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

Chapter 3 – Agroforestry's Effects on Olive Diseases

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Outline

Agroforestry as a Tool to Manage Olive Pests and Diseases
Agroforestry's Effects on Olive Diseases

1. Olive diseases
2. Conditions associated with diseases
3. Methods to reduce the impact of olive diseases in Agroforestry
4. Example of control methods for *Verticillium dahlia*:
   Planting broccoli
5. Economic considerations

Outline

1. *Olive Diseases*

Examples of Olive Diseases

Fungal Diseases: Foliar

- Mycocentrospora / *M. cladosporioides*

M. cladosporioides causes leaves to appear slightly yellow. The undersides of some leaves become discolored in one stage of the fungus, appearing to be covered with black dust. These leaves may fall, causing some defoliation in some cases. Fruit can also develop small brown lesion spots and fail to mature uniformly.

- Peacock Spots / *Spilocaea oleaginea*

Peacock spot appears on leaves as sooty blotches that develop into circular black spots. There may be a yellow halo around the spot.

Examples of Olive Diseases

Fungal Diseases: Soil-borne

- Phytophthora Root Rot and Crown Rot /*Phytophthora citricola*, *Phytophthora dreschleri*, *Phytophthora* spp.

Phytophthora-infected trees have reduced growth and thin canopies; they often die if the disease progresses rapidly. Roots rotted by *Phytophthora* are dark, and trees affected for long periods by Phytophthora root rot may have few root hairs. The bark of the root crown turns dark as the infection spreads.

- Verticillium Wilt / *Verticillium dahliae*

Symptoms of Verticillium wilt appear when leaves on one or more branches of the tree suddenly wilt early in the growing season; this process intensifies as the season progresses. Mature trees infected with Verticillium may die. The darkening of xylem tissue, a key symptom for distinguishing Verticillium wilt in many crops, is not always apparent in olives.

Photo by:
Dr. Wassim HAbib

Examples of Olive Diseases

Bacterial Diseases

- ### Olive Knot / *Pseudomonas savastanoi*

Olive knot appears as rough galls or swellings about 0.5 to 2 inches in diameter on twigs, branches, trunks, roots, leaves, or peduncles (fruit stems). Small shoots may be girdled, defoliated, and killed. Galls also form at trunk or limb wounds.

- ### Olive Quick Decline Syndrome / *Xyllela fastidiosa*

This disease is characterized by leaf scorching, twig and branch dieback and, ultimately, tree death.

In perennial crops, agroforestry has been associated with

➢ Fewer pests

➢ Less plant damage

(Pumariño *et al.,* 2015)

Outline

2. Conditions Associated with Diseases
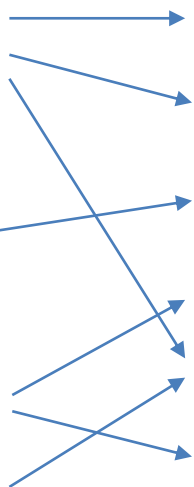
Examples of Conditions Associated with Olive Diseases

- High humidity and rain, wet weather occurring in spring
- Excessively wet soils, clay-panning or poor drainage
- Uncontrolled weeds in the field
- Frost, hail, or cold injury

- Mycocentrospora
- Peacock Spots
- Phytophthora Root and Crown Rot
- Verticillium Wilt
- Olive Knot
- Olive Quick Decline Syndrome

Outline

3. *Methods to reduce the impact of olive diseases in Agroforestry*

Conditions associated with olive diseases
and their solutions in Agroforestry

Frost, Hail, or Cold Injury

➤   Windbreaks reduce the exposure of olive trees to hail and cold wind.
(Molla, 2016)

Excessively Wet Soils, Clay Panning or Poor Drainage

Clay panning refers to the creation of a layer of hard soil, largely composed of clay, that is difficult for roots and water to penetrate.

- **Cover crops and planting different types of plants** can help avoid the above mentioned conditions. Deep rooted cover crops increase subsoil water holding capacity. A bare soil holds 1.7 inches of water, while a continuous living cover holds 4.2 inches of soil water. (USDA-NRCS Engineering handbook)

- **The reduced tillage** practiced in agroforestry can also reduce the above mentioned conditions and it was proven to lower the amount of dormant fungi in soil (lowering the microsclerotia density), compared with conventional tillage. (Terry A. Wheeler *et al.,* 2020)

Uncontrolled Weeds in the Field

Cover crops will reduce unwanted weeds. This is important since weeds can host disease-causing organisms and help them propagate and persist in olive groves.

Excessive Use of Fertilizers / Nitrogen

- Nitrogen has negative effects on plants' physical defenses and the production of anti-microbial substances called **phytoalexins**, but it has positive effects on defense-related enzymes and proteins that affect local defense and systemic resistance.

- This is why adequate nitrogen fertilization is important, but excess nitrogen will cause problems. (Sun, Y *et al.,* 2020)

➢ In agroforestry, the use of leguminous cover crops or a rotation with leguminous crops can provide a natural substitute for the uncontrollable high use of fertilizers.

Examples of Agroforestry Practices Associated with Disease Control

Practices	Weed control	Soil wetness control	Increasing organic matter	Improving the microclimate	Using less fertilizer	Improving microbial life in the soil	→ Disease Control
Cover crop / Intercropping	+	+	+		+	+	
Windbreaks				+			
Use of livestock manure		+	+			+	
Crop rotation					+	+	

Outline

4. Example of control methods for
Verticillium dahlia:
Planting broccoli

1. In a study done in a commercial field infested with the microsclerotia (resting structures) of the fungus *V. dahlia,* broccoli residues reduced *V. dahliae* microsclerotia in the soil and wilt of cauliflower as much as or more than the commonly used fungicides chloropicrin and Metam sodium (Subbarao *et al.,* 1999).

2. As described in the following slides, a more recent study successfully used broccoli in an Integrated Pest Management (IPM) strategy to control *Verticillium* in potato production (Baroudy *et al.,* 2019).

Incorporating broccoli residues into the soil after harvesting the crop. Photos by: Dr. Farah Baroudy

Example:

Control of *Verticillium dahliae*

The bar graph summarizes the effect of different treatments on **wilt incidence** at different times after sowing. While the results of broccoli residue use are modestly good here, the **plant height and tuber yield** described in the next slide are quite impressive.
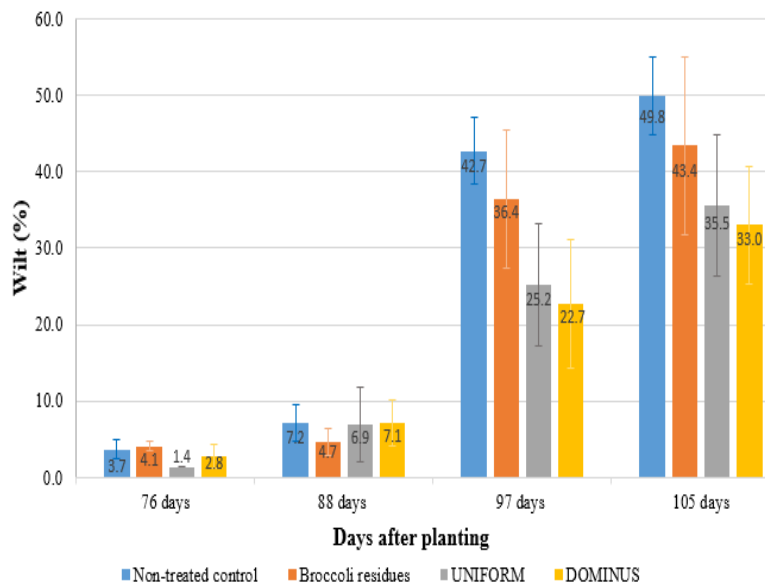
Example:

Control of *Verticillium dahliae*

Treatment	Plant height (cm)		Yield (t ha⁻¹)	
	Days after planting		Total tuber yield	Marketable tuber yield
	76 days	88 days		
Non-treated control	44.8 ± 3.8 ab	**46.2 ± 4.2 ab**	11.4 ± 1.3 a	7.7 ± 0.9 a
Broccoli residues	49.8 ± 2.8 a	**50.0 ± 3.9 a**	14.3 ± 4.6 a	9.8 ± 4.3 a
UNIFORM	43.4 ± 2.2 ab	**45.0 ± 2.0 b**	12.4 ± 0.8 a	9.6 ± 0.6 a
DOMINUS	37.3 ± 1.8 b	**40.0 ± 1.7 c**	11.2 ± 2.1 a	7.6 ± 2.2 a

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Conclusion:

Bio-fumigation using broccoli also revealed the potential to **improve crop growth and production** in infected soils. This potential could be enhanced if the method is repeated for several consecutive years.

How does it work?
Find out in the next slide.

LIVINGAGRO

How does it work when we add chopped broccoli to the soil?

- The chopped broccoli attracts more microbes to the soil; that help protect against Verticillium wilt and other plant diseases.

(Inderbritzin *et al.,* 2017)

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Outline

5. Economic Considerations

Economic Considerations

Many agroforestry practices reduce the cost of production by decreasing the cost of soil cultivation, irrigation, and chemical fertilizers.

More specifically, disease management in agroforestry can help

Reduce the use of pesticides and fumigation, including

- copper pesticides used for such olive diseases as Mycocentrospora, peacock spots and olive knot
- soil fumigation needed during grove establishment in fields highly infested with soil-borne diseases

Reduce the loss of olive trees

- caused by many diseases, including soil-borne diseases such as *Verticillium dahlia*

Increase income from healthier trees

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