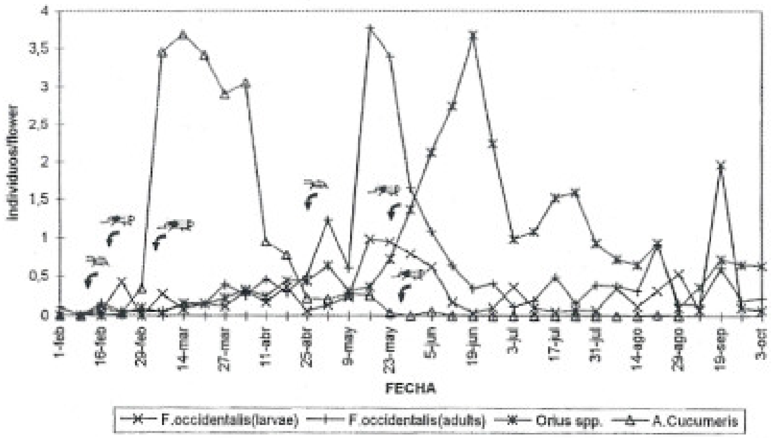

Fig. 3. Plastic-house B. Evolution of *F.occidentalis, Orius spp.* and *A.cucumeris.* Nat enemies release. *Orius spp.* . *Amblyseius cucumeris*.

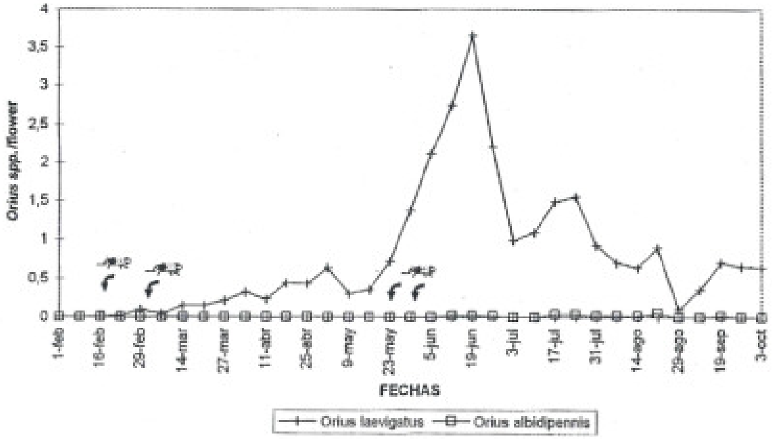

Fig. 4. Plastic-house C. Evolution of *Orius laevigatus* and *Orius albidipennis.*

mites/flower from early March until the middle of April, and then decreased drastically. Later the decline continued until the middle of June, when they disappeared. The release of *A.cucumeris* made at the end of April had no impact in the population level registered inside the flowers.

The first larvae of *O.laevigatus* were found two weeks after the release. The total population of this *Orius sp.* was maintained between 0'2-0'3 Orius/flower from the middle of March until the middle of April, while the level in the middle of May fluctuated between 0'4-0'6 Orius/flower. After that moment numbers increased parallel to the increase of the density of thrips/flower, reaching a maximum of 3'5 Orius/flower on 20th of June. Later the population decreased drastically and continued at the level of 1 Orius/flower until the middle of August, mantaining the level of thrips low from the middle of June until the end of the crop. *O.albidipennis* appeared in the flowers a few weeks after the release, but the population of Orius was composed mainly, of *O.laevigatus* (Fig. 4). In general, the level of flowering in this plastic-house was less variable, with from 6 to 12 flowers/plant from early May until the end of the crop (Fig. 7).

In the plastic-house C, the first few thrips appeared in the flowers at the end of February, not appearing continously until the middle of April (Fig.5). By the middle of May a maximum of 6'6 thrips/flower was reached numbers remained between 2 and 5 thrips/flower from early June until the end of the crop when a maximum of 20 thrips/flower was reached. Even with the treatments, natural populations of *A.barkeri* occurred inside the flowers. These were high during the spring and reduced in the summer, when the treatments were intensified (Fig. 5). The fluctuations in the level of flowering were similar to the plastic-house A.

For the control of *Tetranychus spp. (T.urticae, T.turkestani)* in the plastic-houses of integrated pest management, *A.californicus* was released preventively. In plastic-house A pest hot spots occurred, requiring specific interventions with hexitiazox. In B, *A.californicus* and *Phytoseiulus persimilis*, which appeared spontaneously, achieved a good control of the tetranychids. The control of *Spodoptera exigua* was good, but the control of the caterpillars *Pyrausta nubilalis*, which bore into the fruits was more difficult. In the plastic-houses A and B the control of *Bemisia tabaci* was good, however the population in the plastic-house C was very high after the middle of June. During spring some colonies of Macrosiphum euphorbiae were found in plastic-house B.

DISCUSSION AND CONCLUSIONS

The predators released have established in the crop. They have multiplied and have achieved a good control of the populations of thrips, in comparation with the plastic-house where the chemical control was used.

The phenological evolution of the plant, particularly the level of flowering and the temporal evolution, affects the population evolution of the thrips as well as that of the predators. The decrease of the number of flowers that usually occurs before the first harvest can bring a decrease and in extreme situations nearly cause the extinction of the population of *Orius*. In these cases a second release would be recommended and a change in the plant handling to obtain a level stable of flowering.

The minimum average temperature of the plastic-house is over 10°C after the middle of March, which ensures continued development of the sweet-peppers and of *F.occidentalis*. Between end of April and early May there is a critical period, coinciding with the decrease in the number of flowers/plant. In May the increase of flowering, after the first harvest, is accompanied by an important increase in the population of *F.occidentalis* and a delay of two or three weeks in the increase of the population of *Orius*. The same phenomenom has been

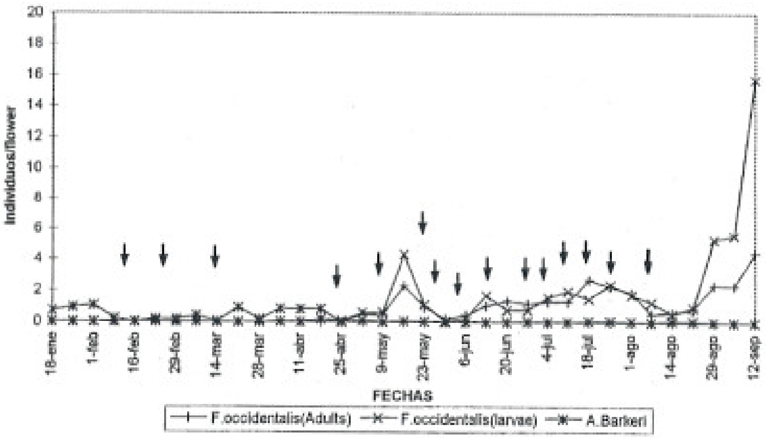

Fig. 5. Plastic-house C. Evolution of *F.occidentalis* and *Amblyseius barkeri*. Treatments for thrips control ↓.

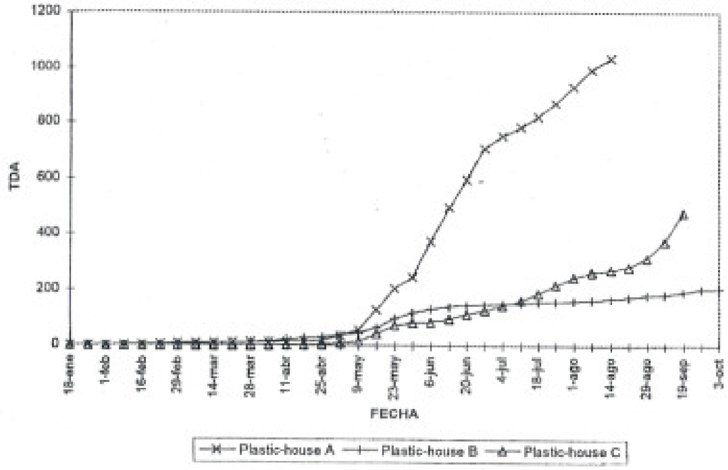

Fig. 6.Evolution of TDA (Acumulated Thrips Day) in the plastic-houses A,B and C.

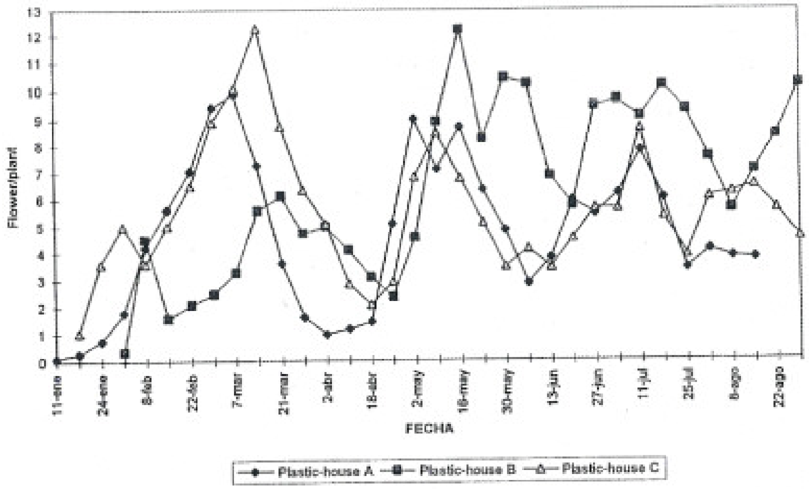

Fig. 7. Flowerin evolution in the plastic-houses A,B and C.

observed by VAN DE VEIRE and DEGHEELE (1993) limiting the growth of *A.cucumeris* populations.

The biological control of F.occidentalis can be achieved by the combined use of *A.cucumeris* and species of *Orius*, as has been stated by RAMAKERS (1993) and SORENSSON and NEDSTAM(1993) in crops under plastic. *A. cucumeris* gives adequate thrips control at the beginning of the crop: it delays the establishment and reduces the multiplication of the thrips, and at the same time it facilitates the establishment of the first releases of Orius.

The drastic decrease of the *A.cucumeris* populations may be a result of the high temperatures and the low humidity which are recorded at the end of April, and by the predatory action of *Orius* (GILLESPIE Y QUIRING, 1992), whose population increased at the same time, when the population of thrips are still low. This direct or antagonistic action of competition for the prey cannot be considered negative in the joint use of both predators (RAMAKERS, 1993).

The evolution of the populations of *F.occidentalis* expressed in TDA (Acummulated thrips day) (Fig. 6) was very close in the plastic-houses B and C, and showded a direct relation with the level of incidence of TSWV, expressed in acummulative percentage of infected plants (LACASA, *et al.* 1994). The proportion of infected plants at the end of the crop was similar in B and C; in plastic-house B the evolution was at progressive intervals from February, while in plastic-house C the progression was higher in the last phases of the crop.

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REFERENCES

GILLESPIE, D.R. & QUIRING, D.J.M. 1992. Competition between *Orius tristicol* (Hemiptera: Anthocoridae) and *Amblyseius cucumeris* (Oudemans) (Acari: Ph feeding on *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae). Entomologist, **124:** 1123-1128.

LACASA, A.; CONTRERAS, J.; TORRES, J.; GONZALEZ, A.; MARTINE GARCIA, F. & HERNANDEZ, A. 1994. Utilización de mallas en el control de *Fr occidentalis* (PERGANDE) y el virus del bronceado del tomate (TSWV) en el Bol.San.Veg.Plagas. **20:** 561-580.

LACASA, A. & CONTRERAS, J. 1993. Comportamiento de *Frankliniella occiden* transmisión del virus del bronceado del tomate: planteamientos para su control. España, **50:** 33-39.

RAMAKERS, P.M.J. 1993. Coexistence of two thrips predators, the anthoco *insidiosus* and the phytoseiid *Amblyseius cucumeris* on sweet pepper. Bulletin OIL **16:** 133-136.

RAMAKERS, P.M.J. & VAN DEN MEIRACKER, R.A.F. 1990. First-rate c Californian thrips with *Orius*. Groenten en Fruit, **46:** 44-45, 47.

SANCHEZ, J.A.; LACASA, A.; CONTRERAS, J. & LORCA, M. 1995. Datos pr sobre la utilización de *Orius laevigatus* (Fieber) en el control de *Frankliniella oc* (Pergande) en pimiento de invernadero. Phytoma-España, **68:** 32-38.

SORENSSON, A. & NEDSTAM, B. 1993. Effect of *Amblyseius cucumeris* a insidiosus on *Frankliniella occidentalis* in ornamentals. Bulletin OILB SROP, **16:** 12

TAVELLA, L.; ALMA, A. & ARZONE, A. 1994. Attività predatrice di *O.* (Anthocoridae) su *Frankliniella occidentalis* (Perg.)(Thripidae) in coltura pr peperone. Informatore fitopatologico, **1:** 40-43.

TEILLER, A.J. & STEINER, M.Y. 1990. Control of the western flower thrips, *Fra occidentalis* (Pergande), with a native predator *Orius tristicolor* (White) in gr cucumbers and peppers in Alberta, Canada. Bulletin OILB SROP, **13(5):** 209-211.

VAN DE VEIRE, M. & DEGHEELE, D. 1993. Control of western flowe *Frankliniella occidentalis* with the predator *Orius insidiosus* on sweet peppers. Bulle SROP, **16:** 185-188.