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Hoverflies in organic apple orchards in north-western Italy

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Abstract

A list is given of hoverflies collected by means of Malaise and white sticky traps in two organic apple orchards in north-western Italy. The total number of collected species was 17 and it was compared with literature, in order to discuss differences due to sampling methods. The predominant species collected were *Sphaerophoria scripta* (L.) (73% of the total sample) and *Eupeodes corollae* (F.) (14%). The trend of adult captures of this species is drawn and discussed. Data on wild plant species in the orchards are also given.

Key words: syrphids, faunistic list, natural enemies, white sticky trap, Malaise trap.

Introduction

Hoverflies (Diptera Syrphidae) belong to one of the most various fly families: they include about 200 genera and 6000 species worldwide, about 500 of which are reported in Italy (Daccordi, 1995; Daccordi and Sommaggio, 2002). The variability of this family finds expression in the various habitats where hoverflies settle, from coastal areas to mountains and deserts or from urban farm areas. Adults feed usually on pollen and nectar, being important pollinators, whilst larvae can have very different feeding habits. In particular, the predatory behaviour toward aphids, scale insects and other arthropods is of great interest in agriculture; furthermore, some species can be phytophagous, other mycophagous and saprophagous (Rotheray and Gilbert, 1999).

Hoverflies have characteristics that make them good environmental quality indicators of forests and fields (Sommaggio, 1999; Speight and Castella, 2001; Sommaggio and Burgio, 2003). Many faunistic researches have therefore been carried on in past years, but there are still gaps in the knowledge of syrphids, in particular in Italy. In the last 30 years, about 20 studies on Italian syrphid species have been published and 16 have been developed in northern Italy (Burgio and Sommaggio, 2002; Delmastro and Sommaggio, 2003).

The aim of this research was to study the hoverfly species in a traditional Piedmont fruit farm area in the province of Turin (northern Italy). Two sampling methods were used and data were compared with research in other areas of northern Italy. This work is also preliminary to a research on possible relationships between the presence of cultivated or wild plants, their blooming period and the syrphid populations.

Materials and methods

The research was carried out in 2 unspecialised, organic fruit farms in the province of Turin (44°48'0'' N; 7°17'0'' E; 320 m a.s.l.), 2 km far one from the other. Farms are located in an area characterised by a high environment and crop variability, the presence of small unspecialised farms, the cultivation of traditional fruit cultivars and by the high percentage of organic-oriented farms.

The apple orchard "I" was located at the "Centro di Riferimento per l'Agricoltura Biologica" in the school-farm "Malva Arnaldi" in Bibiana. Samplings were made in a 7 years old "Pink Lady" apple orchard. Other fruit (cherry and apple) orchards sorrounded the sampled area, and in the farm there were furthermore a maize field, a vineyard, a backgarden and an artificial irrigation pool.

The 8 years old apple orchard "II" was in a farm in Bricherasio and was composed of 2 traditional apple cultivars ("Grigia di Torriana" and "Runsè") in addition to "Goldrush", "Golden Delicious" and "Gala". A kiwi orchard was also present in the farm.

Samplings were carried out from the beginning of March to the middle of September 2004.

A Malaise trap, baited with 70% v/v alcohol, was placed close to one border of both apple orchards. During the whole sampling period, the traps were activated and deactivated for 10 days respectively. On 3 central rows of each apple orchard, a white sticky trap (20.5x15 cm, Rebell Bianco®, Intrachem Bio Italia, Grassobbio, Italy) was hung 2 m high, along a diagonal line of the orchard. Sticky traps were kept in the orchards during all the sampling period and were changed every 10 days. At the end of every 10-day period, collected hoverflies were labelled and identified. Specimens were removed from sticky traps with a plant solvent (Bio-Clear®, Bio-Optica, Milano, Italy).

The identification of hoverflies was made with the keys by Stubbs and Falk (1983), Bradescu (1991) and Verlinden (1994).

Given the absence of environmental differences between the 2 farms, sampling data were pooled before the analysis.

During the sampling period, plant species in the apple orchards were studied. Herbaceous flowering plants were observed in the field, collected and determined with dichotomic keys (Pignatti, 1982).

Results and discussion

During the sampling period 602 specimens were collected (12 were unidentifiable because of a bad state of conservation) belonging to 17 species (table 1). The predominant species were *Sphaerophoria scripta* (L.) (73% of the total sample) and *Eupeodes corollae* (F.) (14%), whilst the amount of specimens belonging to other species was by far smaller. Four saprophytic species, belonging to the genus *Eristalis* and *Helophilus*, were collected. Moreover 13 aphid feeding species, 11 of which are reported as predators of tree aphids (Speight, 2001; Burgio and Sommaggio, 2002; Rojo *et al*., 2003) were collected: *Chrysotoxum arcuatum* (L.), *Episyrphus balteatus* (De Geer), *E. corollae*, *Eupeodes latifasciatus* (Macquart), *Eupeodes luniger* (Meigen), *Parasyrphus vittiger* (Zetterstedt), *Scaeva selenitica* (Meigen), *S. scripta*, *Syrphus ribesii* (L.), *Syrphus torvus* Osten-Sacken and *Syrphus vitripennis* Meigen. The aphid predator species were 95% of the total number of specimens collected. The great amount of predaceous species seems to be typical of agroecosystems (Burgio and Sommaggio, 2002). The biodiversity is medium-low, if it is compared with reference data from similar areas. In table 2 previous studies from northern Italy are compared: only in Setti (1972) a lower number of species is reported than in the studied orchards, whilst species reported by other authors range from 31 to 45. Excluding the research by Chemini *et al*. (1985) that investigated also wild and forest areas with a higher biodiversity, it can be noticed that the use of a sweeping net could have affected the data. Sure enough, a hand-net can sample even not very mobile species and it can be complementary to sticky traps, even if it should not be used for quantitative studies (Sommaggio and Burgio, 2003). The Malaise trap is established as the most efficient sampling method of syrphids, both in number of collected individuals and species, but white sticky traps can represent a good additional method. However table 1 underlines that frequent mechanical damages of individuals sampled with the sticky traps can make specific determination difficult. Moreover, species that fly at a different height from the traps can be underestimated. This could be the case of *S. scripta* and *E. corollae* that lay eggs mostly in aphid colonies on herbaceous plants and so they are collected more frequently

Table 1. Syrphids collected with Malaise trap (Mt) and white sticky traps (Wst) in the two apple orchards. The larval food habit is also indicated (Speight, 2001; Burgio and Sommaggio, 2002).

Species	Total	Mt	Wst	Larval food habit
Chrysotoxum arcuatum (Linné, 1758)	5	1	4	Wood aphids
Episyrphus balteatus (De Geer, 1776)	13	0	13	Ground layer and tree aphids
Eristalis arbustorum (Linné, 1758)	2	0	2	Wet decaying organic material
Eristalis tenax (Linné, 1758)	2	1	1	Wet decaying organic material
Eupeodes corollae (Fabricius, 1794)	84	60	24	Ground layer and tree aphids
Eupeodes latifasciatus (Macquart, 1829)	1	1	0	Root and tree aphids
Eupeodes bucculatus (Rondani, 1857)	5	5	0	Ground layer aphids
Eupeodes luniger (Meigen, 1822)	3	3	0	Ground layer and tree aphids
Eupeodes sp. (female)	11	4	7	
Helophilus pendulus (Linné, 1758)	1	0	1	Wet decaying organic material
Helophilus trivittatus (Fabricius, 1805)	0	1	1	Wet decaying organic material
Melanostoma mellinum (Linné, 1758)	8	7	1	Ground layer aphids
Paragus (Pandasyophthalmus) sp.	1	1	0	
Parasyrphus vittiger (Zetterstedt, 1843)	1	0	1	Tree aphids
Pipizella sp. (female)	1	1	0	
Scaeva selenitica (Meigen, 1822)	2	0	2	Shrub and tree aphids
Sphaerophoria scripta (Linné, 1758)	440	296	144	Ground layer and tree aphids
Syrphus ribesii (Linné, 1758)	7	3	4	Ground layer and tree aphids
Syrphus torvus Osten-Sacken, 1875	1	1	0	Tree aphids
Syrphus vitripennis Meigen, 1822	1	1	0	Ground layer and tree aphids
Unidentified specimens	12	0	12	
Total	602	385	217	

Table 2. Collected species and collecting methods from faunistic research on syrphids in similar areas.

Author	Year	Environment	Collected species	Collecting method
Setti	1972	Orchard	9	Rearing of eggs and larvae, sweeping net
Daccordi	1979	Orchard	33	Sweeping net, yellow sticky traps
Chemini *et al*.	1985	Orchard, marsh, forest	45	Sweeping net, sticky traps
Daccordi *et al*.	1988	Vineyard	36	Yellow sticky traps
Burgio *et al*.	1997	Farms	36	Sweeping net
Burgio and Sommaggio	2002	Organic farm	31	Malaise trap, sweeping net

by the Malaise trap, even if a great number of individuals is also found on sticky traps. In addition, some remarks can be made about the influence of sticky trap colour on sampling amount. A research by Ortu and Floris (1990) highlights that syrphids are attracted by white traps much more than yellow ones, thus differing somehow from other flies; therefore, interpretation and comparison of data should keep this in consideration.

First adults were already collected at the beginning of March, but samplings were considerable from May onwards. Considering capture numbers of the two most representative species, a maximum was recorded between the beginning and the middle of June, then samplings decreased and rose again at the end of July (figure 1). This trend highlights how species that overwinter as adults could have a role in controlling aphids early in the spring (Schneider, 1969). In particular, *S. scripta*, can be a biocontrol agent of aphids, especially because this species seems not to be attacked by parasitoids like other syrphids (Setti, 1972). In general, however, syrphid egg-laying begins only when the aphid population has reached a high level. Hoverfly females usually choose oviposition sites using not only visual and tactile cues, but also volatile chemicals from aphids or infested plants (Burgio and Ferrari, 2000). There is hence a delay between pest and syrphid population growth that allows the former, if no insecticides are sprayed, to reach the damage threshold before the predator can control it.

In the studied area 59 plant species belonging to 21 families were found (table 3). Brassicaceae, Asteraceae,

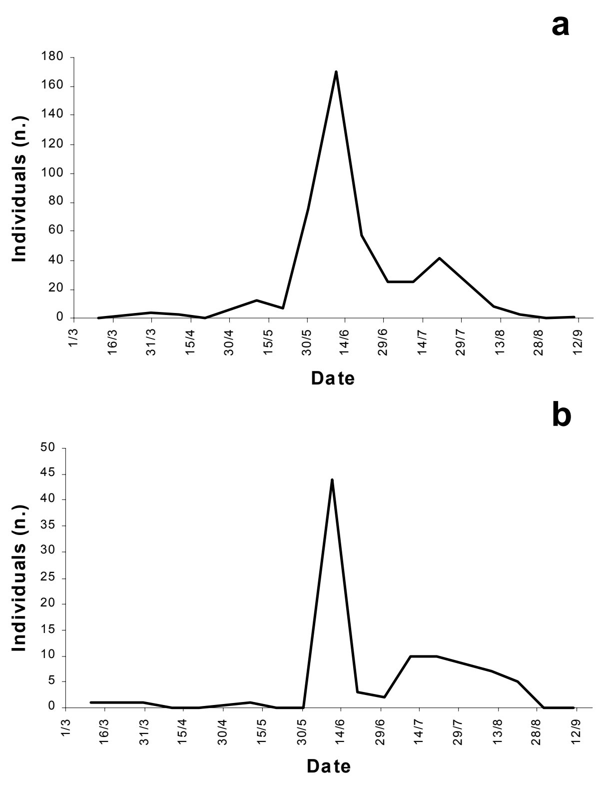

Figure 1. Capture numbers of *S. scripta* (a) and *E. corollae* (b) in the two apple orchards. Sampling data from Malaise and white sticky traps are pooled.

Table 3. Herbaceous flowering plants collected in the two apple orchards during the sampling period and grouped by family.

Family	Flowering plants
Polygonaceae	*Polygonum aviculare* L.
	Polygonum persicaria L.
	Rumex obtusifolius L.
Chenopodiaceae	*Chenopodium album* L.
Portulacaceae	*Portulaca oleracea* L.
Caryophyllaceae	*Cerastium triviale* Link
	Silene vulgaris (Moench) Garcke
	Stellaria media (L.) Vill.
Ranunculaceae	*Ranunculus acris* L.
	Ranunculus arvensis L.
	Ranunculus nemorosus DC.
	Ranunculus repens L.
Hypericaceae	*Hypericum perforatum* L.
Brassicaceae	*Barbarea vulgaris* R. Br.
	Brassica nigra (L.) Koch
	Capsella bursa-pastoris (L.) Medicus
	Raphanus raphanistrum Strobl
Rosaceae	*Fragaria vesca* L.
	Potentilla erecta (L.) Rauschel
	Potentilla reptans L.
Fabaceae	*Lotus corniculatus* L.
	Trifolium pratense L.
	Trifolium repens L.
Geraniaceae	*Geranium sanguineum* L
Malvaceae	*Malva sylvestris* L.
Lythraceae	*Lythrum salicaria* L.
Onagraceae	*Epilobium angustifolium* L.
Primulaceae	*Lysimachia vulgaris* L.
Convolvulaceae	*Convolvulus arvensis* L.
Lamiaceae	*Lamium purpureum* L.
Solanaceae	*Solanum dulcamara* L.
Scrophulariaceae	*Veronica arvensis* L.
	Veronica persica Poiret
Plantaginaceae	*Plantago lanceolata* L.
	Plantago major L.
Asteraceae	*Achillea millefolium* L.
	Conyza canadensis (L.) Cronq.
	Crepis capillaris (L.) Wallr.
	Erigeron canadensis L.
	Eupatorium cannabinum L.
	Galinsoga parviflora Cav.
	Lactuca serriola L.
	Leontodon hispidus L.
	Leucanthemum vulgare Lam.
	Matricaria chamomilla L.
	Matricaria inodora L.
	Senecio vulgaris L.
	Sonchus asper (L.) Hill
	Taraxacum officinale Weber
Poaceae	*Agrostis stolonifera* L.
	Bromus inermis Leyser
	Dactylis glomerata L.
	Digitaria sanguinalis (L.) Scop.
	Festuca arundinacea Schreber
	Holcus lanatus L.
	Lolium multiflorum Lam.
	Lolium perenne L.
	Poa trivialis L.
	Prenanthes purpurea L.

Polygonaceae, Rosaceae, Caryophyllaceae, Fabaceae and Convolvulaceae were already reported as attractive to hoverflies (Branquart and Hemptinne, 2000; Burgio and Ferrari, 2000). A research is in progress in the area to verify the level of attractiveness of some plant species belonging to these families. The identification of correlations between plants and syrphids could give useful information to farmers for a good management of organic orchards. In particular, a help could be given to control one of the apple key pest, i.e. aphids (Vogt and Weigel, 1999; Powell *et al*., 2003). The role of flowering plants in limiting pest population, both feeding and giving shelters and alternative hosts to natural enemies, has been shown by previous studies on herbaceous and tree crops (Burgio *et al*., 1997; Lanzoni *et al*., 2003; Bostanian *et al*., 2004).

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References

BOSTANIAN N. J., GOULET H., O'HARA J., MASNER L., RACETTE G., 2004.- Towards insecticide free apple orchards: flowering plants to attract beneficial arthropods.- *Biocontrol Science and Technology*, 14 (1): 25-37.

BRADESCU V., 1991.- Les Syrphides de Roumanie (Diptera, Syrphidae), clés de determination et répartition.- *Travaux des Museum d'Histoire Naturelle Grigore Antipa*, 31: 7-83.

BRANQUART E., HEMPTINNE J.-L., 2000.- Selectivity in the exploitation of floral resources by hoverflies (Diptera: Syrphinae).- *Ecography*, 23: 732-742.

BURGIO G., FERRARI R., 2000.- Sirfidi, pp. 43-54. In: *Gli ausiliari nell'agricoltura sostenibile* (NICOLI G., RADEGHIERI P., Eds).- Ed. Calderini, Bologna, Italy.

BURGIO G., SOMMAGGIO D., 2002.- Diptera Syrphidae caught by Malaise trap in Bologna province and new record of *Neoascia interrupta* in Italy.- *Bulletin of Insectology*, 55 (1/2): 43-47.

BURGIO G., FERRARI R., BORIANI L., 1997.- Il ruolo delle siepi nell'ecologia del campo coltivato: analisi di comunità dei Ditteri Sirfidi in aziende della Provincia di Bologna.- *Bollettino dell'Istituto di Entomologia "Guido Grandi" dell'Università degli Studi di Bologna*, 51: 69-77.

CHEMINI C., DACCORDI M., MASON F., 1985.- La componente afidifaga in alcuni popolamenti di Ditteri Sirfidi nelle province di Trento e Verona, pp. 73-79. In: *Atti XIV Congresso Nazionale Italiano di Entomologia*, Palermo, Erice, Bagheria, 28 maggio- 1 giugno 1985. Accademia Nazionale Italiana di Entomologia, Palermo, Italy.

DACCORDI M., 1979.- Ditteri Sirfidi in un frutteto a lotta integrata nella provincia di Verona.- *Quaderni dell'Azienda Agraria Sperimentale di Villafranca*, 3-35.

DACCORDI M., 1995.- Syrphidae, cf pp. 6-19. In: (BELCARI A., DACCORDI M., KOZÀNEK M., MUNARI L., RASPI A., RIVOSECCHI L.) Diptera Platypezoidea, Syrphoidea. In: *Checklist delle Specie della fauna italiana*, 70 (MINELLI A., RUFFO S., LA POSTA S., Eds).- Calderini, Bologna, Italy.

DACCORDI M., SOMMAGGIO D., 2002.- Fascicolo 70 - Syrphidae, pp. 84-90. In: (STOCH F., ZOIA S., Eds) Aggiornamenti alla Checklist delle specie della fauna italiana VII. Contributo.- *Bollettino della Società Entomologica Italiana*, 134 (1): 75-90.

DACCORDI M., MASON F., PLUCHINO P., 1988.- Ditteri Sirfidi raccolti in due vigneti della provincia di Verona: applicazione di alcuni algoritmi per l'analisi di comunità (Diptera: Syrphidae).- *Atti e Memorie dell'Accademia d'Agricoltura, Scienze e Lettere di Verona*, 27: 33-43.

DELMASTRO G. B., SOMMAGGIO D., 2003.- Contributo alla conoscenza dei Sirfidi (Diptera, Syrphidae) del Piemonte Occidentale.- *Bollettino del Museo Regionale di Scienze Naturali di Torino*, 20 (1): 231-268.

LANZONI A., MASETTI A., PLANKESTEINER D., BURGIO G., 2003.- Role of field margin habitats and annual flowering plant mixture on parasitization of economic Agromyzid pests.- *IOBC/wprs Bulletin*, 26 (4): 95-100.

ORTU S., FLORIS I., 1990.- Osservazioni sul cromotropismo di alcune specie di Ditteri Sirfidi (Diptera Sirphidae).- *Bollettino della Società Entomologica Italiana*, 122 (2): 151-157.

PIGNATTI S., 1982.- *Flora d'Italia*. Vol. I, II, III.- Edagricole, Bologna, Italy.

POWELL W., WALTERS K., A'HARA S., ASHBY J., STEVENSON H., NORTHING P., 2003.- Using field margin diversification in agri-environment schemes to enhance aphid natural enemies.- *IOBC/wprs Bulletin*, 26 (4): 123-128.

ROJO S., GILBERT F., MARCOS-GARCIA M. A., NIETO J. M., MIER M. P., 2003.- *A world review of predatory hoverflies (Diptera, Syrphidae: Syrphinae) and their prey*.- Ed. Centro Iberoamericano de la Biodiversidad (CIBIO), Alicante, Spain.

ROTHERAY G. E., GILBERT F., 1999.- Phylogeny of Palaearctic Syrphidae (Diptera): evidence from larval stages.- *Zoological Journal of the Linnean Society*, 127: 1-112.

SCHNEIDER F., 1969.- Bionomics and physiology of aphidophagous syrphidae.- *Annual Review of Entomology*, 14: 103-124.

SETTI M., 1972.- Ricerche sulla attività di alcune specie di Sirfidi (Diptera) predatori di afidi del melo.- *Bollettino dell'Istituto di Entomologia della Università degli Studi di Bologna*, 30: 103-132.

SOMMAGGIO D., 1999.- Syrphidae: can they be used as bioindicators?- *Agriculture, Ecosystems & Environment*, 74: 343-356.

SOMMAGGIO D., BURGIO G., 2003.- Role of Diptera Syrphidae as landscape indicators: analysis of some case studies in Northern Italy.- *IOBC/wprs Bulletin*, 26 (4): 145-150.

SPEIGHT M. C. D., 2001.- Species accounts of European Syrphidae (Diptera): Special commemorative issue, First International Workshop on the Syrphidae, Stuttgart 2001. In: *Syrph the Net, the database of European Syrphidae*, Vol. 26 (SPEIGHT M. C. D., CASTELLA E., OBRDLIK P., BALL S., Eds).- Syrph the Net publications, Dublin, Ireland.

SPEIGHT M. C. D., CASTELLA E., 2001.- An approach to interpretation of lists of insects using digitised biological information about the species.- *Journal of Insect Conservation*, 5: 131-139.

STUBBS A. E., FALK S. J., 1983.- *British Hoverflies. An illustrated identification guide*.- British Entomological and Natural History Society, London, UK.

VERLINDEN L., 1994.- *Faune de Belgique. Syrphides. (Syrphidae)*.- Institut Royal des Sciences Naturelles de Belgique.

VOGT H., WEIGEL A., 1999.- Is it possible to enhance the biological control of aphids in an apple orchard with flowering strips?- *IOBC/wprs Bulletin*, 22 (7): 39-46.

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