

Module 1 - Agroforestry for Oliviculture
Course 3 - Agroforestry as a tool to manage olive pests and diseases

Chapter 2 - The Effect of Agroforestry on Biological Control of Olive Pests

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Olives are the main crop cultivated in the Mediterranean region.

Olives have been and still are one of the most important sources of income for many civilizations in the eastern Mediterranean.

The production of high quality olive fruit is crucial for both table olives and olive oil.

Like other agricultural endeavors, olive production faces many challenges, such as land fragmentation, pest attacks, and a loss of biodiversity.





1) The Impact of Olive Monoculture on Biodiversity

In olive monocultures, habitat diversity is very limited. Many species previously associated with extensively managed olive groves--particularly reptiles, butterflies, natural enemies of pests, and birds--have declined or disappeared.

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1) The Impact of Olive Monoculture on Biodiversity

For decades, wild herbs have been eradicated in olive groves to prevent them from competing for water and nutrients. The result:

- 1- less vegetation, without enough beneficial insects
- 2- a system that cannot regulate itself
- 3- an increased population of olive pests
- 4- high costs for pest and disease control





2) Olive Pests and Beneficial Insects in the Mediterranean Area

The olive fruit fly (*Bactrocera oleae*) is the most severe pest of olive cultivation causing tremendous economic losses. It damages olive fruits, thus reducing olive oil quality and decreasing its selling price.



Photos by Z. Moussa



2) Olive Pests and Beneficial Insects in the Mediterranean Area

There are many parasitoids in the Mediterranean area that naturally control the larvae and pupae of the olive fruit fly:



Psytallia concolor



Cyrtoptyx dacicida



Eupelmus urozonus



Eurytoma sp.



2) Olive Pests and Beneficial Insects in the Mediterranean Area

Black scale (*Saissetia oleae*) is another olive pest; it weakens olive trees and reduces olive production.



Photo by Z. Moussa

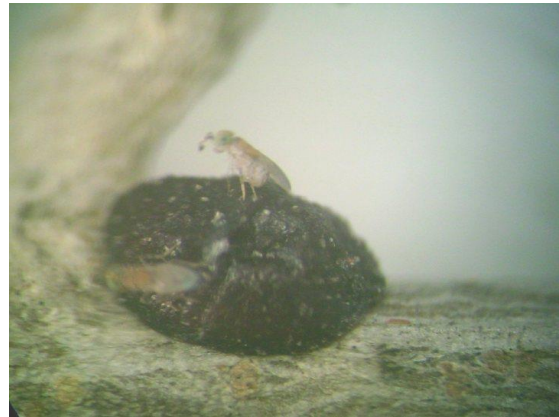


2) Olive Pests and Beneficial Insects in the Mediterranean Area

There are many parasitoids in the Mediterranean area that naturally control black scale, for example these:



Scutellista cyanea



Metaphycus flavus

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2) Olive Pests and Beneficial Insects in the Mediterranean Area

Other harmful olive pests are the olive moth (*Prays oleae*), the jasmine moth (*Palpita unionalis*), and the olive psyllid (*Euphyllura olivine*).



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2) Olive Pests and Beneficial Insects in the Mediterranean Area

There are many general predators in the Mediterranean area that naturally control olive pests.

For example, *Orius*, *Macrolophus* and *Chrysopa* feed on the olive moth, the jasmine moth, olive scale, thrips and the olive psyllid.



Photos by Z. Moussa



3) The Impact of Pesticides on Beneficial Insects

Olive pests are mainly controlled by chemical insecticides.



Studies have found that arthropod communities are dramatically affected by Dimethoate treatments, with their numbers decreased by as much as 44%.



3) The Impact of Pesticides on Beneficial Insects

Olive pests are mainly controlled by chemical insecticides.



Studies have found that the use of growth regulators such as Fenoxycarb has serious effects on beneficial insects such as *Chrysopa* and lady beetles.



4) Olive Agroforestry

Agroforestry can play an important role in maintaining the “ecological infrastructure” of olive groves.



Photo by Z. Moussa



4) Olive Agroforestry

This “ecological infrastructure” is made up of such elements as patches of natural and semi-natural vegetation planted in strips between rows of olive trees or in field margins, as hedges, and as forest trees in addition to the olive trees.



Photo by Z. Moussa



4) Olive Agroforestry

Traditionally, olive trees have been surrounded by forest trees -- commonly *Quercus* (oak) and *Ceratonia siliqua* (carob) -- and they have been cultivated along with horticultural crops such as almonds, pears, or grapevines, or in combination with cereals (wheat, maize), forages (barley, oats) or legumes (faba beans, chickpeas, peas, lentils, beans).

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5) The Effect of Biodiversity on Biological Control of Olive Pests

- Biodiversity can be increased on olive farms by adding patches or strips of natural or sown plants between rows of olive trees or at field margins. This can improve pest management by increasing the diversity of predators and parasitoids.
- Floral diversity patches in olive groves can provide a refuge for flora and fauna. They can serve as a foundation for the biodiversity necessary for many traditional olive grove inhabitants (such as mammals, birds, bees, natural pest enemies and reptiles).

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5) The Effect of Biodiversity on Biological Control of Olive Pests

- The selection of plant species should be based on such criteria as suitability for the region, a long flowering period, attractiveness to beneficial insects, the cost and availability of seeds, and avoidance of the inappropriate introduction of alien species and weeds.
- A mixture is preferred over a single plant species to ensure longer periods of flowering and to provide a greater variety of suitable flowers for pollinators and the natural enemies of pests.

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5) The Effect of Biodiversity on Biological Control of Olive Pests

- Small flowering plants such as wild carrot (*Dacus carota*), coriander (*Coriandrum sativum*), and clover (*Trifolium repens*) are especially attractive to beneficial insects.
- It is particularly helpful to sow a mixture of plants with overlapping blooming periods that cover a long duration from spring to early winter.
 - ✓ Main pest during spring: *Sassietta oleae*
 - ✓ Main pest during summer : *Palpita unionalis*
 - ✓ Main pest during late summer and autumn: *B. oleae* and *Prays oleae*

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5) The Effect of Biodiversity on Biological Control of Olive Pests

Table 1- Plants in olive groves with great potential as a source of predators and parasitoids

| Plant | Attract/repel | Seedling /planting | Flowering Period |
|--|--|------------------------------|--------------------------------------|
| Dandelion (<i>Taraxacum officinale</i>) | Parasitoid wasp | November or February / March | June |
| Wild Carrot (<i>Daucus carota</i>) | Parasitoid wasp, General predator <i>Orius</i> | November or February / March | June |
| Corn daisy (<i>Chrysanthemum segetum</i>) | Parasitoid wasp including <i>Opius</i> | Early spring | summer |
| Parsely (<i>Petroselinum sativum</i>) | Parasitoid wasp, <i>Chrysopa</i> (predator of <i>Prays oleae</i>) | November or February / March | June |
| Coriander (<i>Coriandrum sativum</i>) | Parasitoid wasp including <i>Opius</i> | November or February / March | June |
| Vetch (<i>Vicia sativa, Vicia villosa</i>) | General predator <i>Orius</i> , Parasitoid wasp including <i>Opius</i> | fall | April - May |
| Anise (<i>Pimpinella anisum</i>) | Parasitoid wasp including <i>Opius</i> Repellent to flies and moth | March | June – July |
| Clover (<i>Trifolium repens</i>) | Parasitoid wasp including <i>Opius</i> | Fall Or spring | Spring Or summer |
| White mustard (<i>Sinapis alba</i>) | General predator (<i>Orius, chrysopa</i>), Parasitoid wasp including <i>Opius</i> | November or March - April | April / May Or June / August |
| Sweet Alyssum (<i>Lobularia maritima</i>) | <i>Diachasmimorpha longicaudata</i> (Parasitoid of <i>Bactrocera oleae</i>) | Mid spring | summer |
| Inula (<i>Dittrichia viscosa</i>) | <i>Eupelmus urozonus</i> (parasitoid of <i>B. oleae</i>), <i>Macrolophus sp.</i> (General predator), parasitoid wasp, phytoseiid mite | March - April | August – October Fruit: Oct - Nov |



5) The Effect of Biodiversity on Biological Control of Olive Pests



A study was done in Greece on the potential of ground cover to enhance habitats for natural enemies of pests in olive groves. The study considered mixtures of sown plant species and spontaneous natural vegetation between trees.

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5) The Effect of Biodiversity on Biological Control of Olive Pests

1- These parasitoids were recorded on scale insects and olive fruit flies on the plants and olive trees: *Opius concolor*, *Pnigalio mediterraneus*, Pteromalidae and Trichogrammatidae. Their presence was more evident in May and June, when the main flowers in bloom were white mustard, borage, coriander, and crown daisies.

2- Large numbers of *Orius* predators were found on the patches of ground cover. They feed on mites and thrips and also on pollen when prey is not available. Ground cover patches can serve as banker plants for *Orius* bugs, meaning they help the predators survive and reproduce so they can control olive pests.

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5) The Effect of Biodiversity on Biological Control of Olive Pests

3- Common green lacewings (*Chrysoperla*) were found in greater numbers in the mixture containing mostly white mustard (*Sinapis alba*) and in the olive tree canopy. The *Chrysoperla* larva is a predator of the olive moth (*Prays oleae*), the black scale (*Saissetia oleae*), the olive psyllid, and scales.

4- Sown and natural vegetation patches support the maintenance of natural enemies of olive pests.

5- Especially early in the season, available floral nectar sources play an important role in the population dynamics of parasitoids of olive pests.

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5) The Effect of Biodiversity on Biological Control of Olive Pests

6- The plants white mustard (*S. alba*), borage (*B. officinalis*), vetch (*V. sativa*) and coriander (*C. sativum*) germinate and flower every year.

7- White mustard has a strong capacity to establish itself in large numbers and become dominant.

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6) The Example of *Dittrichia viscosa*

Inula (*Dittrichia viscosa*) is one of the perennial plant species historically associated with olive groves in the Mediterranean region. *Inula* can be used in organic olive groves or integrated pest management (IPM), because it offers food for plant-eating insects unrelated to olive trees and hosts natural enemies of common olive pests.



Photo by Z. Mousa



6) The Example of *Dittrichia viscosa*

Inula (*Dittrichia viscosa*) can play an important role in the conservation of predator populations in olive agro-ecosystems.

Inula grows without care or irrigation.



Photo by Z. Mousa



6) The Example of *Dittrichia viscosa*

It can help control pests of companion plants in the agroforestry system since it hosts aphid parasitoids, lady beetles, phytoseiid mites, and general predators such as *Chrysopa*, *Orius* and *Macrolophus caliginosus*.



Photo by Z. Moussa

6) The Example of *Dittrichia viscosa*

Inula flowers are infested by *Myopites stylata*, a fly that causes gall formation. The larvae of *Myopites stylata* are parasitized by *Eupelmus urozonus*, one of the main parasitoids of the olive fruit fly (*Bactrocera oleae*), and other parasitoids. Thus, inula helps attract parasitoids that can assist in olive fruit fly control.



Myopites



Eupelmus





6- example of *Dittrichia viscosa*



Dittrichia viscosa



Bactrocera oleae



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Myopites stylata



Parasitoid



Photo by Z. Moussa



6) The Example of *Dittrichia viscosa*

Since both the olive fruit fly and the *M. stylata* fruit fly attract the *E. urozonus* parasitoid, the combination of the two makes it more likely that this parasitoid will be present in the olive grove when it is needed.

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6) The Example of *Dittrichia viscosa*

Inula can be used to help control other olive pests since it hosts general predators and plays an important role in the conservation of predator populations in olive agro-ecosystems.

The general predators *Orius*, *Macrolophus* and *Chrysopa* feed on the olive moth (*Prays oleae*), the jasmine moth (*Palpita unionalis*), the black scale (*Sassetia oleae*), thrips and the olive psyllid.





6) The Example of *Dittrichia viscosa*

D. viscosa can offer many benefits as part of an Olive-Agroforestry system, even providing extra income for farmers:

- Pollination
- Honey production
- Conservation of biodiversity
- Pest control
- Essential oil for medicinal drug production



Photo by Z. Mousa



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