

Collection of *Orius* species in Italy

Maria Grazia TOMMASINI

CRPV - Centro Ricerche Produzioni Vegetali, Diegaro di Cesena (FC) Italy

Abstract

Predators belonging to the genus *Orius* were collected in several areas in Italy on 18 species of vegetable crops, 10 species of ornamental crops, on tobacco and prickly pear, and on 6 species of wild plants. Five *Orius* species which prey on small arthropods (thrips included) and one species, *O. pallidicornis* (Reuter), which feeds on pollen of the wild plant *Echallium elaterium* (L.) A. Richard were found. The most common species were *O. niger* Wolff, *O. laevigatus* (Fieber) and *O. majusculus* (Reuter). No clear host-plant preferences of these thrips species were recorded. The species showed different geographic distributions. *O. niger* was found to be widely common in all the Italian regions. *O. laevigatus* was frequently found, was the most abundant species in central and southern regions, but was rare in the northern regions. *O. majusculus* decreased in abundance from northern to central Italy, and was absent below 38° N latitude. *O. horvathi* (Reuter) and *O. vicinus* (Ribaut) were recorded only once on raspberry (in northern Italy) and on sweet pepper (on Sicily), respectively. The phytophagous species *O. pallidicornis* was found only on Sicily. The distribution map of the predators indicates that *O. laevigatus* is the predominant species in the warmest areas, *O. majusculus* in the coldest areas, while *O. niger* occurs all over Italy in similar amount. The survey indicates that *O. niger* and *O. laevigatus* are well adapted to the Mediterranean area which may make them good candidates for biological control of thrips.

A morphological key for identification of live female adults belonging to the three *Orius* species predominant in Italy was designed in order to simplify identification in the future.

Key words: Heteroptera, Anthocoridae, *Orius laevigatus*, *Orius niger*, *Orius majusculus*, *Orius pallidicornis*, *Orius albidipennis*, *Orius horvathi*, *Orius vicinus*, distribution, thrips.

Introduction

The host-plant range of the thrips pest *Frankliniella occidentalis* (Pergande) in Europe is very large and includes both cultivated and non-cultivated plants. Vegetable as well as ornamental crops are damaged by thrips directly and indirectly (i.e. like the transmission of viruses) (Tommasini and Maini, 1995). The list of host plants also includes table grapes, where severe outbreaks have been recorded in southern Italy (Laccone, 1992), and some fruit trees like nectarine in both South (Marullo, 1991) and North Italy (Tommasini and Ceredi, 2001; Tommasini and Burgio, 2004).

The aim of this research was to identify possible candidates as natural enemies of thrips.

To evaluate a natural enemies for biological control, is first necessary to search in the area of origin to determine if an efficient predator, parasitoid or pathogen is present (Luck *et al.*, 1988). A collection of one group of thrips natural enemies, heteropteran *Orius* spp., was carried out in many Italian regions, including greenhouse crops and open field crops infested by *F. occidentalis*. An initial identification of the prey-predator association, the predator location within the habitat and direct observations of predation activity on the target pest is helpful to discover new natural enemies (Luck *et al.*, 1988). The *Orius* species studied here are indigenous predators in Europe, while *F. occidentalis* is a pest imported from North America. Therefore, the approach followed here is not a search of natural enemies in the area of origin of *F. occidentalis*, but a study of potential endemic natural enemies of an introduced exotic pest. Such new combination can give very good biological control results (see e.g. van Lenteren, 1997).

Similar collection studies were carried out along the

North-eastern coast of Spain by Goula *et al.*, (1993), Riudavets and Castañé (1994) and Lacasa *et al.* (1996). A general survey on distribution of *Orius* spp. in Europe was first produced by Péricart (1972). Many authors provided information on *Orius* distribution in specific areas in Europe (González Zamora *et al.*, 1992; Gargani, 1993; Vacante and Tropea Garzia, 1993; Vacante, 1993; Chambers *et al.*, 1993; Frescata and Mexia, 1996; Lykouressis, 1993; Tavella *et al.*, 1994; Ivancich Gambaro, 1995; Lykouressis and Perdikis, 1997; Barbetaki *et al.*, 1999).

In this paper, the results of an intensive predator collection project in Italy are reported and the data are compared with other data on distribution of *Orius* species.

Materials and methods

A list of plants infested by thrips pests and particularly by *F. occidentalis*, was compiled by checking the literature and taking into account the observations of several crop protection specialists working in various Italian regions. The list included 19 vegetable crops (sweet pepper, eggplant, cucumber, melon, watermelon, zucchini, bean, French bean, pepper, basil, pumpkin, tomato, lettuce, onion, leek, strawberry, raspberry, black currant and tobacco), 10 ornamental crops (gerbera, chrysanthemum, oleander, rose, dahlia, gladiolus, geranium, impatiens, prickly pear and hibiscus), and 5 wild plants [*Echallium elaterium* (L.) A. Richard, *Cirsium* spp., *Sinapsis alba* (L.), *Crepis* spp. and *Inula viscosa* (L.)]. Collection of predators belonging to the genus *Orius* was carried out in 30 Italian Provinces from North to South in both pro-

tected and open field crops. The collection was undertaken during the summer periods from June to September during four years (1991-1994). In order to follow a standard methodology for each crop, mainly the flowers were monitored and *Orius* adults were collected with a 'mouth aspirator'. Sampling continued for at least 20 minutes per plant, even when no *Orius* were found.

Specimens were preserved in 75% alcohol. Adult males were dissected in the laboratory for identification by comparing the parameres of their sexual organs using a stereomicroscope. The keys of Péricart (1972) were mostly used for taxonomic identification.

Results and discussion

During the survey of four years, 518 samples were taken resulting in the collection of 4,931 individuals,

which comprised 6 *Orius* species. In the Mediterranean basin plastic tunnels are generally used for growing protected crops and they usually remain open for a large part of the crop cycle. The result is a continuous exchange of pests and natural enemies between outdoors and indoors. Therefore, samples collected in the open field and in the greenhouse were considered together. The sampling data are reported in tables 1a and 1b and figure 1 and show that *O. laevigatus* (Fieber) (subgenus *Orius* s. str.), *O. niger* Wolff (subgenus *Orius*) and *O. majusculus* (Reuter) (subgenus *Heterorius* Wagner) were the species most frequently found. They formed 57.58%, 37.51% and 4.05% respectively of the total number of specimens checked. The other three species, *O. horvathi* (Reuter) (subgenus *Heterorius*), *O. vicinus* (Ribaut) (subgenus *Heterorius*) and *O. pallidicornis* (Reuter) (subgenus *Orius*), were collected in very low numbers (0.82%, 0.02% and 0.02% respectively of the total).

Table 1a. Relative abundance of *Orius* species collected in Italy on several plants.

Plants	<i>O. laevigatus</i>	<i>O. majusculus</i>	<i>O. niger</i>	<i>O. pallidicornis</i>	<i>O. horvathi</i>	<i>O. vicinus</i>
Sweet pepper	+++	+++	+++	–	–	+
Eggplant	+++	++	+++	–	–	–
Melon	+++	++	++	–	–	–
French bean	+++	++	+++	–	–	–
Zucchini	++	++	++	–	–	–
V Pepper	+	+	+	–	–	–
E Pumpkin	+	+	+	–	–	–
G Basil	+++	+	++	–	–	–
E Strawberry	++	+	+++	–	–	–
T Cucumber	++	++	++	–	–	–
A Tomato	–	+	–	–	–	–
B Lettuce	–	+	+	–	–	–
L Water melon	+	+	++	–	–	–
E Bean	++	+	+	–	–	–
Raspberry	+	+	+	–	+	–
Black currant	–	+	–	–	–	–
Onion	–	+	–	–	–	–
Leek	+	+	+	–	–	–
Tobacco	+	+	++	–	–	–
O Oleander	++	+	++	–	–	–
R Rosa	+	–	+	–	–	–
N Gerbera	+	+	++	–	–	–
A Impatiens	–	–	+	–	–	–
M Dalia	–	–	+	–	–	–
E Gladiolus	–	–	+	–	–	–
N Hibiscus	+	++	++	–	–	–
T Geranium	+	+	+	–	–	–
A Chrysanthemum	+	+	++	–	–	–
L Prickly pear	+	–	–	–	–	–
O <i>Ecballium elaterium</i>	–	–	+	+++	–	–
T <i>Cirsium</i>	+	–	+	–	–	–
H <i>Sinapsis alba</i>	+	–	+	–	–	–
E <i>Crepis</i>	–	–	+	–	–	–
R <i>Inula viscosa</i>	+	–	++	–	–	–

Legend: – never found, + rare (1-3 samples occurrence), ++ common (4-10 samples occurrence), +++ abundant (> 10 samples occurrence).

Table 1b. Number specimens of *Orius* species collected in Italy on several plants.

Plants	<i>O. laevigatus</i>	<i>O. majusculus</i>	<i>O. niger</i>	<i>O. pallidicornis</i>	<i>O. horvathi</i>	<i>O. vicinus</i>
Sweet pepper	1360	54	572			1
Eggplant	91	18	68			
Melon	116	7	41			
French bean	1040	17	570			
Zucchini	32	9	28			
V Pepper	7	4	11			
E Pumpkin	3	1	6			
G Basil	101	2	54			
E Strawberry	43	5	199			
T Cucumber	22	32	16			
A Tomato		1				
B Lettuce		4	4			
L Water melon	16	3	65			
E Bean	46	6	9			
Raspberry	1	5	6		1	
Black currant		9				
Onion		1				
Leek	5	2	4			
Tobacco	6	6	14			
O Oleander	31	2	34			
R Rosa	10		6			
N Gerbera	12	1	41			
A Impatiens			1			
M Dalia			2			
E Gladiolus			2			
N Hibiscus	6	6	12			
T Geranium	1	2	3			
A Chrysanthemum	1	1	11			
L Prickly pear	1					
O <i>Ecballium elaterium</i>			1	40		
T <i>Cirsium</i>	1		5			
H <i>Sinapsis alba</i>	1		1			
E <i>Crepis</i>			1			
R <i>Inula viscosa</i>	4		37			
Total	2857	198	1834	40	1	1
%	57.9	4.0	37.2	0.8	0.02	0.02
Total	4931					

Péricart (1972) described *O. pallidicornis* as species feeding on pollen, clearly associated with its host plant *E. elaterium*. Goula *et al.* (1993) found this species also on *Amaranthus blitoides* (L.) in Spain. *O. pallidicornis* was found only in some areas on Sicily (37-38° N latitude) on *E. elaterium*.

When *O. pallidicornis* is excluded from the analysis, no strict link appears to exist between *Orius* species and plants or a groups of plants (tables 1a and 1b), so it can be concluded that no strong host-plant preferences exist in these *Orius* species.

In general, *O. laevigatus* was the most abundant species in Italy, particularly on vegetable crops. This confirms the findings of Tavella *et al.* (1994) who sampled *Orius* spp. on sweet pepper at the North-western Italian coast, and Vacante and Tropea Garzia (1993a) who collected *Orius* species on sweet pepper on Sicily (southern Italy). Similar data were recorded in Spain

(González Zamora *et al.*, 1992; Goula *et al.*, 1993; Riudavets and Castañé, 1994), Portugal (Frescata and Mexia, 1996) and Greece (Lykouressis and Perdikis, 1997; Barbetaki *et al.*, 1999), indicating a probable dominance of *O. laevigatus* in the Mediterranean basin. In Italy *O. laevigatus* numbers were highest on basil, sweet pepper, eggplant, melon and french bean. In Spain, *O. laevigatus* was the most abundant species on strawberry, sweet pepper, cucumber and rose (Goula *et al.*, 1993; Riudavets and Castañé, 1994). In England, it was frequently found on local patches of nettles (Chambers *et al.*, 1993).

O. niger was frequently found on strawberry in the North-eastern Italian regions (Ivancich Gambaro, 1995). I found that this species was the most abundant also on wild plants where *O. laevigatus* and *O. majusculus* were rarely found. Wild plants outside the crop may positively influence occurrence of natural enemies on the

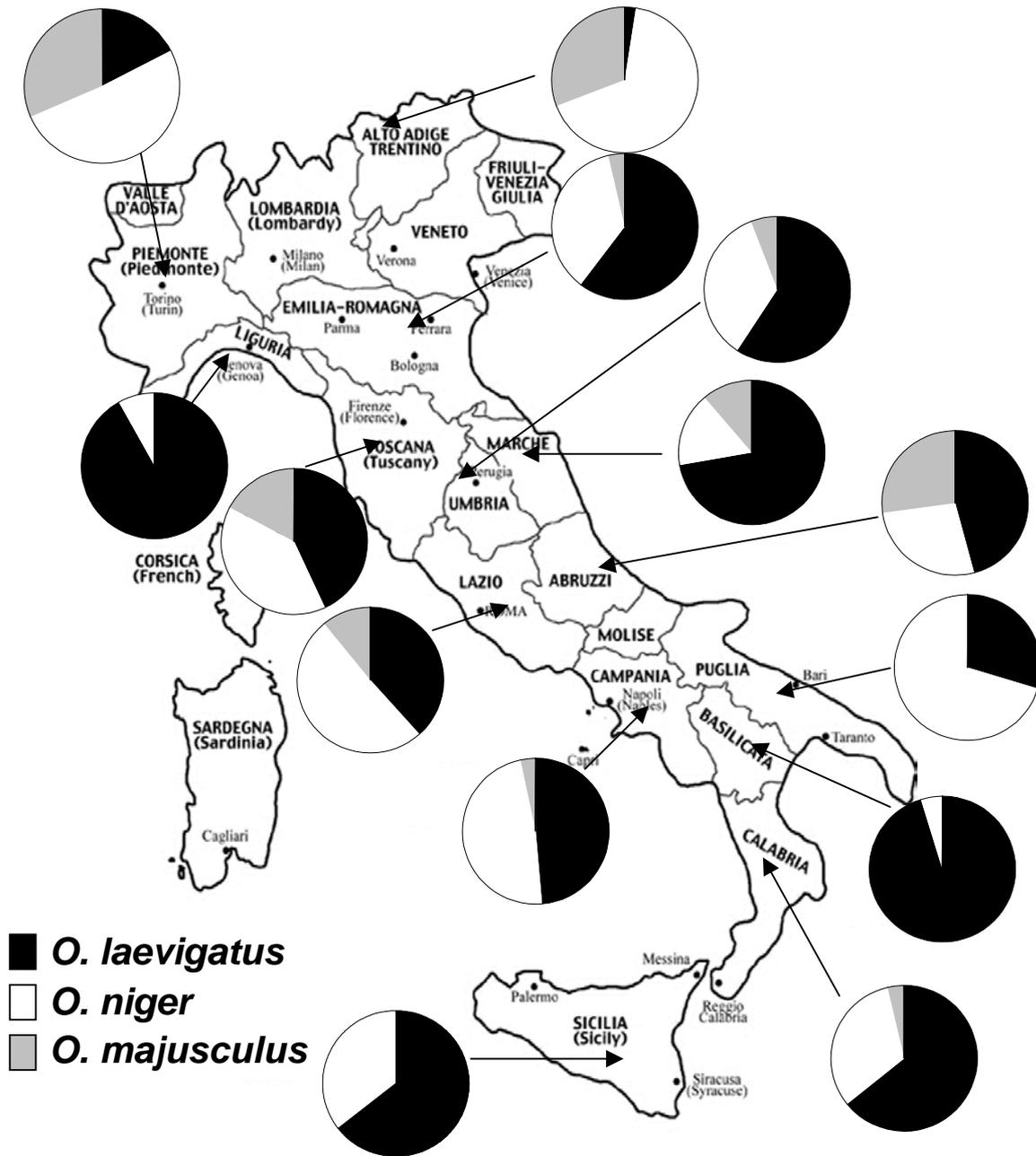


Figure 1. Distribution of *Orius* species collected in Italy (518 samples, 4931 individuals).

crop as wild plants provide alternative food as well as shelter for overwintering (van Emden, 1990). The rare presence of *O. laevigatus* and *O. majusculus* on wild plants might be explained by the higher attraction of the nearby crops infested with thrips, compared to the non-cultivated plants with few thrips. This preference for cultivated plants is a positive parameter for natural enemies. *O. majusculus* was rarely found on ornamental crops. The crops showing the highest attraction for the three most common *Orius* species were sweet pepper, followed by eggplant, French bean, melon and strawberry (table 1a and 1b). *Orius* predators were rarely found on tomato which confirms the results of

Riudavets *et al.* (1993, 1995).

O. horvathi and *O. vicinus* were recorded only once on raspberry in northern Italy and on sweet pepper on Sicily, respectively. *O. horvathi* was also rarely found in Spain (Riudavets and Castañé, 1994).

The various species showed differences also in their geographic distribution (figure 1 and table 2). *O. niger* was widely spread over all the Italian regions. *O. laevigatus* was frequently found in central and southern regions. It was the most abundant species in Liguria, Tuscany, Umbria, Abruzzo, Calabria and Sicily. It was rarely found in the northern regions. *O. majusculus* decreased in its relative abundance from northern

to central Italy and was absent below 38° N latitude. The distribution map of the predators indicates that *O. laevigatus* is predominant in the warmest areas and near the coasts, *O. majusculus* in the coldest areas such as the Po valley, while *O. niger* appears occurs all over Italy. The present data confirm the studies of Alauzet *et al.* (1992; 1994) showing that *O. laevigatus* is more adapted to high temperatures than *O. majusculus*. These data also suggest that *O. laevigatus* and *O. niger* may be good candidates for control of *F. occidentalis* in the warmest areas of the Mediterranean basin. *O. majusculus* might be a good candidate for more northern areas.

No specimens of the exotic *O. insidiosus* (Say) were found, not even in the greenhouses where this nearctic species was released for biological control of thrips together with *O. albidipennis* (on Sicily and Liguria). *O. insidiosus* is apparently unable to establish itself on sweet peppers in greenhouses or on wild plants in the field. This finding is in agreement with Tavella *et al.* (1994). Samples were again collected on Sicily in 2000 on vegetable crops and a high number (>300 individuals) of *O. albidipennis*, native of the Canary Islands, was recorded, but no *O. insidiosus* were found (Tommasini, 2002, unpublished data).

The adults of the species belonging to the family Anthorcoridae are so variable in size and colour of body and wings (Péricart, 1972) that the determination of species based only on phenotypic parameters is un-

reliable. To facilitate the determination of the three most common *Orius* species collected in Italy (*O. majusculus*, *O. laevigatus* and *O. niger*), more than 1,000 predators were carefully studied, observing morphological features of the specimens without killing them. Morphological characteristics can be used to distinguish between *O. majusculus* (subgenus *Heterorius*) on the one hand and *O. niger* and *O. laevigatus* (subgenus *Orius*) on the other hand. The subgenus *Orius* presents four macrochetae in the angular margins of the pronotum, which are absent in subgenus *Heterorius* (Péricart, 1972). The distinction between *O. niger* and *O. laevigatus* was more problematic. The colour of the legs was the unique morphological characteristic discriminating between the two species.

Generally, in *O. laevigatus* the legs were completely yellowish or light yellow-brown, as reported also by Tavella *et al.* (1991). In some specimens the yellowish colour was observed at least at the prothoracic legs or at the tibia of both the prothoracic and mesothoracic legs. In *O. niger* the legs were generally entirely black, even if some specimens showed the tibia or the knee and the distal part of the prothoracic femur to be lightly yellow-brown (table 3). This simple morphological key for separation of the species has been verified by the observation of the male genitalia parameres in more than 1,000 specimens of the three species, confirming the correspondence of the identification in circa 95% of the adults examined.

Table 3. Morphological key to distinguish live females of *O. laevigatus*, *O. niger* and *O. majusculus*.

Characteristics	Subgenus <i>Heterorius</i> (<i>O. majusculus</i>)	Subgenus <i>Orius</i> (<i>O. laevigatus</i>)	Subgenus <i>Orius</i> (<i>O. niger</i>)
Macrochetae	Absence	Presence	Presence
Colour of legs			
1 st pair	Totally yellowish	Totally yellowish	Totally black
		or	or
		Femur brown in the proximal part, the other part yellowish	Femur and tibia black with light-brown knee
		or	Or
2 nd pair	Totally yellowish	Femur black and knee and tibia yellowish	Femur black and knee and tibia yellowish
		or	or
		Femur and tibia black with light-brown knee	Totally black
		Totally yellowish	Totally black
3 rd pair	Totally yellowish or Femur brown in the proximal part, the other part yellowish	Femur brown in the proximal part, the other part yellowish	Totally black
		or	or
		Femur black and knee and tibia yellowish	Totally black
		or	or
		Femur and tibia black with light-brown knee	

Conclusions

This survey indicates that at least three Italian species of the genus *Orius* have become natural enemies of the imported thrips pest *F. occidentalis*. So a new associations between an imported pest and a group of native predators has developed. According to Hokkanen and Pimentel (1984; 1989), new predator-prey associations show generally a higher rate of success in biological control when compared to old association, because specific natural enemy defence mechanisms of the pest against its natural enemy have not yet evolved. In southern Europe, a similar example of an effective new association was recently recorded after the introduction from North America of the leafminer *Liriomyza trifolii* (Burgess) (Diptera Agromyzidae) which is naturally controlled by the native parasitoid *Diglyphus isaea* (Walker) (Hymenoptera Eulophidae) (Vacante, 1993). During the past 25 years, many more new associations have shown to result in good biological control (van Lenteren, 1997).

O. laevigatus was found to be the most common *Orius* species in Italy and it was often found on all vegetable crops on which *F. occidentalis* is an important pest and it showed a wide natural distribution in the warmest Italian regions. *O. niger* showed a wide distribution all over Italy and occurred on a large range of host plants. *O. majusculus* was confined to the northern regions and generally occurred at low densities. The survey indicates that *O. laevigatus* and *O. niger* are well adapted to both climate and the main vegetable and ornamental crops grown in the Mediterranean area. Therefore, these two species seem good candidates for biological control of thrips pests.

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- Author address:** Maria Grazia TOMMASINI (e-mail: tommasini@crpv.it), CRPV - Centro Ricerche Produzioni Vegetali, via Vicinale Monticino 1969, 47020 Diegaro di Cesena (FC), Italy.

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