Integrated pest management of diseases in olives

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Integrated pest management (IPM) of diseases in olives involves managing yield and creating an environment less appealing to disease.
The basic concept in disease development involves the interaction between host, pathogen and environment. In the case of non-pathogenic disorders the interaction will be between the host and environment.
Based on research and diagnostic projects, anthracnose, cercosporiose and peacock spot are the three important fungal diseases affecting olives in Australia. During the 2009-2010 season anthracnose, frost and chilling injuries were mostly observed.
Different symptoms are expressed at the apical end of fruit by different causes:

- **Disease: Anthracnose**
  When olives are turning colour, fruit infected with anthracnose fungus can display soft rot in the apical end and could shrivel very quickly, sometimes in only 2-3 weeks.
- **Disorder: Frost and chilling injuries**
  Fruit shows surface blisters and spots, indicating damage around the pit, or dehydrates, remaining shriveled. It may be blackened throughout the whole fruit or only at the apical end and secondary fungal rots, such as *Alternaria* species, commonly infect the damaged fruit. The apical end is soft.
- **Disorder: Nutritional-Boron deficiency?**
  The brown apical end of the green immature fruits is not soft (it is hard), which could be associated with a nutritional problem. *This disorder is unconfirmed and needs further investigation.*

Diseases and disorders associated with environmental stress play an important role in sustainable olive production and olive oil quality. They can also cause significant economic losses - for example, olive oil made from frosted, chill-damaged and anthracnose-infected fruit is of relatively low quality. In a disease-free crop situation, higher yield and oil quality can be expected and healthy plants are less susceptible to diseases.
However, the yield and quality of olive oil depends on a variety of factors, including cultivars, cultural techniques and environment.

Disease control management

Effective disease control management is obtained via a combination of methods, including prevention, observation and intervention.

Prevention

Preventive cultural practices:

- Selecting varieties suited to local growing conditions
- Maintaining healthy crops
- Plant quarantine (plant sanitation, biosecurity)

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 a specific disease, disorder, or pest outbreak.

Intervention

Cultural - cultivars, agronomic techniques such as pruning, grafting, soil management, irrigation etc
Chemical - timing and type of application of fungicides
Biological - application of antagonistic organisms

Weather

Weather conditions are a very important factor in the development of diseases or disorders throughout the year, and especially prior to harvest. Optimum conditions for disease development depend on temperature, wetness, relative humidity and rain period (total rainfall over number of days).
Ideal conditions for various conditions include:
Anthracnose - hot weather and high humidity within canopy following rain
Cercosporiose - high humidity and moderate temperature
Peacock spot - low temperature and moist conditions during autumn, winter and spring
Frost and chilling injuries – night-time temperature of 6C or lower

Cultivation environment

Environmental factors play an important role in managing diseases and disorders :
Macroclimate refers to the general weather pattern in the region. Obviously it is unpredictable and cannot be managed;
Mesoclimate refers to the climate in the area where the crops are grown. It can be measured but is difficult to control and cannot be managed easily. Planting tree breaks can sometimes change the mesoclimate;
Microclimate refers to the climate within and immediately surrounding the crops. It can be controlled through cultural practices such as opening up the canopy and regulating irrigation.

Anthracnose diseases

In warm and humid conditions olive varieties are susceptible to anthracnose pathogens and epidemics can occur. Infection can be controlled in a number of ways:
Chemical control

- Copper fungicide prevents anthracnose infections, but doesn't reliably control the disease
- Copper sprays are protectant fungicides not systemic – they cannot be carried internally through the plant to kill the pathogen
- In a wet season the application of chemical treatments is difficult
- Managing anthracnose by the application of copper is relatively more effective in more tolerant varieties. This is likely due to higher disease severity in susceptible varieties.

Cultural agronomic techniques - maintaining tree health through proper cultivation techniques, irrigation, pruning and soil health
Cultivars:

- The best way of controlling disease is by planting cultivars resistant to pathogens
- Also re-planting or grafting cultivars resistant to pathogens in that area
- This promotes the use of varieties better adapted to local biotic and abiotic conditions (e.g. biological control of pests and diseases, climatic stress)
  **a survey is needed on regionally-adapted olive cultivars in Australia and their resistance or susceptibility to anthracnose and other diseases.

Fertilizer and compost:

- Compost can help maintain soil moisture and assist in nutrient supply to the plant, helping to maintain tree health and resistance
  **The effect of soil amendments with nutrients or compost on development of fungal disease/s needs further study.

Irrigation:

- Pay close attention to past and current conditions such as rainfall and irrigation to determine favourable conditions for anthracnose development
- Apply irrigation during drought periods but not by overhead irrigation, since this may increase the potential for anthracnose disease infection
  **The interaction between irrigation and disease needs further study.

Pruning:

- Sanitation it is a good IPM control strategy
- Pruning can be effective as a pest and disease management strategy
- Prune out any cankered or dead twigs as they are found and remove from grove
- Remove and destroy fruit mummies when pruning to reduce initial inoculum
- Maintenance of pruning equipment decreases the likelihood of infection - disinfection is recommended using 70% ethanol
  **The interaction between pruning and disease/diseases needs more study, as does the interaction of *Colletotrichum* infection in over-winter mummified fruit with appearance of anthracnose disease in the new season

Research - International Horticultural Congress, Lisbon, Portugal 2010

Recent research work has been done in Portugal on the effects of drip irrigation installed in traditional olive grove on the incidence of anthracnose disease. Four irrigation modalities were tested in the field, each with and without chemical fungicide treatment against anthracnose disease.

Water level :

A - 100% of evaporation

B - Deficit irrigation @ 60%

C - In three critical life cycle periods (before flowering, hardening of fruit pit and before ripening)

D - Not irrigated

Results

Results showed a highly significant effect from water and fungicide application. Without fungicide the percentage of olives with disease symptoms in water levels A and C was significantly higher than in levels B and D. With fungicide application levels B, C and D had significantly lower percentages of infected fruit than A.

At each water level, the percentage of anthracnose infected with and without application of fungicide was significantly different. Level B and C showed the largest amount of disease-infected olives at 74%. On the non-irrigated trees, however, the application of fungicide had no significant impact.

Conclusion

Fungicide application is indispensable to control anthracnose infection in irrigated olive orchards. A grower's decision regarding irrigation levels is essentially economical, according to the differential between costs of water irrigated and market price for olives.

** It would be good to carry out a similar study in Australia in the future.