Landscape Management for Functional Biodiversity
IOBC/wprs Bulletin Vol. 75, 2012
pp. 13-16

Hymenoptera abundance on candidate plants for conservation biological control

Judit Arnó, Rosa Gabarra, Òscar Alomar
Entomology, IRTA, Ctra de Cabrils km 2, 08348 Cabrils, Barcelona, Spain.
E-mail: judit.arno@irta.cat

Abstract: As part of the general goal of identifying plants useful for conservation biological control this study aimed to assess the role of different species as habitat for Hymenoptera. Twenty-four monospecific plots of selected plants were sampled during winter, early and late spring. *Sinapis alba* hosted the highest numbers of Hymenoptera throughout the sampling period, even when it was not blooming. Large numbers of Hymenoptera were also collected on *Brassica nigra*, much related to the flowering period, and on *Medicago sativa*, especially in late spring. Regarding woody plants, *Viburnum tinus* may be of some interest in spring.

Key words: conservation biological control, Hymenoptera, habitat management

Introduction

Conservation biological control is increasingly being used in different agricultural production systems as a strategy to control crop pests. It aims to increase the impact of indigenous natural enemies by providing them with shelter, alternative hosts and prey and plant provided foods such as nectar and pollen by the creation of ecological infrastructures with selected plant species (Landis et al. 2000; Holland, this volume). The implementation of biological control on vegetables often benefits from the action of hymenopteran parasitoids. Such is the case of the control of whitefly, aphid, leaf-mining and lepidopteran pests (Albajes et al. 2003).

As part of the general goal of identifying plants species useful for conservation biological control in vegetable crops (Alomar et al. 2006; Alomar et al. 2008), this study aimed to assess the role of different plant species as habitat for Hymenoptera. We took Hymenoptera abundance as an indicator of the role of these plants in the conservation of different groups of parasitoids.

Material and methods

Experimental field design

A study was conducted during 2004 and 2005 at IRTA Research Station in Cabrils (Barcelona, Spain) in a 1200m^2 field. Twenty-four monospecific plots (1.5x1.5m each) were set in a complete randomized block design with three replications. Plant species included in the trial are shown in Table 1. All the species were selected from those mentioned in the bibliography as of interest for *Orius* and/or hoverflies, and are native or have been used as ornamentals. Five of these species were kept from a previous experiment conducted in 2002-2003, and all other species except *Ocimum basilicum* were transplanted between September and November 2004. Non-established plants were replaced by the end of the year. Five species had to be replanted again in April 2005. *Ocimum basilicum* was transplanted into the field on that date for the first time.

Table 1: Plant species included in the experiment and sampling periods. Most species were transplanted between September and November 2004 except those already planted in 2002-2003 (○). Some were re-planted (∇) or planted for the first time in April (★). Other symbols indicate: sampling done (✓), no vegetation or too small plants to be sampled (∅), and senescent or dead plants (†).

Plant species		Family	Sampling period		
			Winter	Early Spring	Late Spring
Viburnum tinus	○∇	Caprifoliaceae	✓	✓	✓
Cistus albidus	○	Cistaceae	✓	✓	✓
Cistus monspeliensis	○	Cistaceae	✓	✓	✓
Achillea millefolium	○	Compositae	✓	✓	✓
Bellis perennis		Compositae	✓	✓	†
Calendula officinalis		Compositae	✓	✓	✓
Taraxacum officinale	∇	Compositae	∅	✓	✓
Brassica nigra		Cruciferae	✓	✓	†
Diplotaxis erucoides		Cruciferae	✓	✓	†
Lobularia maritima		Cruciferae	∅	✓	✓
Sinapis alba		Cruciferae	✓	✓	✓
Scabiosa sp.		Dipsacaceae	∅	✓	✓
Ocimum basilicum	★	Labiatae	∅	∅	✓
Thymbra capitata	○	Labiatae	✓	✓	✓
Laurus nobilis		Lauraceae	✓	✓	✓
Medicago lupulina	∇	Leguminosae	∅	✓	✓
Medicago sativa	∇	Leguminosae	∅	✓	✓
Onobrychis viciifolia		Leguminosae	∅	✓	✓
Pisum sativum		Leguminosae	✓	✓	†
Trifolium pratense	∇	Leguminosae	∅	✓	✓
Vicia fava		Leguminosae	✓	✓	†
Vicia sativa	∇	Leguminosae	∅	✓	†
Papaver rhoeas		Papaveraceae	✓	✓	†
Verbascum sp.		Scrophulariaceae	∅	✓	✓

Sampling

We sampled each plot during 3 different periods and within each period we took samples on two different dates: winter (February 15th and March 9th), early spring (April 20th and May 10th) and late spring (1st and 30th of June). On each sampling occasion each plot was vacuum sampled with a modified leaf blower fitted with a fine mesh organdy collecting bag (nozzle diameter of 34cm) that was moved over the vegetation for 15 seconds. The bag was taken to the laboratory where all Hymenoptera, excluding pollinators and ants, were counted. Only plots where plants had grown sufficiently and vegetation was not senescent were sampled (Table 1).

Statistical analysis

The mean number of Hymenoptera per plot and sampling period was calculated and the data log-transformed to fit assumptions. The number of individuals was compared between plant species using a one-way ANOVA for early spring and late spring periods separately. Significant differences between means were identified using Tukey HSD test ($P < 0.05$). No statistical analysis was conducted for the winter period due to the low number of Hymenoptera.

Results and discussion

In the winter period (February-March), 14 plant species were available for sampling but Hymenoptera were only found on 7 plant species. Mean numbers (± standard error) of Hymenoptera collected on these plant species were (in decreasing order): *S. alba* (1.2 ± 0.60), *B. perennis* (0.8 ± 0.44), *V. fava* (0.7 ± 0.67), *C. officinalis* (0.5 ± 0.50), *D. erucoides* (0.5 ± 0.29), *P. sativum* (0.3 ± 0.17) and *C. monspeliensis* (0.2 ± 0.17).

In early spring we collected Hymenoptera on 22 species out of the 23 species sampled. Significant differences in insect abundance were found between plant species (F=2.995; d.f. = 21, 65; P = 0.0011). Most Hymenoptera were collected on *B. nigra* and *S. alba*, although numbers on those plant species were not significantly different from numbers collected on *M. sativa* and the other plants, except *Verbascum* sp. on which there were fewest.

In late spring, 17 species were available for sampling. The highest Hymenoptera abundance was recorded on *M. sativa,* although it was not significantly different from abundance on other 10 species including *S. alba*, *V. tinus*, *M. lupulina* and *L. maritima* (Figure 1). Plants that had significantly less Hymenoptera than *M. sativa* were *O. basilicum*, *C. albidus*, *Scabiosa* sp., *L. nobilis*, *T. capitata* and *Verbascum* sp. (F=3.548; d.f. = 16, 49; P $\leq$ 0.001).

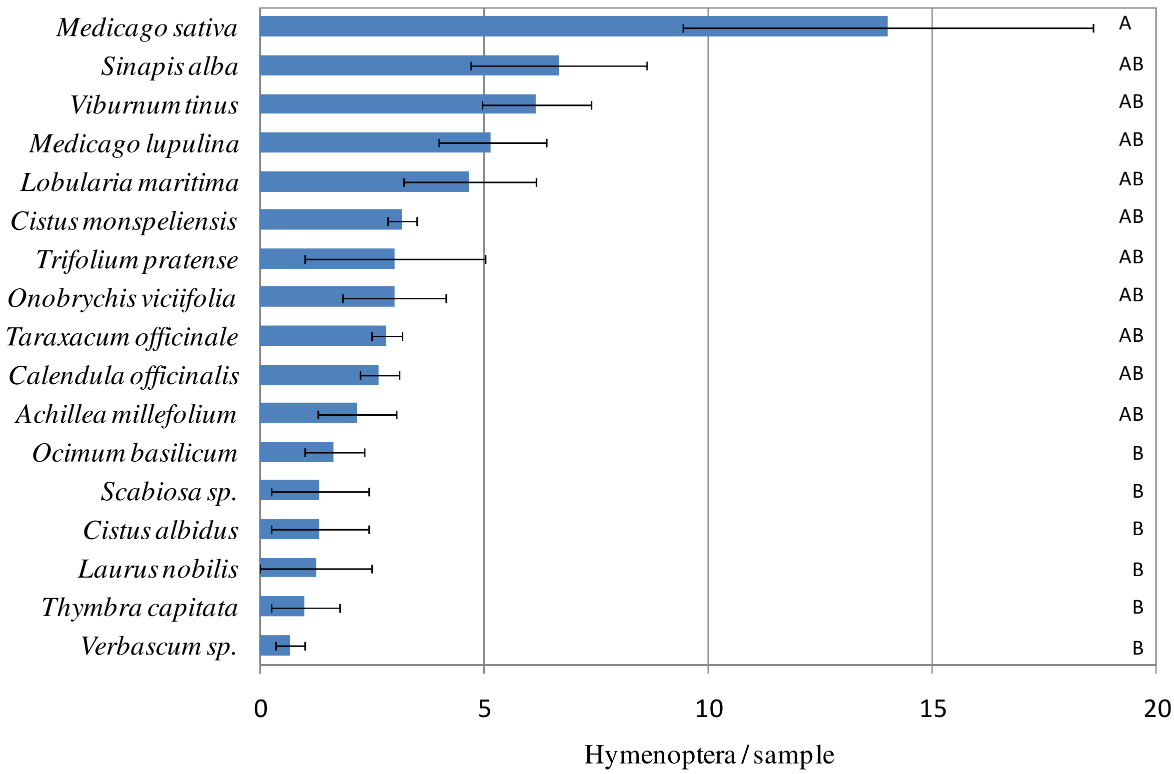

Figure 1. Mean numbers (± standard error) of Hymenoptera collected in vacuum samples on several plant species in late spring.

S. alba hosted the highest numbers of Hymenoptera in each of the three periods. Interestingly, *S. alba* was not in flower during winter, but still attracted the most Hymenoptera compared to the other plant species. *Sinapis alba* has shown to be important in enhancing parasitism of rape pollen beetle (Scheid et al. 2011). In early spring, the greatest number of Hymenoptera was recorded on *B. nigra*, coinciding with the flowering period, but no individuals were collected on that species in winter when it was not in bloom. High numbers of Hymenoptera were also collected on *M. sativa* in early spring and, especially, in late spring, when the plant was well established and started to flower.

Overall, the results show that *S. alba*, *B. nigra*, *M. sativa*, *M. lupulina* and *L. maritima* deserve further detailed studies in regards to their role in the conservation of specific parasitoid groups in Mediterranean conditions. Regarding woody plants which could be suitable as perennial banker plants, none of those tested (*V. tinus*, *L. nobilis*, *C. albidus*, *C. monspeliensis*, *T. capitata*), appeared to be very advantageous in terms of attracting Hymenoptera. Only *V. tinus* may be of some interest in spring.

Acknowledgements

This work was supported by grants of Spanish Government (AGL2003-07532-C03-02 and AGL2010-18811). We thank Oriol González for his technical support.

References

Albajes, R., Sarasúa, M. J., Avilla, J., Arnó, J. & Gabarra, R. 2003: Integrated pest management in a Mediterranean Region: the case of Catalonia. In: Maredia, Dakou & Mota-Sanchez (eds) "Integrated Pest Management in the Global Arena". CABI, UK: 341-355.

Alomar, O., Arnó, J. & Gabarra, R. 2008: Insectary plants to enhance the biological control of *Nasonovia ribisnigri* and *Frankliniella occidentalis* in lettuce. IOBC/wprs Bull. 34: 9-12.

Alomar, O., Gabarra, R., González, O. & Arnó, J. 2006: Selection of insectary plants for ecological infrastructure in Mediterranean vegetable crops. IOBC/wprs Bull. 29(6): 5-8.

Holland, J. M. 2012: Promoting agri-environment schemes for conservation biocontrol. IOBC/wprs Bull. (this volume)

Landis, D. A.; Wratten, S. D. & Gurr, G. M. 2000: Habitat management to conserve natural enemies of arthropod pests in agriculture. Annu. Rev. Entomol. 45: 175-201.

Scheid, B. E., Thies, C. & Tscharntke, T. 2011: Enhancing rape pollen beetle parasitism within sown flower fields along a landscape complexity gradient. Agr. Forest Entomol. 13: 173-179.