Landscape Management for Functional Biodiversity
IOBC wprs Bulletin Vol. 29 (6) 2006
pp. 5-8

Selection of insectary plants for ecological infrastructure in Mediterranean vegetable crops

Oscar Alomar, Rosa Gabarra, Oriol González, Judit Arnó
IRTA, Centre de Cabrils, carretera de Cabrils s/n, E-08348 Cabrils (Barcelona), Spain

Abstract: Mediterranean vegetable growing areas are landscapes characterised by the coexistence of several annual crops, grown on rather small farms, and with a variety of species grown simultaneously all year round. Vegetable production is highly intensive, with up to three crops being produced on the same piece of land each year. The periodic destruction of non-crop vegetation along field margins hinders the establishment of natural enemies that must re-colonize fields each time. Given this scenario, the conservation and exploitation of native natural enemies that are normally found in the production area should assume a central role in biological control. The objective of this paper is to summarize our work related to the identification of insectary plants that may serve as ecological infrastructures in vegetable crops.

Key words: predators, augmentation, habitat management

Introduction

Mediterranean vegetable growing areas are landscapes characterised by the coexistence of several annual crops, grown on rather small farms (2-3 ha), and with a variety of species grown simultaneously all year round (e.g. lettuce, tomato, potato, brassica crops, cucurbits, etc). Greenhouses tend to be only partially sealed, and the boundaries between greenhouses and field crops often become blurred. Because of lagged transplantation times, there may also be overlapping fields of the same crop. As many vegetables share the same pests (e.g. whitefly and thrips) problems are exacerbated as there is a continuous carry-over of pests throughout the year that is hardly interrupted, even in winter.

Vegetable production is highly intensive, with up to three crops being produced on the same piece of land each year. There is also periodic destruction of non-crop vegetation along field margins (e.g. as part of cultural practices to reduce pest infestations). The discontinuous nature of such ephemeral habitats makes the establishment of natural enemies more difficult than in more permanent habitats and natural enemies must re-colonize the fields each time (Gabarra et al., 2004).

Given this scenario, the conservation and exploitation of natural enemies that are native to the production area should assume a central role in biological control (Gerling et al., 2001). Our long-term aim is to develop strategies that allow the conservation and enhancement of key generalist predatory guilds that are useful for several vegetable crops that may be present on farms (Avilla et al., 2004). In greenhouses, biological pest control is based on both conservation and supplemental seasonal inoculative releases of mass reared entomophagues when needed (Albajes et al., 2003).

The creation of ecological infrastructures to provide required resources for natural enemies has proven to be a viable strategy to enhance biological control in crops. Our previous work has addressed identifying host plants for the predator *Macrolophus caliginosus*, which spontaneously colonizes several vegetable crops (Alomar & Albajes, 2003). The objective of this paper is to summarize our work related to the identification of

insectary plants that may be used to enhance *Orius* spp. and hoverflies, which are also common in several vegetable crops (Riudavets & Castañe, 1998; Arnó et al., 2002).

Material and methods

Candidate plants were selected from those mentioned in the bibliography as of interest for *Orius* and/or hoverflies. Native or naturalized plant species were selected in order to prevent new species becoming invasive. Two separate fields at our research institute in Cabrils were planted with seedlings in two separate years (2003, 2005). One field was basically prepared for hoverflies and the other for *Orius* (32 and 25 plant species respectively). Plants were grown in 2.25 m^2 plots in a complete randomized-block design with three replications. In the Orius field, plants were shaken over a tray every three weeks from February to July and all thrips and *Orius* were counted *in situ*. In the hoverfly field, each plot was aspirated for 15 s with a D-Vac. Visits to the plots by adult hoverflies were recorded by visual observation (three minutes) of each plot when plants were in bloom. Observations were made twice a week from March to May before noon on sunny, clear and calm (wind < 3 m/s) days. Syrphid adults were registered as either entering the plot or resting and/or feeding on the flowers.

Results and discussion

Identification of candidate plants

Many of the plants tested in the Orius field had abundant *Orius* populations. Figure 1 shows the cumulative number of adults and nymphs of *Orius* spp. on 12 of the most infested plants. Many of them also had nymphs, indicating that adult *Orius* did not only profit from plant and prey resources, but also reproduced. However, *Orius* were quite late in appearing on some of the plants (e.g. *Ocimum basilicum, Thymbra capitata*), possibly because of their late flowering. Although of potential interest in summer, these plants could be of little use for enhancing *Orius* populations in spring. If the plants selected were restricted to those bearing *Orius* between February and mid-May, only five could be selected: *Vicia faba, V. sativa, Lupinus hispanicus, Lobularia maritima,* and *Achillea millefolium.*

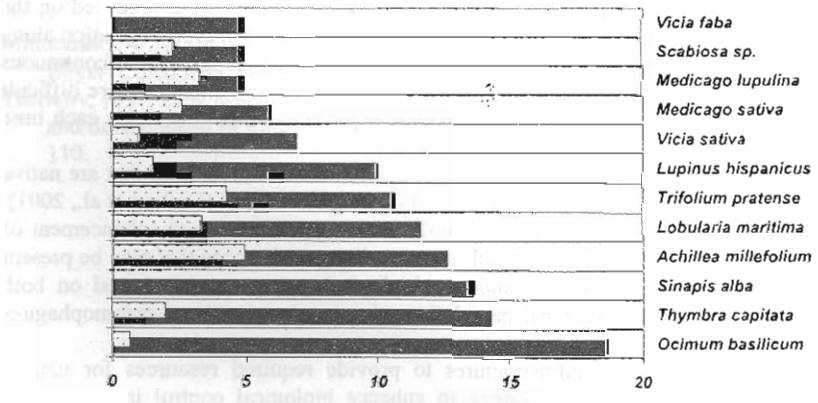

Figure 1. Cumulative abundance of *Orius* spp. (black bars are adults, dotted bars are nymphs) in insectary plants.

The highest populations of *M. caliginosus* (not shown) were found on *Dittrichia viscosa*, which confirmed this plant as the main host for this predator. *M. caliginosus* was also found on *Calendula officinalis*, which confirmed previous field observations on the potential of this plant.

Adults of predatory hoverflies were observed on most plots in the hoverfly field. However, on less plant species adults were observed resting or feeding on flowers (Fig. 2).

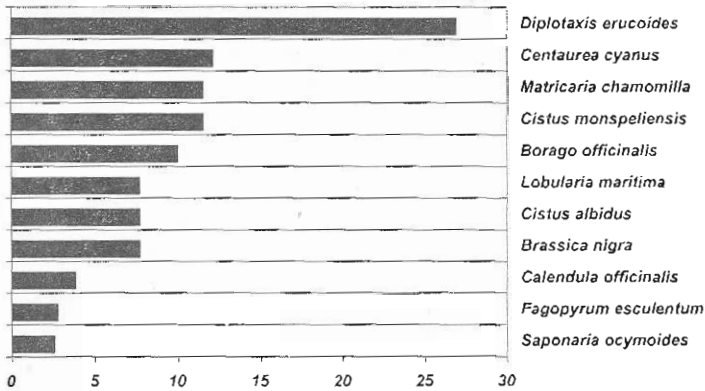

Figure 2. Relative mean visitation rates of adult hoverflies to flower plots in bloom during spring.

Developing a plant mixture for vegetable crops

Based on these results, we defined a preliminary mixture of six plant species to be annually planted along field margins. This year we will assess its utility for the conservation of predators and enhancement of biological control in a field trial on lettuce. The selection of candidate plants will continue in order to further tailor the plant mixture.

The careful selection of plants for the ecological infrastructure is important for preventing or at least minimising the risk of exacerbating pest and disease problems in the target cropping area. Amongst the plants selected for *Orius*, *Vicia faba* is a well known host of the tomato spotted wilt virus (TSWV), transmitted by the thrips *Frankliniella occidentalis*, and affects several vegetable crops in the Mediterranean region. This plant was therefore discarded for our purposes. *Achillea* and *Lobularia*, both had thrips although few were *F. occidentalis*. They might not, therefore, be chosen when *Orius* is our primary concern, and we finally selected *Vicia sativa* and *Lupinus hispanicus* for *Orius*.

For *M. caliginosus*, we selected *C. officinalis* and *Ononis natrix*, the latter is another plant that we know to be a good refuge for this predator. *Inula viscosa* allows the conservation of important populations of *Macrolophus*, but was not selected due to problems associated with its establishment in tomato crops.

For hoverflies, the plants with most visits (e.g. *Diplotaxis arvensis*) also had very abundant thrips populations, or were arbustive and slow growing (e.g. *Cistus* spp.). We therefore selected *Centaurea cyanus* and also included *L. maritima* into our annual planting. Although the presence of *F. occidentalis* in flowerheads of sweet alyssum may present a certain element of risk, it should be noted that this plant has been used in other settings without problems.

Minimizing risk in biological control is an increasingly important issue (Bigler et al., 2006). However, although the selection of plants for natural enemies and against pests is an important goal, achieving total risk prevention in multiple cropping situations may prove extremely difficult (Gurr et al., 2005). Conversely, the co-occurrence of the predator and pest in flowers may also confer some potential for reducing pest populations in refuges, thereby largely preventing problems from developing.

Acknowledgements

This research was supported by MCYT (AGL2003-07532-C03-02/AGR), and by INIA (project SC00-008, and a scholarship to Miguel Louis-Maldonado).

References

Albajes, R., Sarasúa, M.J., Avilla, J., Arnó, J. & Gabarra, R. 2003: Integrated Pest Management in the Mediterranean Region: The case of Catalonia, Spain. In: Integrated Pest Management in the Global Arena, eds. Maredia, Dakouo and Mota-Sanchez, CABI Publishing: 341- 355.

Alomar, O. & Albajes, R. 2003: Habitat management for conservation of the native predator *Macrolophus caliginosus*. IOBC wprs Bulletin 26 (4): 7-12.

Arnó, J., Roig, J. & Gabarra, R. 2002: Avaluació de varietats d'enciam resistents al pugó *Nasonovia ribisnigri*. Catalunya Rural i Agrària: 94.

Avilla, J., Albajes, R., Alomar, O., Castañé, C. & Gabarra, R. 2004: Biological control of whiteflies in protected vegetable crops. In: Biocontrol in protected culture, eds. Heinz, Van Driesche and Parella. Ball Publishing, Batavia, IL: 171-184.

Bigler, F., Babendreier, D. & Kuhlmann, U. 2006: Environmental impact of invertebrates for biological control of arthropods: methods and risk assessment, eds. CAB International (in press).

Gabarra, R., Alomar, O., Castañé, C., Goula, M. & Albajes, R. 2004: Movement of greenhouses whitefly and its predators between in-and outside of Mediterranean greenhouses. Agriculture, Ecosystems and Environment 102: 341-348.

Gerling, D., Alomar, O. & Arnó, J. 2001: Biological control of *Bemisia tabaci* using predators and parasitoids. In: Challenges and Opportunities for Pest Management of *Bemisia tabaci* in the New Century, eds. Naranjo and Ellsworth, Crop Protection 20(9): 779-799.

Gurr, G.M., Wratten, S.D., Kehrl, P. & Scarrat, S. 2005: Cultural manipulations to enhance biological control in Autralia and New Zealand: Progress and prospects. In: 2nd International Symposium on Biological Control of Arthropods, ed. Hoddle, USDA Forest Service, Publication FHTET-2005-08: 154-166.

Riudavets, J. & Castañe, C. 1998: Identification and evaluation of native predators of *Frankliniella occidentalis* in the Mediterranean. Environ. Entomol. 27(1): 86-93.