diagnostic and research work presented at national and international conferences

**Anthracnose in olives: symptoms, disease cycle and management**
4th OLIVEBIOTEQ International Conference for olive tree and olive products, Chania, Greece, 2011

**The role of epidemiology in developing integrated management of anthracnose in olives**
7th International Symposium on olive growing, San-Juan, Argentina, 2012

**Hemibiotrophic infection of the Colletotrichum causing anthracnose in olives**
10th International Congress of Plant Pathology, Beijing, China, 2013

**Current research approaches for the understanding and control of anthracnose in olives**

Dr Vera Sergeeva
www.olivediseases.com
Anthracnose - widespread and severe disease in most olive-growing countries, causing significant yield losses, poor fruit and olive oil quality

In this presentation images of susceptible anthracnose cvs Barnea, Manzanillo and Kalamata were used
Anthracnose
Olive Anthracnose affects:

- Buds
- Flowers
- Sepals
- Pedicels
- Peduncles
- Fruitset
- Immature fruits at all phenological stages
- Ripening fruits
- Leaves
- Petiole
- Twigs/shoots
- Mummified fruits
- Suckers and water spouts

Fungal inoculum present year-round throughout the canopy
Different types of symptoms caused by anthracnose

Both species can occur in one olive grove and fungal isolates appear to be quite diverse.
Colletotrichum species most important pathogens, cause latent infection. Produce two types of colonizations: biotrophic and necrotrophic.

During the symptomless biotrophic phase pathogen invades host cells without killing them and feeds on living cells.

Necrotrophic lifestyle kills plant tissue.

Colletotrichum survive under different conditions and environments.
Anthracnose fungi overwinter in mummified fruits on the tree, woody tissue and leaves.
Fungi survive within the tree canopy

New fungal spores are produced in early spring in these old infections such as mummified fruits, twigs, leaves and peduncles

Disease cycle plays an important role in working out strategies for effective and timely management of anthracnose and in reducing the number of unnecessary fungicide applications
Shoot dieback causes entire branch dieback.
Fungus produces conidia in acervuli that develop on infected tissues and exude orange sticky masses of spores.

Fungus has long saprophytic survival ability on dead peduncle and pedicel and mummified fruit.

Spores from these fungal colonies could be important sources for infection of buds and flowers.
Anthracnose on leaves

Brown spots carrying sporulating colonies of the fungus

Spores from leaf fungal colonies could be important sources for infection of buds and flowers
Moist environmental conditions in general favor the spread of disease.

Heavy dews associated with severe anthracnose epidemics.
Biotrophic asymptomatic infection of leaves during flower bud formation

Fungal spores spread from pedicel to infect healthy tissue during flower bud formation

Necrotrophic - kills plant tissue
Young leaves infected by anthracnose fungus
Young shoot and leaf infected by anthracnose fungus

spores

spores
Spores from these sucker's fungal colonies could be important sources for infection of buds, flowers, leaves and fruits.
Symptoms of disease appear on newly developed suckers after pruning.
Reinfection of tree by repeating spore stage is responsible for increased anthracnose symptoms during summer to new growth suckers and waterspouts.

Symptoms enlarged from tip to bottom of infected shoots, suckers and water spouts.
Asymptomatic infection of flower buds

Flower buds infection

spores
Different olive cultivars have varying responses to flower infection. Flower buds and flowers - more critical for infection to anthracnose.
Infection of flowers, leading to fruit rot, is of economic importance as anthracnose results in significant losses in yield and reduced oil quality.

Research need: Timing of fungicide applications to manage latent infection of flower buds & flowers. Application of nutrients to strengthen the floral tissues.
Weather conditions very important for disease development during the year

Optimum conditions for disease development

- Temperature
- Relative humidity
- Wetness
- Rain period (total rainfall, number days)

Stressed trees more susceptible to disease

- Water stress (draught, floods)
- Temperature extremes
- Lack of nutrients
- Chemical damages
Anthracnose difficult to control after symptoms appear, particularly when environmental conditions are favorable for infection.
Fruitset:
Fruit infected at these stages can drop and those that remain on the trees can exhibit sporulating colonies of fungus.

Flowering and fruit set (late in summer) carry fungal infection during fruit development on a single peduncle.
Infection that occurs on the pedicels after flowering can move into the fruit
Heavy infections cause rapid rotting, sometimes shriveled and mummified fruits. Immature fruits may persist on tree, providing inoculum for new infections.
Symptomless necrotrophic phase infection that occurs on the pedicels after flowering can move into the fruit, causing rot in immature fruits.

Pathogen grows into the fruit.
Symptomless biotrophic phase - *Colletotrichum* invades host cells without killing them and feeds on living cells.

Spores on receptacle permit survival of anthracnose pathogen during hot and dry summer or after fungicide applications.
Anthracnose fungal spores on olive fruits damaged by sun & chemicals

Spores on fruits permit survival of anthracnose pathogen during hot and dry summer or after fungicide applications
Asymptomatic infection of peduncle

spores

spores
Stomata can respond to water stress within the tree by opening and closing.
Open stomata are more susceptible to disease development.
Anthracnose pathogen enters immature fruit—associated with raised stomata?
Immature fruits infected by anthracnose fungus
Immature fruits infected at all phenological stages
Fungus spreads from adjacent diseased fruits as contact infection.
Wind, rain, heavy dew or mist and even fog can increase spread the disease.
Mummified fruits before harvest
Queensland fruit fly and Green vegetable bug

Control of pests damage which provides entry points for fungal rots will limit surface damage of fruit and reduce severity of anthracnose.

Insects can increase disease severity by carrying fungal conidia and provide entry points for fungal rots.
Symptoms after fungicide applications:

Copper-based: copper hydroxide, cuprous oxide, Tri-Base-Blue

Strobilurins: Amistar (azoxystrobin) and Aero (pyraclostrobin)
Diseased fruits before harvest

Anthracnose pathogen survive after fungicide applications
Growers can find it difficult to correctly identify these diseases, as symptoms can look similar.
Factors affect the farmer’s choice of pesticide - “To spray or not to spray?”

- Approval for the intended use-crop and pest
- Efficacy (does it kill the pest?)
- Safety to environment
- Safety to beneficials
- Safety to people or their property or yourself
- Price
- Easy to use
- Avoiding resistance
- Ability to stimulate pests and diseases
- Incomplete or missing information
- Disease management made more difficult by presence of different species of *Colletotrichum*
- Pesticides can cause stress to plants which they were created to defend
- Complete coverage of large, tall trees hard to achieve; spraying is not very efficient and might not be justified or feasible
- In rainy year application of chemical treatments is difficult
- Pesticide residues can persist to harvest stage, making possible contamination of fruits.
What are the most important steps to improve anthracnose control?

- Integrated disease management

Maintain tree health through proper cultivation techniques, irrigation, fertilization, pruning and soil health
Yield and quality of olive oil depends on many factors, including cultivars, cultural techniques and environment.
Disease Prevention

Preventive cultural practices: *planting cultivars that are not susceptible to pathogens*
- Selecting varieties suited to local growing conditions
- Maintaining healthy crops
- Plant quarantine (plant sanitation, biosecurity)

Disease Observation

- Monitoring:
- Inspection and identification (regular observation is the cornerstone of IPM)
- Monitor the degree days of an environment to determine the optimal time for the onset of anthracnose.

Disease Intervention

- Cultural (cultivars, agronomic techniques such as pruning, fertilization, irrigation, soil management)
- Chemical (timing and type of application of fungicides)
Pruning: diseased twigs should be pruned, removed from grove & destroyed

- helps with natural control of Anthracnose and reduces pressure on fungicides
- disrupt lifecycle at commencement or interrupt lifecycle once lifecycle has started
Sap - physiological disorder: dripping from tree after use of in automatic irrigation, heavy rains following a dry period or fluctuations in the temperature.
Does nutrition have an affect on disease management?

Is Anthracnose disease by lack of Calcium?

**Calcium improves:**

Olives
- Boron and calcium improving fruit set of olive flowers
  

Other crops
- reduces fruit drop in citrus and other fruits
- accelerates flower opening
- promotes fruit quality
- makes stronger cell walls, which can avoid the invasion of pathogen
- plays role in regulation of the stomata
- influence of calcium sprays reduce fungicide inputs against apple scab
- participates in metabolic processes of uptake other nutrients.

Plants suffering a nutrient stress will be more susceptible to pests and diseases, while adequate crop nutrition makes plants more tolerant of or resistant to pest or disease.
High pesticide levels can become toxic to roots, may also interfere with the uptake of plant nutrients, disrupt the natural ecological balance in the soil by killing beneficial soil microbes. Like all living things, creatures of the soil community need food, water and air to carry on their activities. Plant’s pest and disease resistance is strongly related to the fertility of soil in which they grow.
Thank you