Boll. Zool. agr. Bachic.
Ser. II, 33 (2): 93-102

30 August 2001

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Dicyphini collected in horticultural areas of north-western Italy (Heteroptera Miridae)

Abstract - In the last years, some species of Dicyphini (Heteroptera Miridae) have revealed to be efficient pest predators in horticultural crops of the Mediterranean Basin; they may colonize vegetables when the pesticide pressure is reduced. Thus, to improve the knowledge on these mirids, studies on their distribution and host plants were carried out in horticultural areas of north-western Italy from 1990 to 1999. Insects were collected on vegetables and wild plants growing around the crops in several localities of Piedmont and Liguria. The main vegetables checked were tomato, sweet pepper, eggplant and zucchini, either in greenhouses or in the open air. During the surveys, eleven Dicyphini species were found, but only four were sampled also in the crops: *Dicyphus errans* (Wolff, 1804), *Macrolophus melanotoma* (Costa, 1853) [= *M. caliginosus* Wagner, 1950], *M. pygmaeus* (Rambur, 1839) [= *M. nubilus* (Herrich-Schaeffer, 1836)], and *Nesidiocoris tenuis* (Rambur, 1895). For these species, tomato was the most favourite crop, whereas *Calendula officinalis* L., *Inula viscosa* (L.) Aiton, *Parietaria officinalis* L. and *Solanum nigrum* L. were the preferred wild plants. The presence and abundance of the species were related to the area and the season. Generally, in Piedmont *D. errans* was the predominant mirid, whereas *Macrolophus* spp. prevailed in Liguria; *N. tenuis* was found only in Liguria, never in Piedmont. Their distribution and alternative host plants are discussed.

Riassunto - *Rilevamento di Dicyphini in aree orticole dell'Italia nordoccidentale (Heteroptera Miridae).*

Negli ultimi anni alcune specie di Dicyphini (Heteroptera Miridae) si sono rivelate efficienti predatori di fitofagi dannosi in colture orticole del Bacino Mediterraneo, in grado di insediarsi nelle coltivazioni allorché vengano ridotti gli interventi insetticidi. Pertanto, allo scopo di migliorare le conoscenze su questi miridi, studi sulla distribuzione e sulle piante ospiti sono stati condotti in aree orticole dell'Italia nordoccidentale dal 1990 al 1999. Gli insetti sono stati catturati su piante orticole e flora spontanea, presente nelle zone circostanti le coltivazioni, in varie località del Piemonte e della Liguria. Fra le orticole, sono state principalmente indagate pomodoro, peperone, melanzana e zucchino, sia in coltura protetta sia in pien'aria. Nel corso dei sopralluoghi undici specie di Dicyphini sono state rilevate, ma soltanto quattro sono state rinvenute anche nelle coltivazioni: *Dicyphus errans* (Wolff, 1804), *Macrolophus melanotoma* (Costa, 1853) [= *M. caliginosus* Wagner, 1950], *M. pygmaeus* (Rambur, 1839) [= *M. nubilus* (Herrich-Schaeffer, 1836)],

e *Nesidiocoris tenuis* (Rambur, 1895). Per tutte quattro le specie, il pomodoro è risultato la coltura di elezione, mentre *Calendula officinalis* L., *Inula viscosa* (L.) Aiton, *Parietaria officinalis* L. e *Solanum nigrum* L. sono state le piante spontanee preferite. Presenza e abbondanza dei miridi sono apparse correlate all'area investigata e alla stagione. In genere *D. errans* era predominante in Piemonte, mentre le due specie di *Macrolophus* prevalevano in Liguria; *N. tenuis* è stato catturato solamente in Liguria, mai in Piemonte. Distribuzione dei dicifini e loro piante ospiti sono discussi.

Key words: *Dicyphus*, *Macrolophus*, *Nesidiocoris*, host-plants, pest predators.

INTRODUCTION

The tribe Dicyphini (Heteroptera Miridae Bryocorinae) is world-widespread, and comprises small, slender, long-legged species that may live on a large variety of host plants. Recently, a particular attention has been focused on some species as they revealed to be efficient pest predators in horticultural crops. In fact, these species may colonize IPM crops, both in greenhouses and in the open air, and carry out their beneficial role in controlling pest outbreaks, when the reduced pesticide pressure allows them to settle and reproduce on the cultivated plants. These species are usually generalist predators, characterized by a zoophytophagous behaviour, i.e. they can feed on both animals and plants; the preys are small arthropods, such as mites, thrips, aphids and whiteflies.

At the end of '80s, the presence of these mirids was reported in IPM vegetable crops of different regions of South Europe, such as France (Malausa *et al.*, 1987), Greece (Roditakis & Legakis, 1989), Italy (Arzone *et al.*, 1990), and Spain (Alomar *et al.*, 1990). Since then, several studies have been carried out on these pest predators to investigate their biology, predatory efficiency, and crop colonization ability (Fauvel *et al.*, 1987; Gabarra *et al.*, 1995; Tavella *et al.*, 1997; Tedeschi *et al.*, 1999). Dicyphini are abundant and commonly spread in the Mediterranean Basin, although each species may have a more restricted distribution within the area. Therefore, it becomes important in the different regions to assess which species are present and which are their host plants, both wild and cultivated. Only so it will be possible to enhance mirids in the cropped areas, i.e. increasing their alternative host plants and offering suitable conditions to their reproduction and overwintering, and to allow them to colonize rapidly the crops. Thus, the aim of the research was to improve the knowledge on Dicyphini species present in crop and non-crop plants of Piedmont and Liguria, north-western Italy, for their successful application in IPM programmes.

MATERIALS AND METHODS

The collections of Dicyphini have been carried out in areas cropped with vegetables of Piedmont and Liguria, two regions of north-western Italy, for ten years from 1990

to 1999. Insects were collected in IPM vegetable crops and on the spontaneous flora growing around the cultivations. Samplings on vegetables were performed by visual checks and beating parts of plants over a white Plexiglas tray (250-350 mm), whereas the wild plants surrounding crops were prospected using a sweeping net (diameter = 500 mm). The main surveyed crops were tomato, pepper and zucchini, both in greenhouses and in the open air; the prospected crop and non-crop plants are listed for each locality investigated in Piedmont and in Liguria in Table 1.

In the laboratory, the collected specimens were killed by ethyl acetate vapours, and dry mounted on entomological cards or stored in ethanol 70%. Adults belonging to *Dicyphus* and *Nesidiocoris* were identified using the keys of Wagner (1951, 1974), checking male genitalia characters for specific features. The taxonomy of *Macrolophus* was revised in the last decade, so the identification and nomenclature of the species stated in this study are based on Josifov (1992) and Carapezza (1995). In particular, it has to be taken into account that *Macrolophus melanotoma* (Costa, 1853) and *M. pygmaeus* (Rambur, 1839) are to be considered junior synonyms of *M. caliginosus* Wagner, 1950 and *M. nubilus* (Herrich-Schaeffer, 1836), respectively.

RESULTS

Collected species of Miridae Dicyphini and their distribution

The species of Miridae Dicyphini found in Piedmont and Liguria, together with the plants on which they were collected, are reported in Table 2; furthermore, their distribution in the investigated area is shown in Figure 1. A total of eleven species were found during the surveys, but only four of them were sampled also in the crops: *Dicyphus errans* (Wolff, 1804), *Macrolophus melanotoma* (Costa, 1853) [= *M. caliginosus* Wagner, 1950], *M. pygmaeus* (Rambur, 1839) [= *M. nubilus* (Herrich-Schaeffer, 1836)], and *Nesidiocoris tenuis* (Rambur, 1895). The other seven species were never observed on vegetables, although they were captured on the spontaneous flora surrounding the surveyed crops in different localities. Actually, on their preferred hosts they were found in large quantities. For example, *D. escalerae* Lindberg, 1934 and *D. epilobii* Reuter, 1883 were always collected on *Antirrhinum majus* L. and on *Epilobium hirsutum* L. respectively, while *M. costalis* Fieber, 1858 was often captured on *Cistus monspeliensis* L., a very common plant in the Mediterranean Basin.

For all the four species collected on vegetables, tomato was the most favourite crop; in fact, individuals of at least a species were always found on tomato plants, both in greenhouses and in the open air, not sprayed with pesticides. The presence and abundance of one or other species were related to the area and the season. Generally, in Piedmont *D. errans* was the predominant mirid, whereas *Macrolophus* spp. prevailed in Liguria; *N. tenuis* was found only in Liguria, never in Piedmont. The distribution and seasonal abundance on the crops, and alternative host plants are reported below in detail for these four species.

Table 1 - Surveyed localities and prospected plants, both cultivated and wild, in Piedmont and Liguria, north-western Italy.

Locality	Crops	Wild plants
Piemonte		
Torino (TO)		*Antirrhinum majus* L., *Polygonum* sp., *Solanum nigrum* L.
Carmagnola (TO)	potato, tomato	*Amaranthus retroflexus* L., *Conyza canadensis* (L.) Cronq., *Galinsoga parviflora* Cav., *Polygonum persicaria* L., *Portulaca oleracea* L., *S. nigrum*
Trofarello (TO)	tomato, zucchini	*A. retroflexus, Chenopodium* sp., *G. parviflora, Parietaria officinalis* L., *S. nigrum, Urtica dioica* L.
Valperga (TO)		*Epilobium hirsutum* L., *Geranium* spp.
Fubine (AL)	tomato	*Calendula officinalis* L., *Cornus sanguinea* L., *Delphinium* sp., *G. parviflora, P. officinalis, Silene* spp., *S. nigrum, U. dioica*
Guazzora (AL)	melon, tomato	*S. nigrum*
Isola S.Antonio (AL)	tomato	*S. nigrum*
Quargnento (AL)		*C. officinalis, Silene* spp., *S. nigrum, U. dioica*
Sale (AL)	melon, small red pepper, tomato	*A. retroflexus, Convolvulus arvensis* L., *P. persicaria, S. nigrum*
Asti (AT)	pepper, tomato	
Costigliole (AT)	eggplant, potato, pumpkin, sweet pepper, tomato, zucchini	*Lamium* sp., *P. officinalis*
Montemagno (AT)	zucchini	*P. officinalis, Potentilla* sp., *U. dioica*
Bra (CN)	sweet pepper, tomato	
Ceresole d'Alba (CN)	tomato	
Racconigi (CN)	tomato	
Liguria		
Genova Prà (GE)	eggplant, pumpkin, tomato, zucchini	*Inula viscosa* (L.) Aiton, *P. officinalis, S. nigrum*
Albisola (SV)	tomato	*C. arvensis, C. canadensis, I. viscosa, Verbena officinalis* L., *Origanum majorana* L., *P. officinalis, Senecio* sp., *S. nigrum*
Albenga (SV)	tomato, sweet pepper, pumpkin	*A. majus, Chenopodium* sp., *Cistus monspeliensis* L., *Epilobium* sp., *Geranium* spp., *I. viscosa, Malva* spp., *S. nigrum*
Campochiesa (SV)	tomato	*I. viscosa, Geranium* spp., *Epilobium* sp., *S. nigrum*
Ceriale (SV)	tomato, sweet pepper	*I. viscosa, Geranium* spp., *S. nigrum*
Giogo di Toirano (SV)		*Galeopsis tetrahit* L.
Diano Marina (IM)	tomato	
Sarzana (SP)	sage, tomato	*A. retroflexus, Borago officinalis* L., *Delphinium* sp., *I. viscosa, Lamium* sp., *Malva* spp., *Mentha* sp., *P. officinalis, Silene* spp., *S. nigrum, U. dioica*

Table 2 - Species of Miridae Dicyphini found in Piedmont and Liguria, and their relative host plants.

Species	Vegetable crops	Wild plants
Dicyphus errans (Wolff, 1804)	melon*, pepper, potato, pumpkin, tomato, zucchini	*Calendula officinalis*, *Chenopodium* sp., *Epilobium hirsutum**, *Geranium* spp., *Polygonum persicaria*, *Silene* spp., *Solanum nigrum*, *Urtica dioica*
D. albonasutus Wagner, 1951		*Silene* spp.
D. eckerleini Wagner, 1963		*Geranium* spp., *Galeopsis tetrahit*
D. epilobii Reuter, 1883		*Epilobium hirsutum*
D. escalerae Lindberg, 1934		*Antirrhinum majus*
D. flavoviridis Tamanini, 1949		*Geranium* spp., *Galeopsis tetrahit*
D. geniculatus (Fieber, 1829)		*Mentha* sp., *Parietaria officinalis*, *Silene* spp.
Macrolophus costalis Fieber, 1858		*Cistus monspeliensis*
M. melanotoma (Costa, 1853)	tomato	*Inula viscosa*
M. pygmaeus (Rambur, 1839)	pepper, tomato	*C. officinalis*, *Chenopodium* sp., *I. viscosa*, *Malva* spp., *P. officinalis*, *Origanum majorana*, *S. nigrum*
Nesidiocoris tenuis (Rambur, 1895)	tomato	*I. viscosa*, *S. nigrum*

Legend: * *Dicyphus* cf. *errans*, only females collected

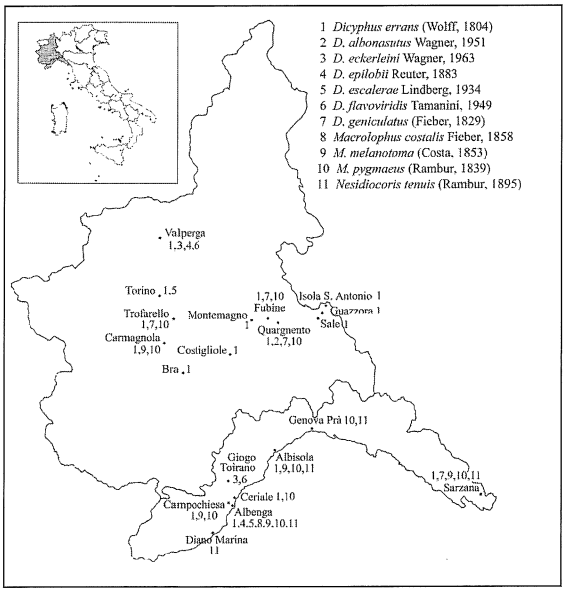

Fig. 1 - Species of Miridae Dicyphini captured in the investigated localities of Piedmont and Liguria.

Dicyphus errans (Wolff, 1804)

Besides on tomato, *D. errans* was collected in large amounts on pumpkin in both Liguria and Piedmont, differently from the other three species. Both adults and nymphs of this mirid were almost always monitored in the investigated tomato crops throughout the season; however, the population density varied in relation to the locality: they were more abundant in Piedmont and in the eastern Ligurian Riviera than in the western Ligurian Riviera. Among the spontaneous plants, *Solanum nigrum* L. can be actually considered the most favourite host; in fact, *D. errans* was usually found abundantly on this species during surveys in north-western Italy. Furthermore, in Liguria this mirid was often collected on wild *Geranium*, especially on *G. rotundifolium* L., on which it could overwinter in all stages.

Macrolophus species

The two *Macrolophus* species found in vegetable crops were separated mainly according to the colour of the first antennal joint: completely black in *M. pygmaeus*, blackish at the ends and pale in the middle in *M. melanotoma* (Josifov, 1992; Carapezza, 1995). Unfortunately, this character was sometimes not so evident, and newly emerged adults, or those preserved in ethanol for long time, may be difficult to identify. Anyhow, over 93% of the collected individuals belonged to *M. pygmaeus*.

Macrolophus species were captured in large quantities on tomato in Liguria, particularly in the western Riviera. In May, adults, particularly ovipositing females, started to colonize crops in greenhouses and more easily in the open field, where tomato was just transplanted. Since then, mirid populations tended to increase throughout the season, reaching their maximum density in September. In late summer, adults migrated to the winter host plants (Tavella *et al.*, 1997). Although *M. pygmaeus* was collected on a large variety of wild plants, its favourite host plant was *Inula viscosa* (L.) Aiton, on which individuals of all the stages were observed from late summer to spring. *I. viscosa* is a very common plant in the Mediterranean area, especially in the waste lands of the western Riviera, whereas it is rarer in Piedmont. In the latter region, *M. pygmaeus* was sampled on *Calendula officinalis* L., like in Liguria, and also on *Chenopodium* sp. growing near vegetable crops. *M. melanotoma* was found only on *I. viscosa* in Liguria besides on tomato in both regions.

Nesidiocoris tenuis (Rambur, 1895)

This mirid was collected only in Liguria, whereas it was never found in Piedmont. In the Ligurian Riviera, *N. tenuis* began to colonize tomato plants in summer and, starting from August, its populations increased so that in September and October it could become the predominant species on the crops. It was rarely found on wild plants: only few individuals were collected on *I. viscosa* and on *S. nigrum* in Liguria. Differently from the other three species, with its nutritional punctures to tomato, *N. tenuis* caused

characteristics symptoms: brown rings on petioles and peduncles. However, these alterations did not compromise the yield in the Ligurian tomato crops (Tavella *et al.*, 1997).

DISCUSSION

On crop and non-crop plants sampled in north-western Italy, the Dicyphini fauna was quite diverse; however, seven species were never collected on vegetables although they were found on plants growing near the crops. Since these mirids are zoophytophagous, plants exert a strong influence on them and seem to condition what species they host. In fact, among *Dicyphus* species, *D. errans* appeared attracted mainly by Solanaceae, both wild and cultivated, and also by Cucurbitaceae; it dwells very few plants not belonging to these two families. On the contrary, the other *Dicyphus* species were not collected on these plant families. Moreover, the seven species never found on the crops were captured on a very restricted range of plants or, more often, on a single plant species.

Dicyphini previously recorded in Italian IPM crops, mainly on tomato, were *D. errans*, *M. melanotoma* and *N. tenuis* (Arzone *et al.*, 1990; Calabrò & Nucifora, 1993; Petacchi & Rossi, 1991; Ronco & Faure, 1993). In this research, another *Macrolophus* species was found on vegetables: it is *M. pygmaeus* which was collected more frequently and abundantly than *M. melanotoma*.

Comparing Dicyphini collected in Piedmont and in Liguria, the most conspicuous difference is the absence of *N. tenuis* in the former region. In fact, this mirid is a tropical species and Liguria can be considered its northern limit of distribution (Arzone *et al.*, 1990). In the crops of this area, it usually reached high population levels at the end of the growing season without compromising the yield. Actually, the performance of *N. tenuis* has been much discussed: it can prey on pests but also produce damage piercing plants and injecting toxic saliva (Malausa, 1989). However, in Italy and in the Canary Islands it plays a useful pest predator role in tomato crops (Vacante & Tropea Garzia, 1994; Carnero *et al.*, 2000).

Also the distribution of *D. errans* and of the two *Macrolophus* species was different in the two investigated regions: the former one was predominant in Piedmont and in the eastern Ligurian Riviera, whereas the last two prevailed in the western Ligurian Riviera. Their presence in the crops was related to the diffusion and abundance in the cropped areas of their natural host plants, from which the mirids can migrate to the crops in the growing season. For example, among the wild plants in north-western Italy *D. errans* dwelled on *Geranium* spp. and *S. nigrum*, while *M. pygmaeus* preferred *C. officinalis* and *I. viscosa*. Moreover, in Piedmont this latter species was found abundantly on *Salvia glutinosa* L., a plant spread in damp undergrowth areas, thus growing usually not near vegetable crops (personal observations). In Sicily, besides on tomato, Dicyphini were collected on tobacco, eggplant and barberton daisy; among the wild plants they were found on *I. viscosa*, *Malva* sp., *Parietaria* sp. and *S.*

nigrum, reported as hosts also in these investigations, and on *Datura* sp. *N. tenuis* was also observed on *Ecballium elaterium* (L.) A.Rich., a Mediterranean plant spread along the Italian coasts (Calabrò & Nucifora, 1993). Moreover, in a recent study on biodiversity of Heteroptera in viticultural areas of Valtellina (northern Italy), *D. errans* was found in large quantities in a vineyard, especially on *Amaranthus retroflexus* L., which was the main weed together with *S. nigrum* (Lozzia *et al.*, 2000).

Different Dicyphini species have been reported around the Mediterranean Basin, related to IPM vegetable agro-ecosystems. Research conducted in Spain showed that *D. tamaninii* Wagner, 1951 was the mirid most frequently found in the crops, whereas *D. errans* was only occasionally captured (Goula & Alomar, 1994; Goula & Arnó, 1994). However, for this mirid, ten wild plant species were reported as host plants in Alomar *et al.* (1994); half of them were sampled unsuccessfully in Piedmont and/or in Liguria. Always in Spain, besides on tomato, *Macrolophus* species were observed on cucumber, green bean, eggplant, potato, sweet pepper, and zucchini (Goula & Alomar, 1994); as natural hosts, fifteen plant species were recorded, among which five also reported in the present paper (Alomar *et al.*, 1994). In Greece, *M. pygmaeus* was reared on broad bean, eggplant, cucumber, melon (Perdikis & Lykouressis, 1996), and *M. melanotoma* was collected on melon and tomato (Roditakis & Legakis, 1989; Roditakis & Roditakis, 1994); on the contrary, *Dicyphus* species have not yet been reported as being of IPM interest (Roditakis, personal communication).

ACKNOWLEDGEMENTS

We thank Dr. M. Lodovica Gullino (Università di Torino, Italy) and Dr. Ramon Albajes (Universitat de Lleida, Spain), for their encouragement. We are also very grateful to Dr. Oscar Alomar and Dr. Nikos Roditakis for their helpful revisions. This work was jointly supported by the Spanish Ministry of Education and the Italian M.U.R.S.T., in the frame of the Integrated Action Spain-Italy HI 1998-0003.

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Accepted 2 May 2001