Seasonal Abundance of Aphidophagous Hoverflies (Diptera: Syrphidae) and Their Population Levels In and Outside Mediterranean Sweet Pepper Greenhouses

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ABSTRACT The species composition and the population dynamics of aphidophagous syrphids (Diptera: Syrphidae) in polyethylene-covered greenhouses of sweet pepper (*Capsicum* spp.) were studied over a 3-yr period in southeastern Spain. Modified Malaise traps were used to sample the adult flies within the greenhouses, accompanied by direct sampling of syrphid larvae on the sweet pepper plants. Over a 2-yr period, modified Malaise traps also were used to record the movement of syrphids into the greenhouses from the surrounding environment. Additionally, the effect of opening or closing the side walls of the greenhouse (ventilation management) on syrphids was assessed by census techniques. In total, nine species of aphidophagous syrphids were found as larvae, preying on aphids on sweet pepper plants. Three of these species, *Eupeodes corollae* (F.), *Episyrphus balteatus* (De Geer), and *Sphaerophoria rueppellii* (Wiedemann), made up 98% of the larvae collected. There was a temporal succession during the season, attributed to temperature, and variability among years related to drought. *S. rueppellii* seems to be the most adapted to survival in the high temperatures and dry conditions. Modified Malaise traps proved effective for monitoring adult syrphids in greenhouses, but they also captured species whose larvae are not associated with the aphid colonies in sweet pepper. This indicates that when studying aphidophagous syrphids, sampling of adults by Malaise trap should be accompanied by sampling of larvae. Larger numbers of syrphids were captured outside of the greenhouse than inside. Opening the side walls of greenhouses increased syrphid numbers within it, and this should be considered in pest management regimes.

KEY WORDS biological control, greenhouses, modified Malaise trap, population dynamics, Syrphidae

The origin of most horticultural products consumed in the European Union is the Mediterranean basin, and Italy, France, and Spain are the main producers (FAO 2006). The main source of sweet peppers (*Capsicum* spp.) in Europe (FAO 2006) is southeastern Spain, which produces 50% of the yield for this crop. In this region 54% of the sweet pepper crops are grown in greenhouses (MAPA 2006). These greenhouses differ in character from those of more northern parts of Europe. Mediterranean greenhouses are usually covered with a single layer of polyethylene (Lindquist and Short 2004), and they have side walls that can be manually opened or closed to improve ventilation.

Aphids are some of the most destructive pests in sweet pepper greenhouses and they tend to become the dominant pest (Ramakers 2004). Aphidophagous hoverflies (Diptera: Syrphidae) are valuable biocontrol agents whose larvae are mainly aphid predators, whereas adults feed on pollen and nectar. Recently, several works have suggested their suitability to be combined with other natural enemies in integrated pest management (IPM) programs (Frechette et al. 2007, Pineda et al. 2007). However, the importance of hoverflies is usually underestimated, because larvae show nocturnal behavior and during the day they are partially hidden on the plants. Several studies have shown that they are the most abundant aphid predators in outdoor crops (Niehoff and Poehling 1995, Jansen 2000, Miñarro et al. 2005, Freier et al. 2007). However, similar studies on crops grown under cover are scarce and mainly related to North American crops (Bugg and Ellis 1990). Today, syrphids are commercially available for release in greenhouses. But, first it is necessary to establish which species are already abundant in the area and to study their phenology, to understand which species might be most usefully released and when releases might appropriately be carried out. This knowledge is available for syrphids in relation to several crops grown in central and northern Europe (Chambers and Adams 1986, Tenhumberg and Poehling 1995, Jansen 2000). However, Mediterranean areas have not yet been well studied.

Opening the side walls of Mediterranean greenhouses is known to facilitate a high degree of inter-

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action between insect populations and some crops (Sánchez and Lacasa 2006), and it can lead to an influx of natural enemies from the surrounding environment, into the greenhouse. Gabarra et al. (2004) have already suggested that greenhouse ventilation could be managed to enhance the entry of whitefly predators. In this work, we report the first results of the effects of ventilation management on aphidophagous syrphid populations.

The movement of adult hoverflies is usually assessed through the use of traps (Laubertie et al. 2006), and in crops yellow water traps are most commonly used. However, these colored traps have proven not to be as effective as other techniques in assessing populations of hoverflies because their selective attraction (Hickman et al. 2001, Laubertie et al. 2006). Moreover, captures using colored water traps are very scarce in the greenhouse (unpublished data). Malaise traps are an effective method of capturing adult syrphids, although they are not commonly used in agroecosystems, due to their complexity, their size, and the high number of captures they achieve, which can decrease natural enemy populations. Platt et al. (1999a) designed a Malaise trap modified for insect monitoring in crops, which is also effective for capturing adult hoverflies (Platt et al. 1999b). Here, we present the first results of use this modified Malaise trap in greenhouses.

The objectives of this work were to 1) identify the aphidophagous syrphid species present in sweet pepper greenhouses in a Mediterranean location, and characterize the population dynamics of the most abundant species during the crop cycle; 2) evaluate the effectiveness of a modified Malaise type trap in monitoring syrphids in greenhouses; 3) assess the population levels of adult hoverflies within greenhouses and in their immediate vicinity; and 4) evaluate the effect of ventilation management on syrphid populations inside the greenhouses.

Materials and Methods

Study Site. The study was conducted in commercial greenhouses of sweet pepper owned by the agricultural cooperative SURINVER S.C., located on Pilar de la Horadada (Alicante). This is in a semiarid climatic zone (Alcaraz et al. 1991) of southeastern Spain, near the Mediterranean coast. Temperature, precipitation, and potential evapotranspiration data were registered by Instituto Valenciano de Investigaciones Agrarias (IVIA) in the agroclimatic station of Pilar de la Horadada. The climatic conditions in the greenhouses also were registered, but because humidity and temperature are controlled with the ventilation management, no differences were observed between years. For this reason and because natural populations of syrphids come from the outside of the greenhouse, we report here the exterior climatic data. Sampling was carried out between 2004 and 2006, when the growing period of the sweet pepper plants takes place. The beginning and ending dates of such sampling were as follows: in 2004, 22 January (week 4) and 9 July (week 28); in 2005, 25 January (week 4) and 6 July (week 27); and in 2006, 27 January (week 4) and 12 July (week 28). Samples were taken every 2 wk until the first syrphids were observed and at weekly intervals from that point onward.

In 2004, 20 greenhouses were monitored, whereas in 2005 and 2006 monitoring took place in a total of 28 greenhouses. Each greenhouse occupied between 1,000 m^2 and 12,000 m^2. All the greenhouses were of the type "Almería", a wooden or aluminum structure covered by thermal polyethylene. Ventilation was made possible by roll-up side walls made of two layers: a polyethylene layer, which is closed during the night, and an anti-thrips net layer, which is managed according to temperature. This net was open during an increasing number of hours as the season progressed, and in spring (from April to July) most of the nets were continuously open. The greenhouse crops were grown either under an IPM system, or an organic system. Agrochemicals were used when required by the farmers, under the rules of the corresponding management system. The region is a traditional agricultural zone and on the land surrounding the greenhouses other crops are grown, both outdoors and under cover. There was no natural vegetation present, and plants developing in crop margins were removed manually, chemically or by burning them.

Sampling of Immature Stages. To investigate which syrphid species were preying on the aphids and their population dynamics, a study of the immature stages was carried out. This part of the work was performed over a 3-yr period, between 2004 and 2006. The sampling methodology began with visiting greenhouses with aphid infestations (indicated by growers), and the establishment of a severity level, on a scale of one to four, related to the status of the majority of the plants. Level 1 meant aphids were present, but only on the terminal apex; level 2 corresponded to aphid presence on two parts of the plant, but the plant as a whole was not infested; level 3 meant that aphids had infested the whole plant, but without a clear reduction in growth, whereas level four showed a clear growth decrease. Next, the aphid species was identified, or a sample was taken and then examined by a specialist. Nevertheless the effect of syrphid presence on plant damage was not evaluated, because it was not one of the aims of this work. Counts of immature syrphids were taken over the entire area of the infestation, by rigorous observation of 200 leaves (sampling unit) of the pepper plants, chosen at random. All the leaves with eggs, larvae, or pupae of syrphids were collected into rearing cages (21 by 15 by 9 cm), and those leaves with such high numbers of aphids that reliable counts could not be undertaken in situ. A single sample was taken in each aphid-infested greenhouse, which changed every week: this translated into working with between zero and seven replications per week. Collected material was reared in a climatic room (22°C, 60–70% RH) until the emergence of the syrphid adults, which were then identified to species level. When needed, larvae were fed ad libitum with *Myzus*

Table 1. Species composition of syrphids occurring in sweet pepper greenhouses in 2004–2006

Species	Larvae						Adults			
	2004		2005		2006		2005		2006	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Chrysotoxum intermedium	0	0	0	0	0	0	0	0	11	1.4
Episyrphus balteatus	483	38.8	2	0.9	81	15.3	0	0	13	1.7
Eupeodes corollae	399	32.0	70	31.1	276	52.1	21	13.6	311	39.9
Meliscaeva auricollis	5	0.4	0	0	0	0	0	0	0	0
Paragus bicolor	0	0	0	0	0	0	9	5.8	48	6.2
Paragus haemorrhous	0	0	0	0	0	0	48	31.2	10	1.3
Paragus quadrifasciatus	0	0	0	0	5	0.9	20	13	34	4.4
Paragus strigatus	0	0	0	0	0	0	4	2.6	0	0
Paragus tibialis	0	0	0	0	0	0	4	2.6	0	0
Scaeva albomaculata	1	0.01	0	0	0	0	0	0	1	0.1
Scaeva pyrastri	0	0	0	0	12	2.3	0	0	1	0.1
Sphaerophoria rueppellii	343	27.6	153	68	147	27.7	47	30.5	297	38.1
Sphaerophoria scripta	13	1.1	0	0	2	0.4	1	0.7	42	5.4
Syrphus ribesii	0	0	0	0	0	0	0	0	1	0.1
Syrphus vitripennis	0	0	0	0	7	1.3	0	0	0	0
Xanthogramma pedissequum	0	0	0	0	0	0	0	0	10	1.3
Total	1,244	100	225	100	530	100	154	100	779	100

persicae Sulzer (Hemiptera: Aphididae) from a stock culture.

Sampling of Syrphid Adults. During 2005 and 2006, a study of syrphid adults was performed using modified Malaise traps. The aim was to compare the population levels of syrphids inside and outside the greenhouses in a long-term study, and to test the efficiency of these traps inside the greenhouses. The trap design is based on the work of Platt et al. (1999a), with an aluminum structure and a collecting container of 100 ml, where 70% ethanol was introduced to kill and preserve the insects. Experimental design consisted of placing one trap inside a greenhouse and one trap outside, in a total of four locations separated from one another by >1 km and surrounded by a similar landscape.

Ventilation Management. During 2005, a short-term study was done over a 7-d period between 7 June and 14 June, to assess the effects of ventilation management on syrphid presence in greenhouses. In total, four greenhouses were selected and divided with an anti-thrips nylon net into units of the same surface area (≈500 m^2). Two greenhouses were divided into three parts and two greenhouses into two parts. The side walls were completely opened in one greenhouse with three units and in one with two units. The side walls were closed with a screen net on the other two greenhouses (one with three units and one with two units), working with a total of five units for each treatment. No aphid populations were present in any of the greenhouses selected, because aphids can greatly influence syrphid behavior. Visual censuses of 15-min duration were carried out in random order (enough time to walk along the whole unit), repeated twice per day. The censuses consisted of walking between every two lines of pepper plants and shaking them simultaneously. All aphidophagous syrphid adults were counted.

Statistical Analyses. To compare differences in captures with Malaise traps inside and outside the greenhouse, and between the 2 yr of sampling, a Mann–Whitney *U* test has been applied because of the nonnormality and nonhomogeneity of variances of the data even after common transformations. Generalized Linear model (GLM) with repeated measures was used to determine the effect of ventilation management on syrphid counts. Sampling days and day period were set as within-group factors and treatment as a between-group factor. Data satisfied the assumptions of sphericity (Mauchly) and homogeneity of variances (Levene). All data were analyzed with the SPSS statistical package (SPSS Inc. 2004).

Results

Syrphid Species Composition and Phenology. During the 3 yr of direct sampling from aphid colonies, we collected a total of 1,999 larvae and puparia of syrphids, belonging to nine aphidophagous species (Table 1). The predominant three species (97.8% of individuals) were *Eupeodes corollae* (F.) (37.3%), *Sphaerophoria rueppellii* (Wiedemann) (32.2%), and *Episyrphus balteatus* (De Geer) (28.3%). In 2004, a total of 1,244 larvae were reared. The three predominant species proved to make up similar proportions of the total catch (Table 1).

During 2004, the three predominant species (Fig. 1a) did not occur in the greenhouses before week 15 (5 April), although aphid colonies had already been present from week 3 (15 January). A temporal succession in the appearance of the three main species was observed. *E. corollae* occurred first, exhibiting a maximum in week 15 (5 April), with a decrease in larval numbers when the temperature increased. *E. balteatus* peaked in week 21 (20 May), followed by *S. rueppellii*, which was most abundant during weeks 23–26 (June). The last observation of hoverflies was in week 26, and the last aphid colony was sampled in week 27.

During 2005, the total number of syrphid larvae observed was 225, 80% less than was observed in 2004. The relative numbers of the three main species

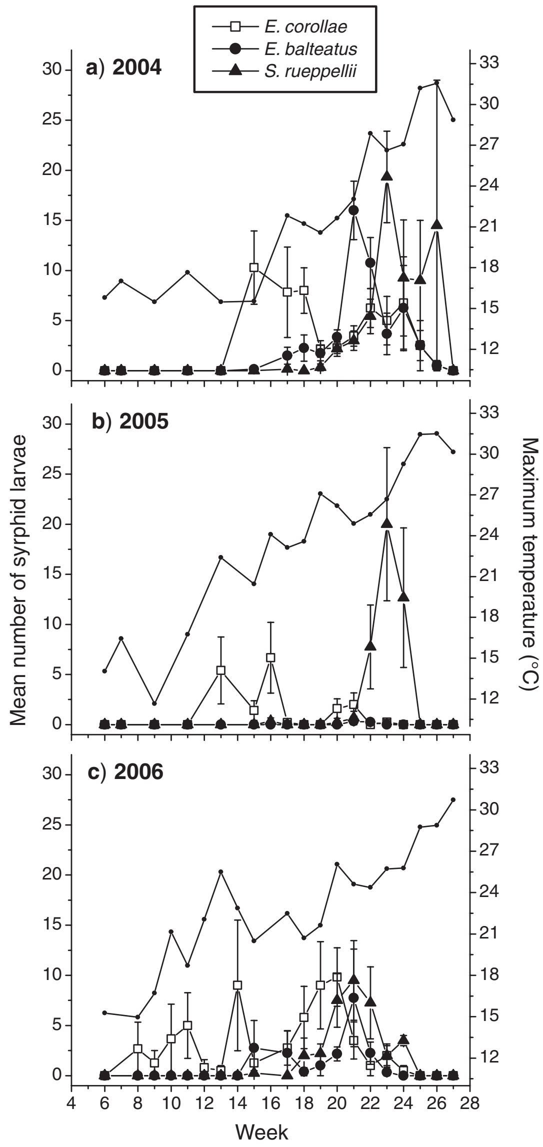

Fig. 1. Maximum temperature (°C) and population dynamics of the main aphidophagous syrphid species observed as immature stages during the pepper culture in 2004 (a), 2005 (b), and 2006 (c). Sampling unit consisted of the observation of 200 leaves per greenhouse. Data are means and standard errors.

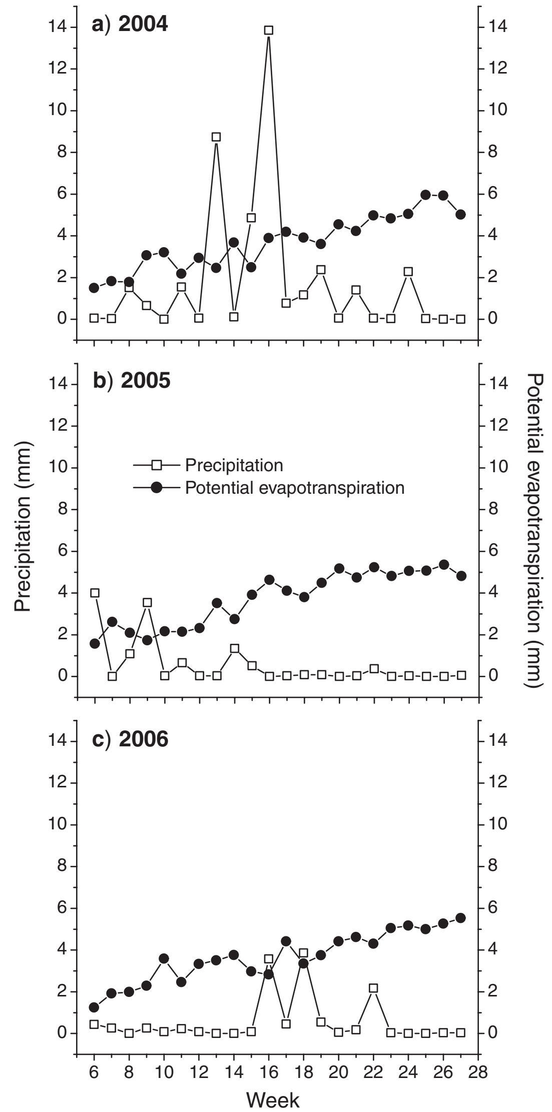

Fig. 2. Precipitation (millimeters) and potential evapotranspiration (millimeters) registered at the climatic station located close to the study area (Pilar de la Horadada). Data from the Servicio de Tecnología del Riego (IVIA). Data are means and standard errors.

changed also in 2005 (Table 1). *E. balteatus* was the least abundant with only 1% of the total catch, followed by *E. corollae* with the same proportion as in 2004, and the most abundant species was *S. rueppellii,* with a relative abundance of 68%. We can observe (Fig. 1b) that the population dynamics of these species follow the same pattern as in 2004, but with a reduced peak in the *E. balteatus* population.

In 2006, we counted a total of 530 syrphid larvae (Table 1), intermediate between 2004 and 2005. *E. corollae* was the most abundant species, followed by *S. rueppellii* and *E. balteatus.* The population dynamics of these species were similar to previous years, but with a greater peak for *E. balteatus* compared with 2005 (Fig. 1c).

Figure 2 shows the potential evapotranspiration and precipitation over the 3 yr, indicating the drought conditions. In 2004, there was a rain period between weeks 12 and 17, at the beginning of the spring. In 2005, the rain period occurred earlier than in 2004 (between weeks 6 and 9), and with less intensity than in 2004, leading to a drought period during the rest of the period of crop development. In 2006, the precip-

Table 2. Percentage of samples (%) of a 3-yr sampling, with a severity level from 1 to 4, with presence or not of immature stages of syrphids, and with different aphid species

Year	No. samples	Severity level				Syrphid presence		Aphid species[a]			
		1	2	3	4	Yes	No	Mp	Me	Ag	As
2004	90	5.6	31.1	41.1	22.2	92.2	7.8	81.1	13.3	4.4	1.2
2005	45	44.4	35.6	15.6	4.4	44.4	55.6	48.9	20	31.1	0
2006	72	32.9	34.2	27.4	5.5	61.6	38.4	41.1	49.3	8.2	1.4

[a] M. persicae, M. euphorbiae, A. gossypii, and A. solani.

itation level was similar to 2005, but the rain period was in spring as it was in 2004, between weeks 15 and 19.

Aphid Species and Their Relationship with Syrphids. On the sweet pepper plants, we found the aphid species *M. persicae* (60%), *Macrosiphum euphorbiae* (Thomas) (27%), *Aphis gossypii* Glover (12%), and *Aulacorthum solani* (Kaltenbach) (1%), with some differences over the 3 yr. Considering aphid attack severity (Table 2), 2004 registered the highest and most frequent infestations. The two lowest levels of infestation were 80% in 2005 and 67% in 2006, respectively. A change in the relative abundance of the two main aphid species also was observed (Table 2), with a continuous increase for *M. euphorbiae* over the period of study, coinciding with a decrease of *M. persicae.*

Table 3 shows the relationships reported for the first time between syrphid species, aphid species and host plant (sweet pepper). All the syrphids found feeding on aphids, with the exception of *Scaeva pyrastri* (L.), have not previously been reported in the literature in connection with sweet pepper. One new syrphid–aphid relationship was found, namely, predation by *Paragus quadrifasciatus* Meigen on *M. euphorbiae.* All the syrphid–aphid–host plant relationships observed were novel.

Malaise Trap Catches. The Malaise trap catches of aphidophagous syrphids showed a species composition slightly different from that obtained by direct sampling (Table 1). The first difference was that adults of several species of the genus *Paragus* were proportionally more frequent in Malaise trap catches from the greenhouses than in catches from direct sampling. With regard to the three main syrphid species, *E. balteatus* always made up a smaller proportion of Malaise trap catches than catches from direct sampling. By contrast, the proportion of Malaise trap catches represented by *E. corollae* and *S. rueppellii* paralleled their representation in catches from direct sampling.

The population dynamics of the main aphidophagous species observed in the catches from Malaise traps inside greenhouses in 2005 (Fig. 3a) and 2006 (Fig. 3b) shows a similar pattern to that obtained from the results of direct sampling of the developmental stages (Fig. 1). In both years, we observed clearly the same temporal succession of *E. corollae* and *S. rueppellii.* However, in 2006 the most important fact is that the numbers of syrphids trapped outside the greenhouses (Fig. 3d) were almost 10 times greater than inside (Fig. 3a and b) and than in 2005 (Fig. 3c).

Movement of Hoverflies. For the species captured by Malaise trap (Fig. 4), we found a significantly higher number of syrphids in the traps installed outside the greenhouses than inside in 2005 ($Z = -4.43$, $P < 0.001$) and 2006 ($Z = -5.76$, $P < 0.001$). The number of syrphids captured outside was significantly higher in 2006 than in 2005 ($Z = -2.15$, $P = 0.03$), but the captures from inside the greenhouse did not differ between years ($Z = -1.30$, $P = 0.19$).

The ventilation management experiment (Fig. 5) shows that significantly higher numbers of adult syrphids occur inside the greenhouses when their side walls are open, than when the side walls are closed ($F = 162.77$, df = 1, $P < 0.001$). No significant differences were found between the 6 days of sampling ($F = 1.03$, df = 5, $P = 0.41$) or between morning and afternoon sampling ($F = 0.28$, df = 1, $P = 0.61$).

Table 3. List of the new relationships found in this work between syrphid–host plant (sweet pepper), syrphid–aphid (aphid), and the combination of both syrphid–aphid–host plant (comb.)

Syrphid species	Sweet pepper	*M. persicae*		*M. euphorbiae*		*A. gossypii*		*A. solani*	
		Aphid	Comb.	Aphid	Comb.	Aphid	Comb.	Aphid	Comb.
Episyrphus balteatus	*	R	*	R	*	R	*	—	—
Eupeodes corollae	*	R	*	R	*	R	*	R	*
Meliscaeva auricollis	*	R	*	—	—	—	—	—	—
Paragus quadrifasciatus	*	—	—	*	*	—	—	—	—
Scaeva albomaculata	*	R	*	—	—	—	—	—	—
Scaeva pyrastri	R	R	*	R	*	—	—	—	—
Sphaerophoria rueppellii	*	R	*	R	*	R	*	—	—
Sphaerophoria scripta	*	R	*	—	—	—	—	—	—
Syrphus vitripennis	*	—	—	R	*	—	—	—	—

*, new relationships reported here; R, already reported by Rojo et al. (2003); and —, relationship not observed in this work.

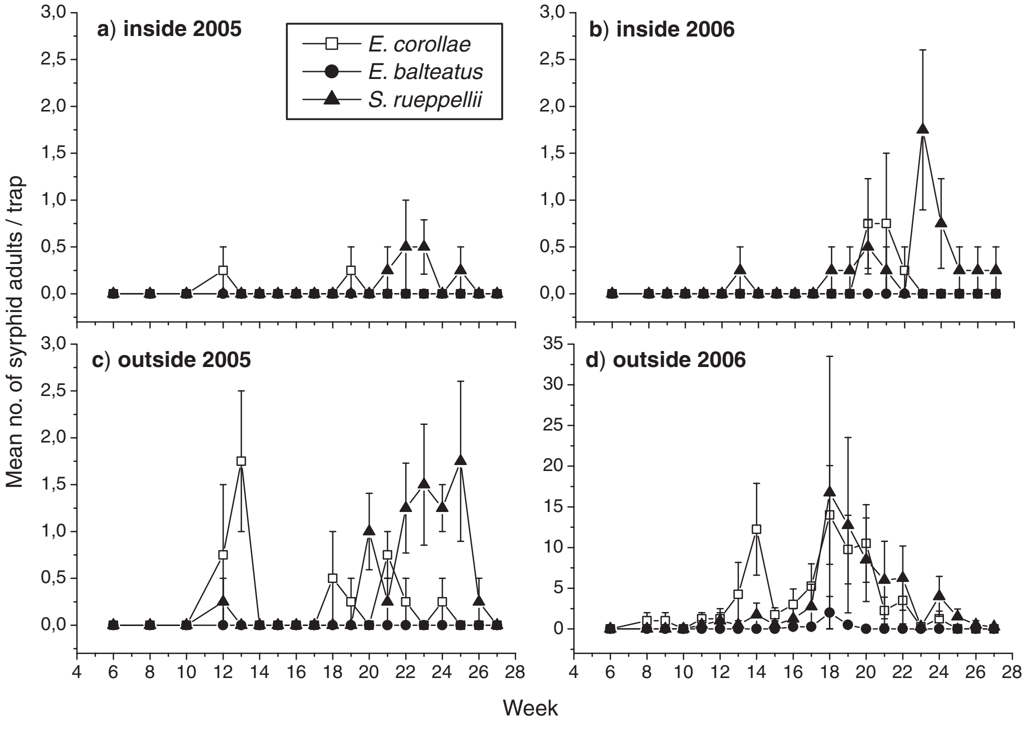

Fig. 3. Population dynamics of the main aphidophagous syrphid species, captured as adults by the modified Malaise trap during the pepper culture. Traps were placed inside in 2005 (a) and 2006 (b) and outside the greenhouses in 2005 (c) and 2006 (d). In d, the scale is 10 times higher than in the rest figures. Data are means and standard errors.

Discussion

This work confirms, for the first time, that natural populations of aphidophagous syrphids can occur inside Mediterranean region greenhouses with sweet pepper crops. We found that the most abundant species were *E. corollae*, *E. balteatus*, and *S. rueppellii* and that the larvae of these species succeed one another on the plants (Fig. 1), during the crop's growing period. Several studies carried out in outdoor crops have reported that sometimes *E. balteatus* occurs before *E. corollae* (Rojo 1995, Krause and Poehling 1996). For this reason, and because both species are very common in central Europe, we believe that the succession observed in *E. corollae* and *E. balteatus* is probably due to differences in the local population levels and not to

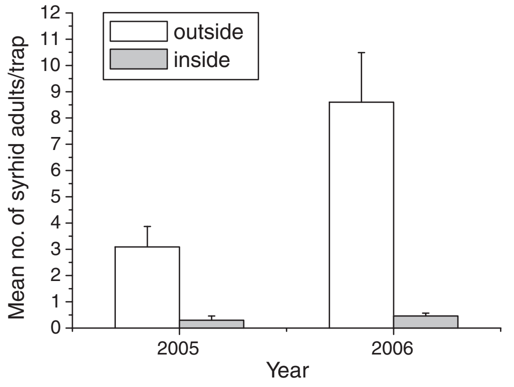

Fig. 4. Adult hoverflies recorded with modified Malaise traps during 2005 (n = 64) and 2006 (n = 80), outside and inside sweet pepper greenhouses. Data are means and standard errors.

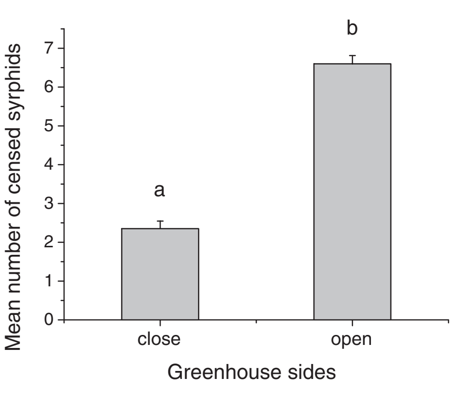

Fig. 5. Syrphid adults observed in greenhouses with side screens open and closed, assessed by censuses of 7-d duration. Different letters indicate statistically significant differences ($P < 0.001$; GLM). Data are means and standard errors.

migration or an increase in temperature. Nevertheless, the later disappearance of *E. balteatus* and appearance of *S. rueppellii* seems to be related to the climatic conditions, and more specifically to the temperature increase (Fig. 1). Hart et al. (1997) observed a high mortality of *E. balteatus* with temperatures over 25°C. The daily maximum temperature recorded was over this limit from week 22 in 2004, week 19 in 2005, and week 20 in 2006. This is concordant with the results here proposed, where *E. balteatus* population level decreased around week 21 for the 3 yr.

The order of abundance we observed was first, *E. corollae,* then *S. rueppellii,* and last *E. balteatus* (Table 1). This result is different from studies performed in several countries from central Europe, which found that *E. balteatus* was by far the most abundant species (Chambers and Adams 1986, Tenhumberg and Poehling 1995, Jansen 2000, Freier et al. 2007). The population dynamics of *E. balteatus* show great variation between years (Fig. 1). We would agree with the suggestion of Niehoff and Poehling (1995) that this variability is due to climatic factors, and more specifically, the drought. In Fig. 2, when the line of potential evapotranspiration crosses the line of precipitation, drought is occurring (Lockwood 1999). According to this analysis, the driest year was 2005, followed by 2006, and then 2004. The population levels of *E. balteatus* were negatively correlated with these climatic data, being highest in 2004, intermediate in 2006, and lowest in 2005. The *E. corollae* population also was negatively affected by the drought, following the same pattern as *E. balteatus.* Both species play an important role in aphid pest control in central Europe (Chambers and Adams 1986, Krause and Poehling 1996), but our results suggest that *E. corollae* seems to be more tolerant to the dry conditions than *E. balteatus.*

S. rueppellii provides a special case, being much more abundant than the other species in the driest year (2005). Other studies in the southeast of Spain also have shown its importance in several outdoor crops (Rojo and Marcos-García 1998, Pascual-Villalobos et al. 2006), but to our knowledge this is the first work that shows its importance in greenhouse conditions. *S. rueppellii* is widely distributed, but it is especially abundant in crops in the Mediterranean basin (Speight 2005). We consider that of all the species recorded, this is the best adapted to the dry and warm conditions present in this Mediterranean area and in particular to the extreme conditions present inside greenhouses. Because only *E. balteatus* is in commercial production, we believe that *S. rueppellii* would be a very interesting species to make available commercially, mainly because of its abundance even in drought conditions.

Aphid attack also was affected by the dry conditions, and we observed the same pattern during the 3 yr as for the syrphids *E. balteatus* and *E. corollae.* This decrease in aphid populations in dry years could also indirectly affect the syrphid population dynamics observed. Nevertheless we did not perform any exclusion experiment to assess if the impact of aphids on plants was reduced with syrphid presence. Most of the aphid samples collected the first year were composed of *M. persicae,* but this species progressively decreased over the 3 yr, whereas the proportion of samples of *M. euphorbiae* progressively increased (Table 2). This change has consequences for pest management, because *M. euphorbiae* is not effectively controlled by *Aphidius colemani* Viereck (Hymenoptera: Aphidiidae), the main biological control agent released in greenhouses for aphid control.

Malaise traps captured large numbers of adults of several species from the genus *Paragus.* But only five larvae (from 1999 individuals) of *P. quadrifasciatus* were collected on the sweet pepper plants. However, we consider that the role of *Paragus* species in aphid control in sweet pepper greenhouses is not important, even though adults are abundant in such greenhouses.

The syrphids observed in Mediterranean greenhouses show a movement of natural enemies, another confirmation of the semiopen structure of Mediterranean greenhouses as an intermediate condition between an open-air field and a glass greenhouse. Greenhouse screening was designed to avoid the passage of pests to the greenhouses, and it is sometimes recommended in the Mediterranean region (Berlinger et al. 1988). Nevertheless, because of the extreme temperatures that are present in the greenhouses during spring and summer, keeping these side screens open for ventilation is a common practice in the Mediterranean region. We have shown that by opening the side walls completely, the presence of syrphids inside the greenhouse increases, as Gabarra et al. (2004) found for whitefly predators. Syrphids are easily observed in the field in sunny days of spring, between 0800 and 1100 h in the morning (unpublished data). This research suggests that under these conditions, and when there is a high aphid attack, greenhouse ventilation can be managed to enhance syrphid entrance.

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