The Australian National conference 17th—19th September 2014

# DISEASES & PESTS: Anthracnose management factors influencing yield and quality of olives

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# Global impact of pests and diseases



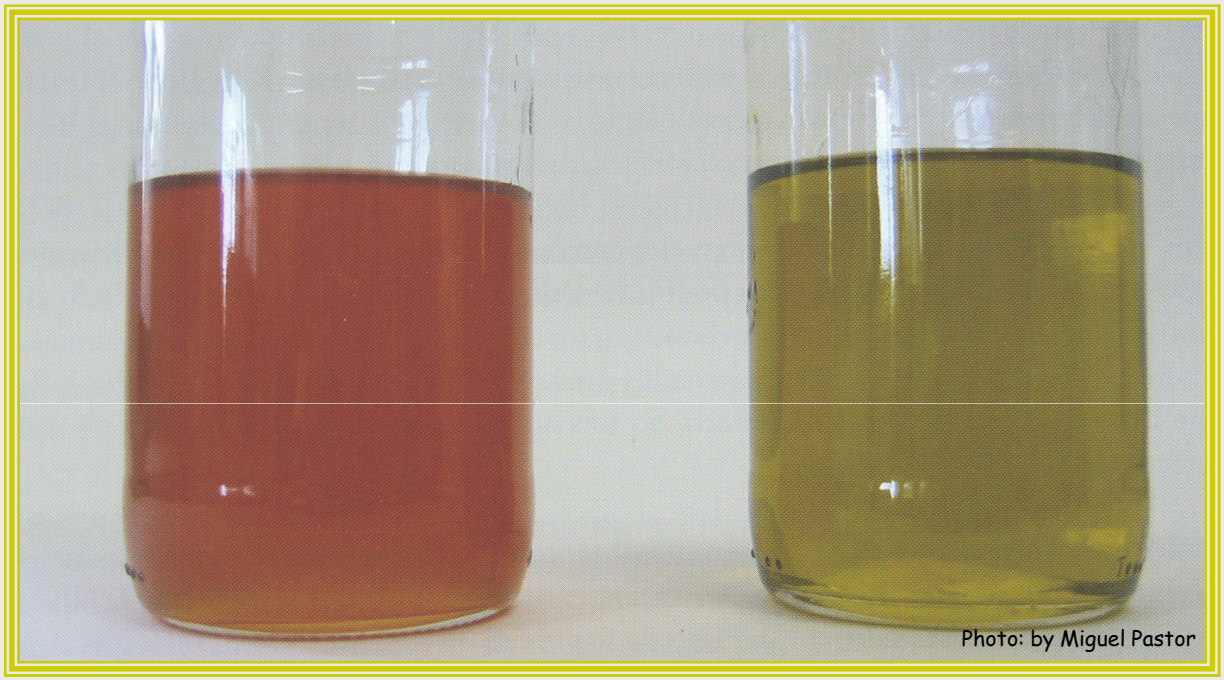

•about 2.5 million tonnes of pesticides are used on crops each year
•annual crop lost 20-25% of potential world yield
•one third of global production valued at several billion dollars is destroyed annually by over 20,000 species of pests in field and storage
•*Botrytis cinerea* and *Colletotrichum spp.* fungi attacks flowers, fruits, leaves and stems of more than 200 plant species causing several pre- and post-harvest diseases

Plant protection plays an extremely important role in increasing production of horticultural crops for our growing populations

# ANTHRACNOSE

Anthracnose may affect up to 80% of olives in susceptible cultivars
Pest damage results in yield loss and higher spraying cost

**Disease may take several years before it becomes serious**




Olive oil obtained from olives harvested with anthracnose produce a very turbid and highly acidic reddish oil of poor quality

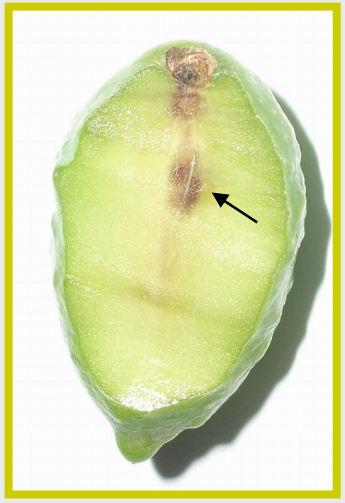
Olive Anthracnose affects:

- Flower buds
- Flowers
- Sepals
- Pedicels
- Peduncles
- Fruitset
- Immature fruits at all phenological stages
- Ripening fruits
- Leaves
- Petiole
- Twigs/shoots
- Mummified fruits
- Suckers and waterspouts

Fungal inoculum present year-round throughout the canopy

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 life style kill plant tissue

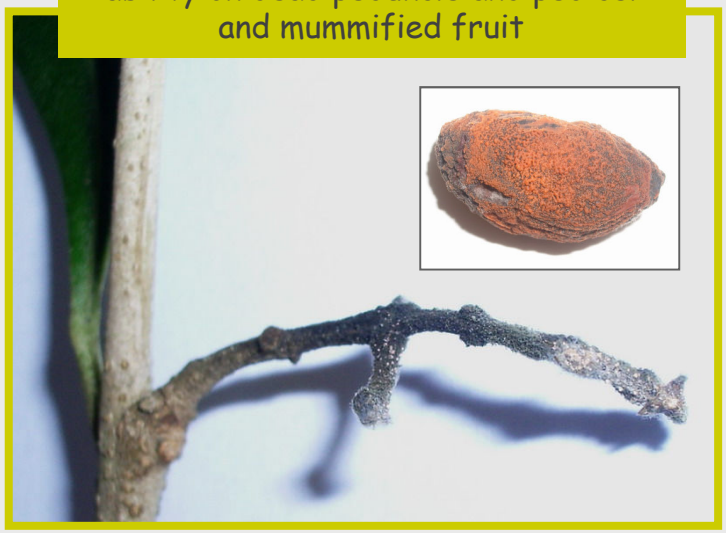
Colletotrichum survive under different conditions and environments

Anthracnose fungi overwinter in mummified fruits on the tree, woody tissue and leaves

Disease cycle plays an important role in working out strategies for effective and timely management of anthracnose and in reducing the number of unnecessary fungicides applications

Fungus produces conidia in acervuli that develop on infected tissues and exude orange sticky masses of spores

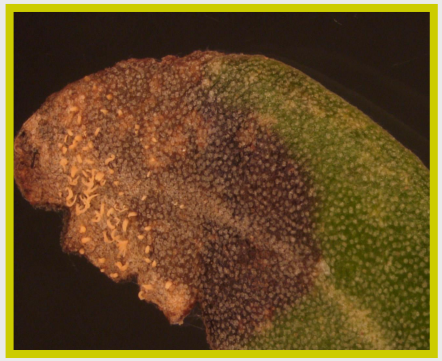
Fungus has long saprophytic survival ability on dead peduncle and pedicel and mummified fruit



Spores from these fungal colonies could be important sources for infection of flower buds and flowers

# Anthracnose on leaves

Brown spots carrying sporulating colonies of the fungus
Spores from leaf fungal colonies important sources for infection of buds and flowers



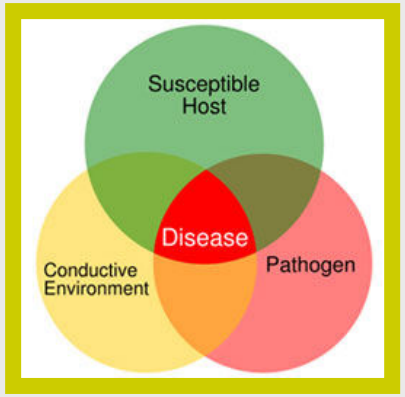
Young shoot and leaves infected by anthracnose fungus

**Biotrophic** asymptomatic infection of leaves during flower bud formation

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

**Necrotrophic** -kill plant tissue

Heavy dews associated with severe anthracnose epidemics




Moist environmental conditions in general favor the spread of disease. Anthracnose is difficult to control after symptoms appear, particularly when environmental conditions are favorable for infection

# Suckers and waterspouts


Symptoms of disease appears on newly developed suckers after pruning

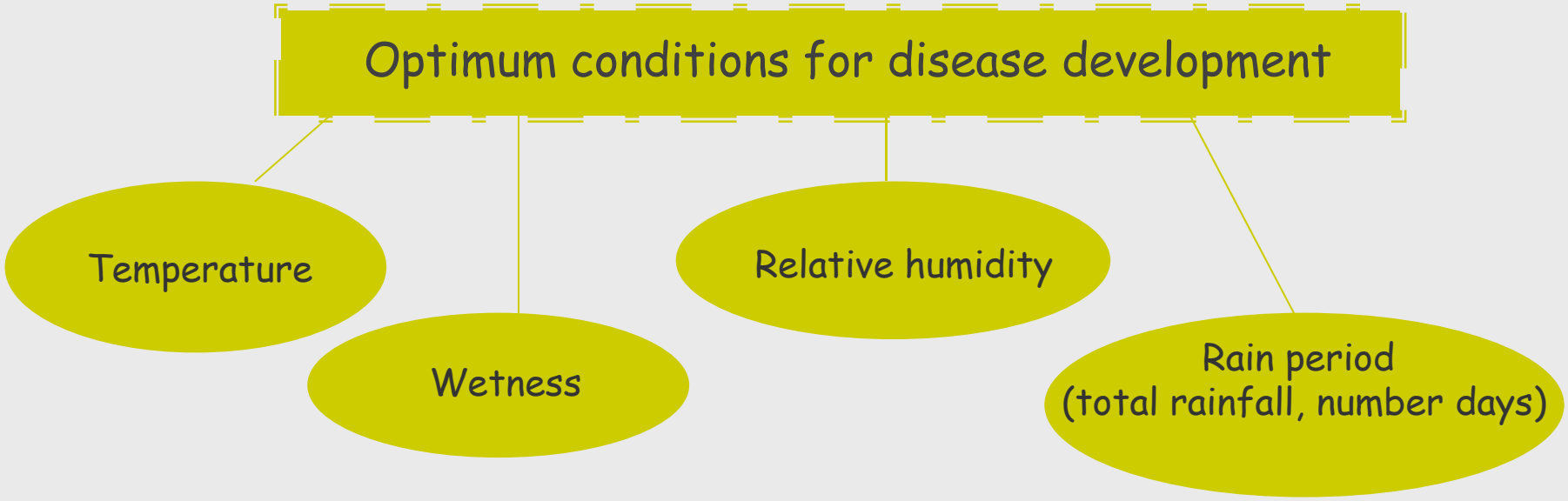
Spores from these suckers fungal colonies could be important sources for infection of buds, flowers, leaves and fruits

# Suckers

Symptoms enlarged from tip to bottom of infected shoots, suckers and waterspouts

Reinfection of tree by repeating spore stage is responsible for increased anthracnose symptoms during summer to new growth suckers and waterspouts

# Weather conditions are very important for disease development during the year

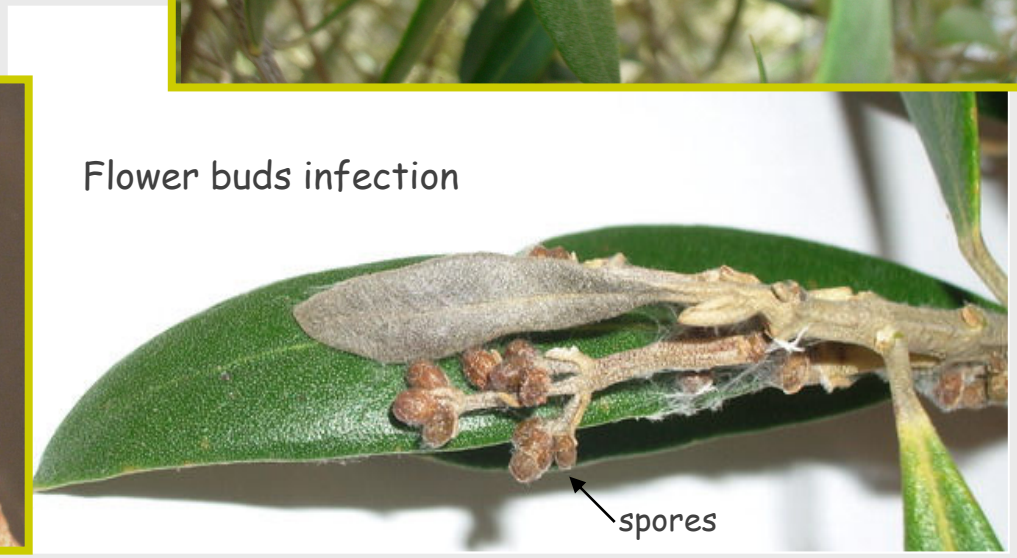



Stressed trees more susceptible to disease

- water stress (drought, floods)
- temperature extremes
- lack of nutrients
- chemical damages

# Flower buds

Asymptomatic infection of flower buds




Flower buds infection

Different olive cultivars have varying responses to flower infection
Flower buds and flowers - more critical for infection to anthracnose

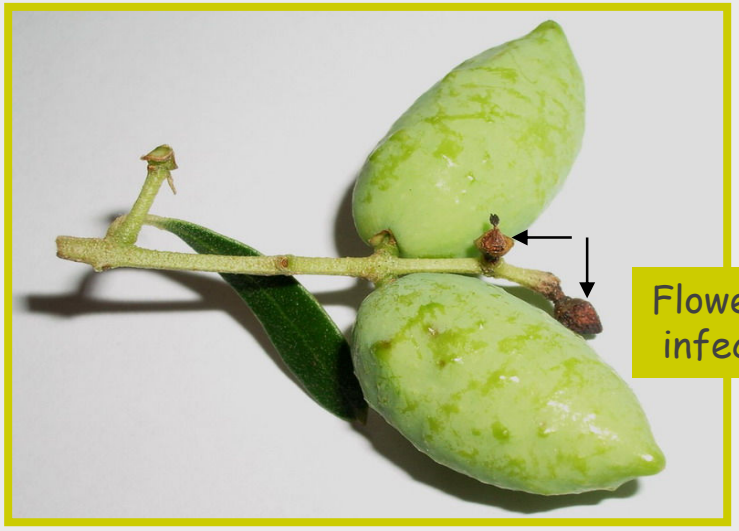
Flowers

Asymptomatic infection of olive flowers

Infected flowers dry quickly


Infection of flowers, leading to fruit rot, is of economic importance as anthracnose results in significant losses in yield and reduced oil quality

# Fruitset:

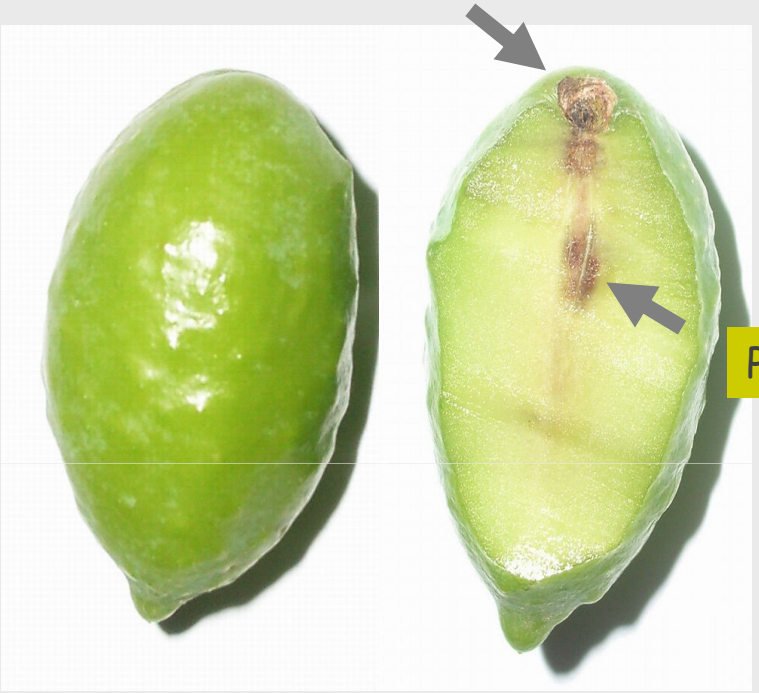


Fruit infected at these stages can drop; and those that remain on the trees can exhibit sporulating colonies of fungus

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

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

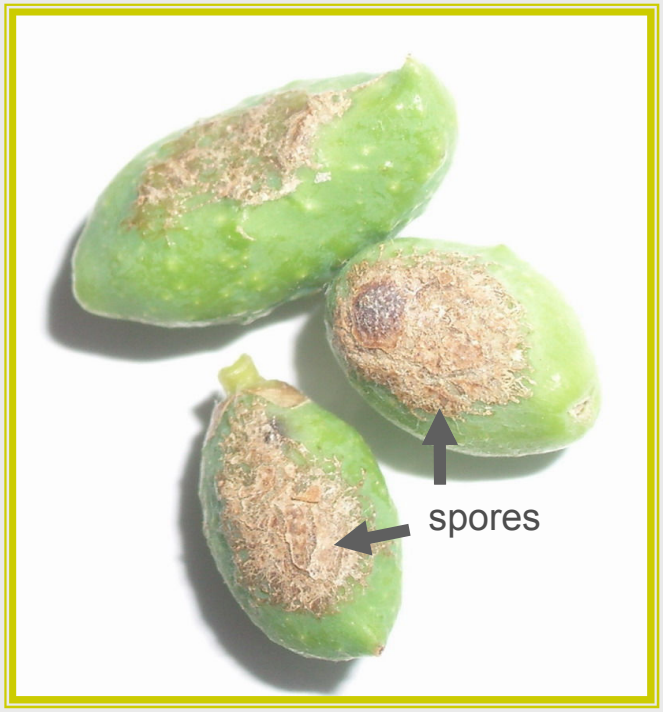
Anthracnose pathogens survive during hot and dry summer or after fungicide applications

Symptomless Biotrophic phase – Colletotrichum fungi invades host cells without killing them and feeds on living cells



Spores on receptacle permit survival of the anthracnose pathogen during hot and dry summer or after fungicide applications

Anthracnose fungal spores on olive fruits damaged by sun & chemicals



cv. Barnea

cv. Frantoio is moderately resistant to anthracnose infected with disease

Stomata can respond to water stress within the tree by opening and closing
Open stomata are more susceptible to disease development
Anthracnose pathogen enter in  immature fruit associated with raised stomata ???

# Immature fruits infected by anthracnose fungus

mummified fruits cv. Barnea

mummified fruits cv. Manzanillo

Heavy infections cause rapid rotting, sometimes shriveled and mummified fruits
Immature fruits may persist on tree, providing inoculum for new infections

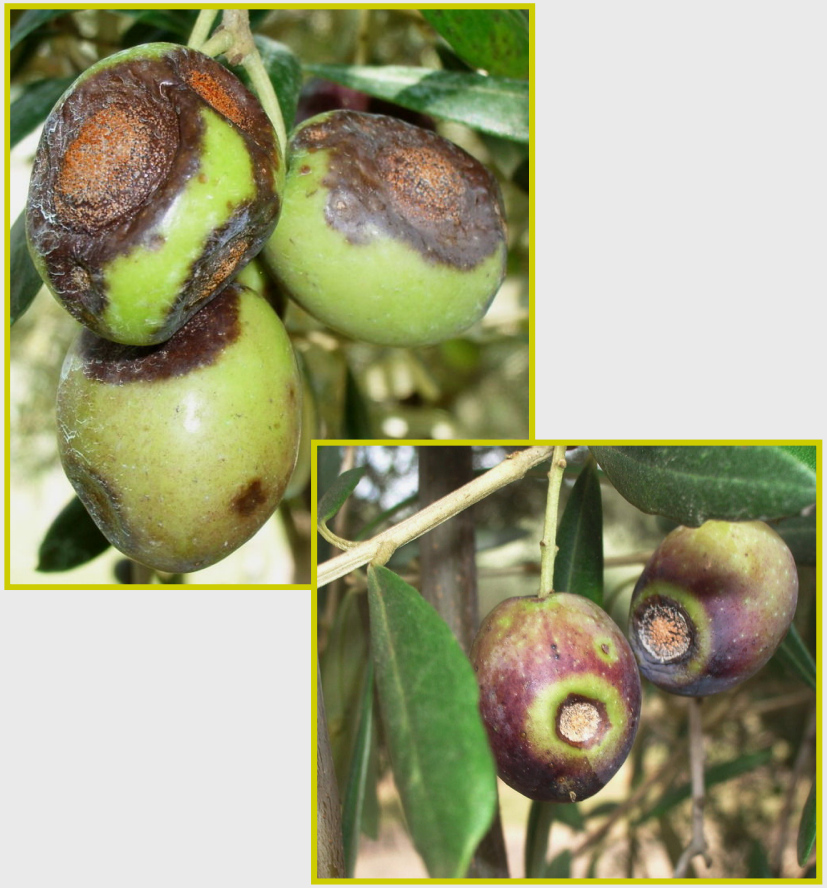
Fungus spreads from adjacent diseased fruits as contact infection
Wind, rain, heavy dew or mist and even fog can increase spread the disease

Symptoms after fungicide applications :

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

Strobilurins: Amistar (azoxystrobin)

Diseased fruits before harvest

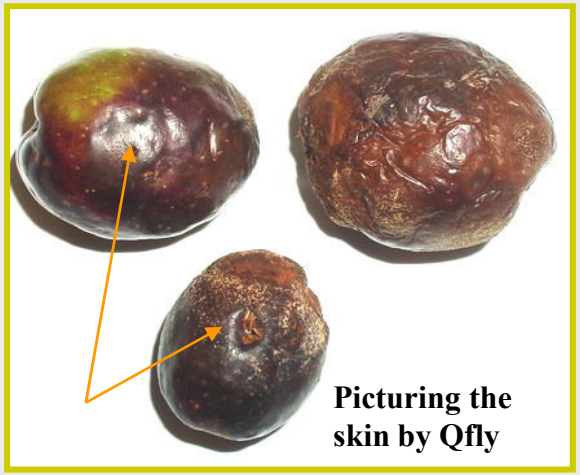


Anthracnose pathogens survive after fungicide applications

Insects can increase disease severity by carrying fungal conidia and provides entry points for fungal rots

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

# QUEENSLAND FRUIT FLY




Larvae while feeding, tunnel throughout the fruit, destroying pulp & allowing secondary infestations of bacteria and fungi that rot the fruit

Larvae produced during late fall pupate in the soil, where they spend the winter

QFfly lays eggs which then hatch and destroy fruit; 3-5generations per year depending upon local conditions

# GREEN VEGETABLE BUG

Green vegetable bug with hatching eggs

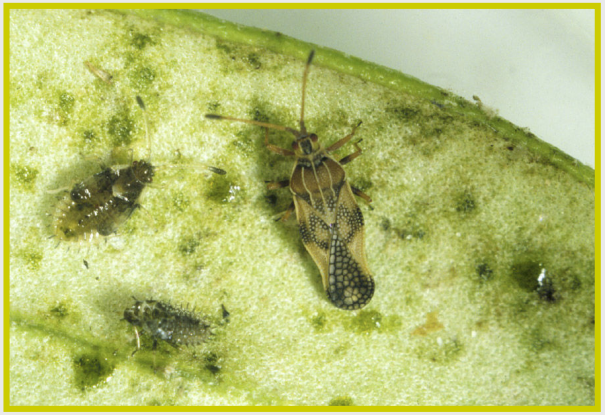
insect changes colour quite extensively as it goes through its younger stages and nymphs showing this variation before reaching the adult insect which is green

- Over-wintering adults are purple-brown
- Four generations can develop in one year
- Pierces the fruit and sucks out juices from the olive
- Piercings provide entry points for fungal rots such as anthracnose
- Eggs take between 5 and 21 days to develop, depending on the temperature
- Nymphs moult five times before reaching maturity, increasing in size each time
- Bugs should be controlled before nymphs reach a damaging size

# LACE BUG

*Plerochila australis* recorded in Ethiopia in 1960s. In 2013 over 80 hectares was infested

*Plerochila australis* in Ethiopian region, Mauritius, Zimbabwe, Mascorene islands and South Africa



*Froggatia olivinia* in Australia

Tingidae Family observed on olive, *Olea europaea africana* in Kenya, 2012

# Olive lace bug (*Froggatia olivinia* )

- OLB overwinter as eggs in leaves and as adults in protected areas on tree
- OLB colonies on suckers could be important sources for infection
- Feeding undersides of leaves, inserting their needle-like mouthparts into leaf tissue cells to extract cell contents
- Heavy feeding can cause leaf discoloration
- Reduce it's photosynthsis through damaged leaves & loss of leaves resulting in lower growth potential
- Female lace bugs lay 3-4generations of eggs per year
- Eggs laid on undersides of leaves protected by a cover of black excreta

- OLB has a very short life cycle and numbers can build up rapidly

- Monitoring is very important to ensure you know where the activity is in the orchard and to ensure good control

- If an infestation was seen early it might be controlled within a grove by pruning infested leaves and burning them

- Lace bugs generally eggs hatch in spring (1st generation), some eggs may hatch during the winter months (warm-weather)

- In spring is a good time for spraying with recommended chemicals when insects are active

- OLBs are relatively immobile insects. If infestations in previously uninfected groves are detected early, judicious pruning and destruction of infested canopy may control it

The anthracnose pathogen was isolated consistently from the advancing margins of the necrosis surrounding the lace bug colonies in avocado. Feeding damage may provide entrance for pathogenic fungi such as leaf anthracnose

# Pesticides Mode of Action

- Broad Spectrum -- Kills broad range of pests, usually refers to insecticides, fungicides and bactericides
- Contact Poison -- Kills by contacting pest
- Disinfectant (Eradicant) -- Effective against pathogen that has already infected the crop
- Germination Inhibitor -- Inhibits germination of weed seeds, fungus spores, bacterial spores.
- Nonselective -- Kills broad range of pests and/or crop plants, usually used in reference to herbicides
- Nerve Poison -- Interferes with nervous system function
- Protectants -- Protects crop if applied before pathogens infect the crop
- Repellents -- Repels pest from crop or interferes with pest's ability to locate crop
- Systemic -- Absorbed and translocated throughout the plant to provide protection
- Stomach Poison -- Kills after ingestion by an animal

**Permits for use on olives**

Fruit fly outbreak (SA only)--- See permit

Peacock spot (nursey stock only)---Flusilazole1 Expires Sept 2014

Fruit Loosening ---Ethephon Expires 30 Jun 2017

Various insect pests ---Dimethoate Expires 05-Oct-14

Curculio Beetle & Cutworms --- Alpha-Cypermethrin Expires 30 Nov 2015

Anthracnose --- Azoxystrobin (Amistar) Expires 31 Aug 2019

Black Olive Scale --- Fenoxycarb Expires 31 Aug 2015

Olive Lace bug ---Natrasoap insecticidal soap spray Expires 30-Sep-23

Olive lace bug & Rutherglen bug --- Fenthion Expires 30-Oct-14

**Registered Products: – "olive" referred to on the label**

Scale insects --- Pyriproxyfen (Admiral)

Scale insects --- Paraffinic oil (Trump)

Infection of fruit & foliage --- Copper oxychloride (various)

Foliar chemicals --- Trisiloxane Ethoxylate (Du-Wet)

Two-spotted mite --- Dicofol (Kelthane)

# Oil-based pesticides

- **Amurca** olive oil lees is one of olive oil byproducts which is watery bitter tasting and dark colored sediment that settles at the bottom of olive oil container after several months of storage.

  According to some ancient texts amurca was used in moderate amounts as a fertilizer or pesticide. The leftover water from the milling process is called amurca in Latin and a morge in Greek, a watery, bitter-tasting, smelly, liquid residue.

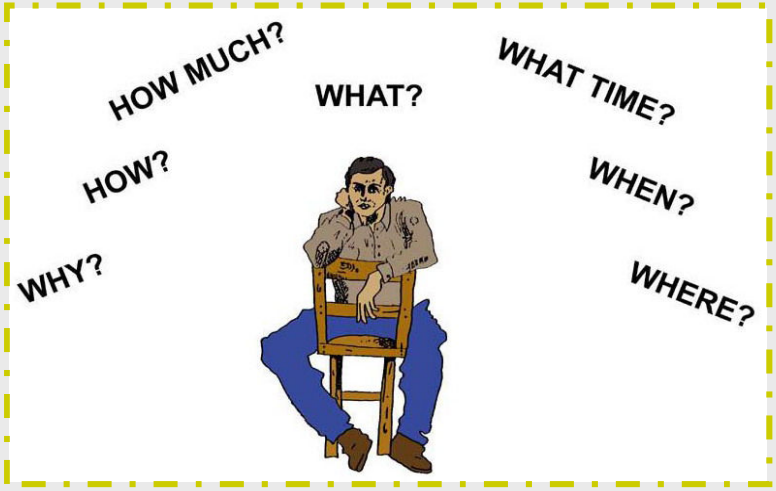
- **Vegetable oil**: An oil derived from the seeds of some oil seed crop (e.g., canola, soybeans, cottonseed).

- **Natrasoap** formulated using potassium salts combined with fatty acids in a vegetable oil base.

- **Petroleum oils** are highly refined, paraffinic oils that are used to manage pests and diseases of plants.

  Petroleum oils may be referred to by many names, including horticultural oil, spray oil, dormant oil, summer oil, supreme oil, superior oil, white mineral oil. These names usually refer to particular types, uses or brands of petroleum oil.

# Factors affect the farmer's choice of pesticide – "To spray or Not to spray ?

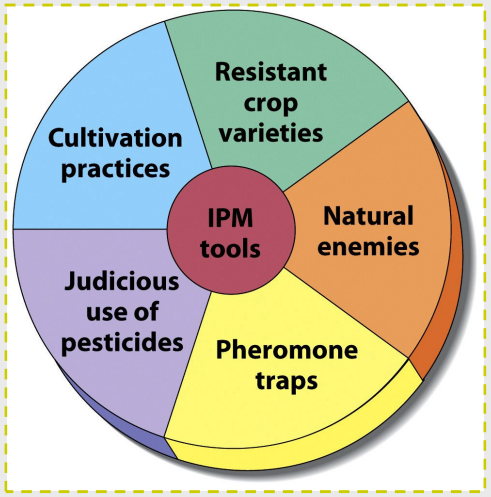



- Approval for the intended use-crop and pest
- Pesticide efficacy (does it kill the pest?)
- Safety to environment
- Safety to beneficials
- Safety to people or their property or yourself
- Price
- Easy to use
- Avoiding resistance
- Ability to stimulate pests and diseases
- Incomplete or missing information
- Disease management made more difficult by presence of different species of *Colletotrichum*
- Pesticides can cause stress of plants which they were devoted 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 pest management

Maintain tree health through proper cultivation techniques, irrigation, fertilization, pruning and soil health




IPM

•Combination of pest control methods that keeps pest population low without economic loss

•Conventional pesticides are used sparingly when other methods fail

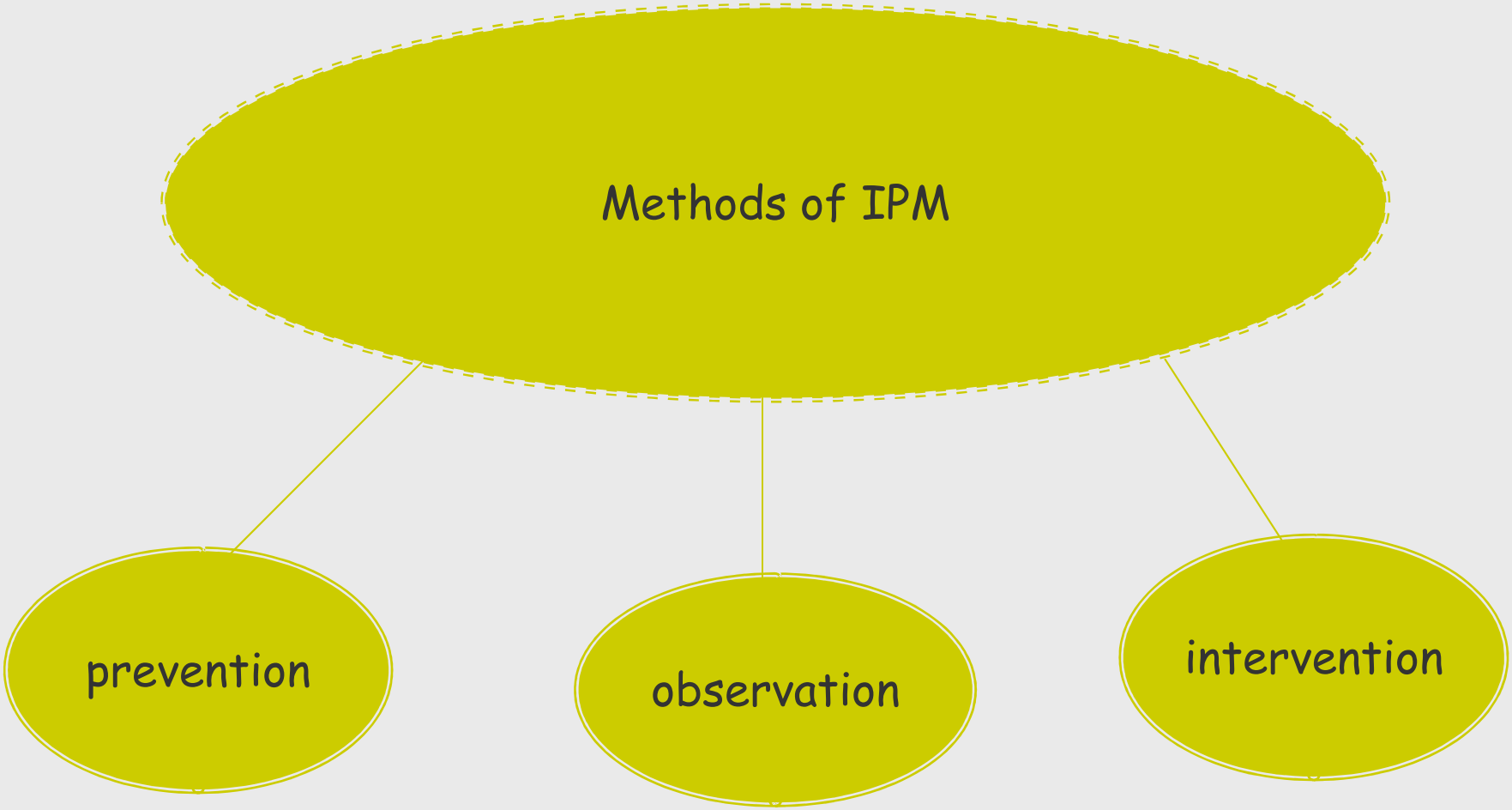
# IPM Attributes

IPM must be effective and so there are several criteria to evaluate:

- Effectiveness in controlling pest populations
- Cost of treatment
- Human and nontarget-animal toxicity
- Environmental persistence
- Quality of product

Yield and quality of olives & olive oil depends on many factors

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)





Growers can find it difficult to correctly identify these diseases, as symptoms can look similar

# Pruning

Helps with natural control of anthracnose and reduces pressure on fungicides
Disrupts lifecycle from starting or interrupts life cycle once it has started

Diseased twigs should be pruned, removed from grove & destroyed

## Creating Healthy Soil ! “Feed the soil, not the plant”

High pesticide levels can become toxic to roots, and 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, pest and disease resistance is strongly related to the fertility of soil in which they grow

Sap - physiological disorder dripping from tree after use in automatic irrigation, heavy rains following a dry period or fluctuations in the temperature


Sap - loss of water, fluid may contain a variety of organic and inorganic compounds, mainly sugars, mineral nutrients, potassium and calcium

# Does nutrition have an affect on pest and disease management ?

Is Anthracnose disease by lack of Calcium ?

Calcium improves:

*Olives*

- Boron and calcium improving fruit set of olive flowers

*Other crops*

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

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

## Why does a plant cell need a chlorophyll ?

**More chlorophyll- More "fuel" energy-Higher yield (profit)**

Important minerals in photosynthesis process:
Magnesium (Mg) --Iron (Fe) -- Manganese (Mn) – Zinc (Zn)

➢ Magnesium is essential to plant development. Required by plants to produce chlorophyll (magnesium is part of the chlorophyll in all green plants and essential for photosynthesis)
• helps plants absorb phosphorous
• increases a plant's natural resistance to disease
• absorbed by both the leaves and the roots

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• Potassium silicate use for natural control of fungal plant pathogens and insects
• Potassium carbonate, baking soda as a foliar nutrient spray controlling black scale & OLB
• Washing soda 110g dissolved in 5.5L water; add 56g soap and use immediately
• Edible salts alone or in combination with biocontrol agent reduced Green mold on oranges
• Oil spray by blending two cups of vegetable oil with one cup of pure liquid soap, and mix it until it turns white. Dilute one tablespoon of the emulsion to one liter of water and spray. Helps control whiteflies, aphids & other soft-bodied insects
• Olive trees will crop if irrigated with saline water with a conductivity of 2400 mS/cm
• Potassium addition in saline water also causes an earlier change of fruit colour from green to dark

## Why does a plant cell need a thick cell wall?

Plant cell wall serves a variety of functions:

- Provides a circulation and distribution of water, minerals, and other nutrients
- regulate growth and protect the plant from diseases and pests (plants do not have immunity system and cell wall is a good barrier)
- cell wall thickness may influence resistance to certain pathogens

## An especially important concept is the plant health care attempts, to manage plant health rather than just control pest problems

- Healthy, productive plants can use their natural defense systems to resist environmental stresses.
As a result, they need less chemical input for survival and productive long-term growth

- The sensible approach to pest control is to create a natural balance of organisms in grove. In a diverse ecosystem, pest populations are naturally regulated. Development of this balance relies on using products that minimize harm to beneficial organisms

- "Life consists not in living, but in enjoying health“ - Martial—Epigrams. Bk. VI.

- "Food should be your medicine and if you need medicine, take it from food” - Hippocrates (460-377 B.C.)

- “Naturally it is organically grown – better for us as the farmer, better for the environment and above all, better for you.”

- Food is the most important meal of the day. High-quality food is better for our health.

  Pest control is fundamental to sustainable crop production in terms of both quality and quantity. Environmental protection of ecosystems and biodiversity is now also factored into the equation.

# THANK YOU