



R&D Insights contains the latest levy-funded R&D project updates, research findings and related industry resources, which all happen under the Hort Innovation Olive Fund.

Hort Innovation partners with leading service providers to complete a range of R&D projects to ensure the long-term sustainability and profitability of the olive industry.

Technology, tools and knowledge among benefits of tree crop monitoring project

The Final Report of the project *Multi-scale monitoring tools for managing Australian tree crops - phase 2 (ST19001)* has been published, outlining the new technologies, tools and data created to benefit growers across both participating and wider horticultural industries.

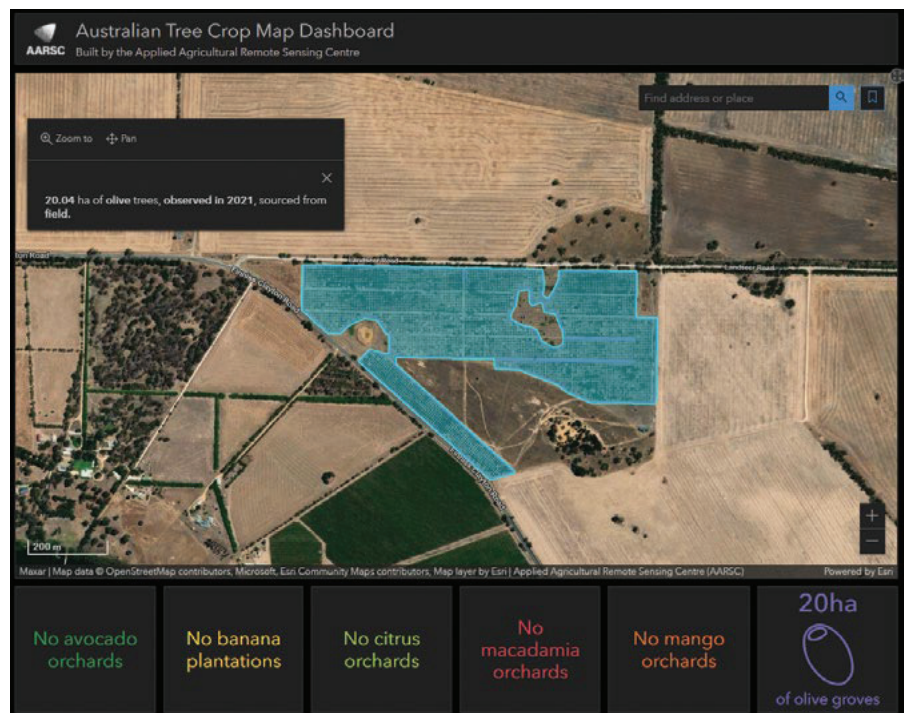
The two-part collaborative horticultural industry levy project - commonly known as the remote sensing project - involved the development, trial and extension of technology-based crop mapping and monitoring tools to help growers in predicting fruit quality and yield. It also focused on monitoring of tree health, including the early detection of pest and disease outbreaks.

Building on industry needs

Phase 2 of the project directly responded to the specific needs of the participating banana, citrus, macadamia, mango and olive industries, and built on the outcomes of the project's first phase. Significant for our industry was the inclusion of a deficit irrigation trial to determine the effects of water stress on olives, particularly in terms of oil yield.

Phase 1 had successfully delivered the first map of all commercial avocado, macadamia and mango orchards (> 2 ha) across Australia.

It also developed remote-sensing-



based tools to provide accurate measures of tree health; improved yield forecasting and yield mapping at the orchard block level; increased the understanding of fruit size distribution and maturity; and developed a more efficient method for measuring disease and pollination efficiency.

Improvement objectives

These outcomes and outputs stimulated significant interest and initiated the Phase 2 project, which had the objectives of:

- improved pre-harvest yield forecasting accuracies at the national, regional and farm level;
- improved detection and control of future biosecurity threats and natural disasters;
- improvements to 'within orchard' mapping of tree health, fruit quality and maturity.

The AOA was one of three industry partners for the Phase 2 project, along with the Australian Macadamia Society and Citrus Australia Ltd.

Project outcomes

The total project produced multiple deliverables. While some cover multi-industries and others are specific to the industry studied, all provide valuable data and methodologies for further future development across the horticultural sector.

National mapping

All commercial avocado, banana, citrus, macadamia, mango, and olive orchards (> 1 ha) across Australia were mapped. The map has been published within the ATCM Dashboard and is available in industry-specific dashboard applications (hosted on industry websites).

Yield forecasting

A key outcome of the project was the development of remote sensing (satellite and airborne) methodologies for yield forecasting across all participating tree crop industries.

More accurate pre-harvest yield forecasting of tree crops offers significant benefit at a range of scales. At the national and regional scale higher prediction accuracies support the respective industry bodies in making more informed decisions around forward-selling to both domestic and overseas markets; while at the farm level, growers can better plan logistics around harvesting including labour, machinery, packaging, transport, and storage requirements, as well as their own capacity to meet market demands. All these aspects can improve profitability for growers and industry stakeholders.

Two main approaches to yield forecasting were developed: the '18 calibration tree' method and the 'time series' method*. Their development would have not been possible without the high quantity and quality of data that growers provided.

Discussions with growers, consultants and fruit processors provided insights that helped build a greater understanding of plant budding, flowering and fruiting stages, the influence on yield of previous season conditions, and tree planting practices in the Australian growing environment.



In-grove monitoring equipment was utilised and appraised as part of the project.

*Yield forecast methods:

'18 calibration tree': describes yield variability within orchard level. Ideally suited for young orchards or where no historical productivity information is available. Requires high resolution imagery and manual fruit counts.

'time series': suitable for forecasting yield at block, farm, regional and national level. Utilises open-source (free) imagery, requires no field work and can provide predictions months before harvest.

Yield and vigour variation

Classified maps of tree vigour variation across orchard blocks and whole farms (for citrus, mango and olive orchards) were derived from satellite imagery to better understand variability across orchards and direct in-field assessments of fruit quality, size and maturity.

Remote sensing has been demonstrated as a highly accessible and accurate tool for identifying variation in tree vigour (health and size) across orchards within a growing season and across years. The provision of tree vigour maps was able to directly inform growers on where poor and high performing areas were occurring in their orchards.

Water stress in olives

Increased understanding of the impacts of water stress on yield, oil accumulation and final oil content to inform irrigation and production decisions.

Fruit harvest timing and volume (mangoes)

Tools to aid forecasting of harvest timing were progressed, involving heat units and fruit dry matter

content. The use of handheld near infrared spectroscopy to assess dry matter content was advanced.

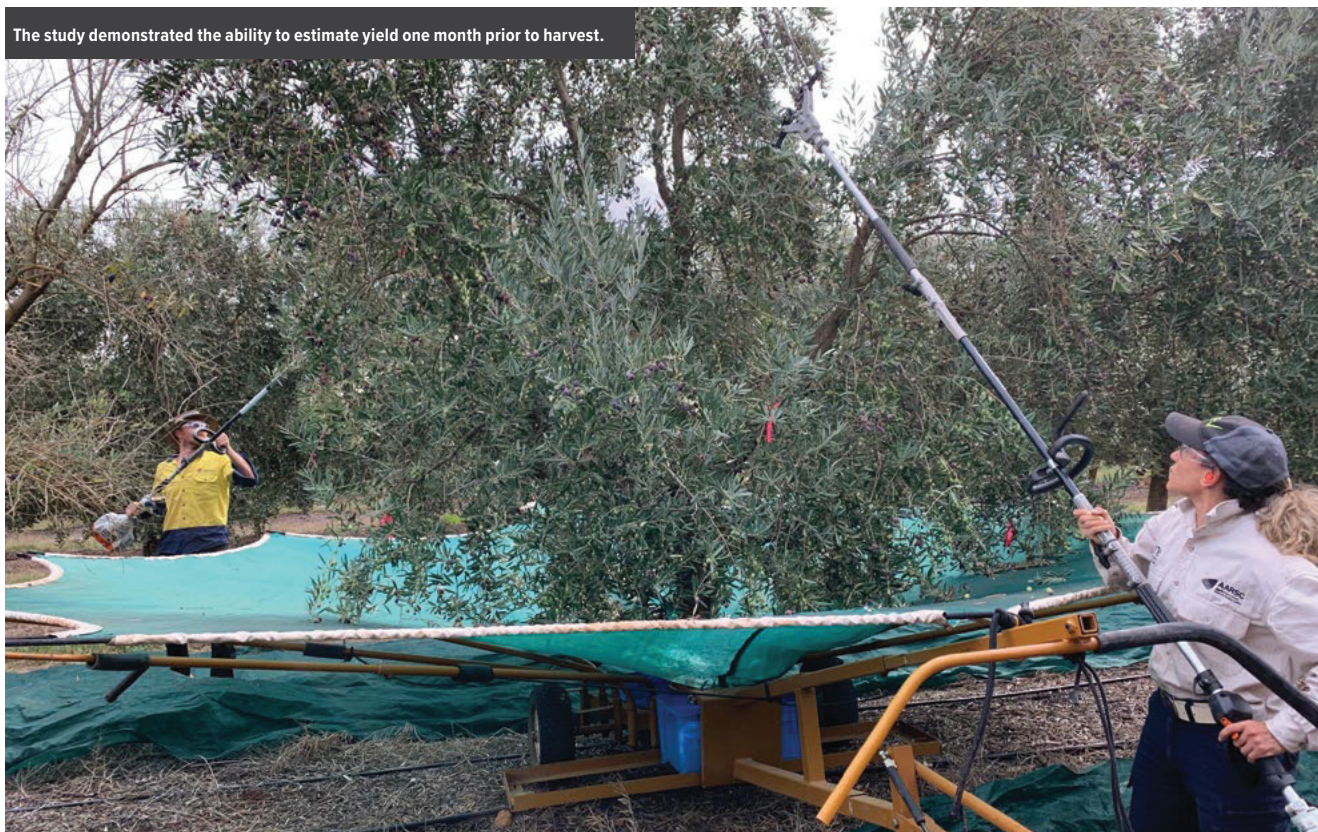
Machine vision technology (mangoes)

A machine vision system mountable on a farm vehicle was developed and implemented in whole orchard fruit count exercises. The tool provided pre-harvest forecasting of fruit size and distribution.

Mechanical harvester prototype (mangoes)

An eight-arm prototype was developed and deployed in field trials, with improvements in gripper design and arm movements providing increased speed and effectiveness of picking.

The study demonstrated the ability to estimate yield one month prior to harvest.



Olive component

The olive component of the project utilised groves in Mornington Peninsula and Boort (both VIC). A total of 19 groves were sampled between 2020 and 2022 to test the '18 calibration tree' (18CT) methodology for yield estimation at the block level.

The study demonstrated the ability of the 18CT to estimate yield one month prior to harvest with varied accuracies that were dependent on the conditions during calibration and harvest timings. Accuracies at the block level ranged from 63% to 99.8% with eight out of 11 groves, producing an overall accuracy of above 85% at the farm level (Farm 1). Lower accuracies were achieved at the two other farms (Farm 2 and Farm 3) as a result of external factors not related to the methodology (e.g. harvest losses).

Overall, the remote sensing yield forecasting methodology developed through this project offers prediction accuracies higher than current commercial practice.

In addition to yield forecasting, the commencement of this project aligned with a prolonged drought that occurred across many olive growing regions and as such the industry expressed a strong need to evaluate a range of technologies to better measure water stress in olive

trees and to better understand the impacts of water stress on yield, oil accumulation and final oil content (%). As such a comprehensive irrigation trial was undertaken as part of the phase 2 project (more detail in the December edition).

Wider benefits of tree crop mapping

The Australian Tree Crop Map (ATCM) has provided numerous benefits on a national basis, with a reach far greater than agriculture alone:

Biosecurity

The map identifies the location and distribution of all commercial orchards. In the event of an incursion, the freely-available mapping layer can support the rapid deployment of surveillance staff and the establishment of exclusion zones to prevent further spread.

Natural disasters

The map can determine the areas of each industry impacted by natural disaster, in near real time.

Traceability

Citrus Australia value-added the national map of orchards by adding additional 'attribute' data (citrus type, variety, productivity, grower details and a GS1 international traceability code) at block level.

Irrigation modelling

The Murray-Darling Basin Authority are using the mapping for irrigation modelling.

Labour force planning

The ATCM Dashboard has been used by the Federal government to co-ordinate the Harvest Trail program, connecting workers with farmers.

Land use mapping

The map has contributed to the updating of national land use mapping programs across all Jurisdictions, including at the catchment scale.

More information

To download the full final report from the Hort Innovation website go to www.horticulture.com.au and type 'ST19001' into the search bar.

This project was funded by Horticulture Innovation through the Australian Government Department of Agriculture, Water and the Environment's Rural R&D for Profit program, along with funding and support from project collaborators including industry R&D Levy funds and representative bodies, UNE, Central Queensland University, AMIA, NT DITT, NSW DPI, DAF Qld and Tie Up Farming, CERES Imaging and participating growers.



Olive Wellness
INSTITUTE™

Olive Wellness Institute highlights olive benefits for gut health

Gut health is firmly in the public spotlight these days, with an estimated one in five Australians (20%) currently dealing with Irritable Bowel Syndrome (IBS) and one in 100 with coeliac disease. Globally, around one in seven people (15%) is affected by IBS.

That's a significant percentage of our population needing help with what are often life-affecting gut issues.

So it's important for all of us to know how to look after our gut health, and what will benefit or detract from a healthy, happy gut.

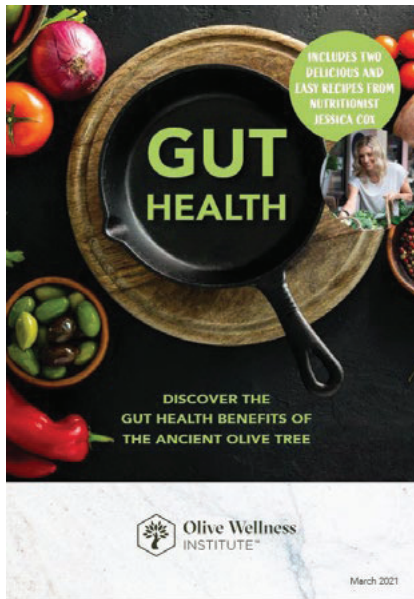
Gut Health e-book

To make that easy, the Olive Wellness Institute (OWI) has created a Gut Health e-book, highlighting the benefits of olive products in improving and maintaining a healthy gut. It's one of the ongoing resources available on the OWI website.

Assembled by a group of the OWI's expert health professionals, the Gut Health e-book showcases the gut health benefits of the "olive supertree", looking at both the olive fruit and olive leaf:

Olive fruit

- freshly squeezed into delicious extra virgin olive oil, which is rich in antioxidants and other healthy compounds. Extra virgin olive oil contains healthy (monounsaturated) fats plus unique polyphenols (antioxidants) that are associated with a raft of health benefits.
- table olives also contain dietary fibre and are a source of probiotics.



Olive leaf

- the secret ancient ingredient from the olive tree that is also packed with natural olive goodness.
- can be consumed as olive leaf tea or, more traditionally, as olive leaf extract - a herbal remedy that contains all the antioxidants from the olive leaf.

Microbiome and more

The 15-page book starts with the basics, explaining how the gastrointestinal system (aka the digestive system) works. There's a big emphasis on the microbiome and its importance in the system's healthy functioning, along with a break-down of the opposite state - 'gut dysbiosis' - caused by a disruption in the types and amounts of bacteria living within the gut.

It then provides tips to improving gut health through diet, including consuming adequate dietary fibre

(table olives) and plentiful quantities of polyphenol-rich foods (extra virgin olive oil), and aiming to eat 30 different plant foods each week (table olives and extra virgin olive oil).

Olive products and gut health

It then moves the focus firmly to the specific benefits of olive products for improving and maintaining gut health:

Extra virgin olive oil and gut health

- Antioxidant activity - extra virgin olive oil contains compounds known as polyphenols (antioxidants), which protect against free radical damage. Free radicals can build up due to exposure to irritants such as sun, smoke and pollution. Too many free radicals in the body can cause inflammation and can increase levels of harmful bacteria and pathogens. Extra virgin olive oil contains a unique antioxidant called oleocanthal, a powerful anti-inflammatory.
- Acts as a prebiotic - research has shown extra virgin olive oil can act as a prebiotic by encouraging the growth of good gut bacteria.
- Acts as an antibacterial - extra virgin olive oil can also reduce the growth of bad gut bacteria, leading to reduced inflammation and improved overall gut health.

Table olives and gut health

- Table olives are fermented, which leads to them being a source of probiotics. Probiotics are live bacteria and promote the balance of the good bacteria in our gut.

- Table olives have also been found to contain a type of good gut bacteria known as lactobacillus, which can improve digestion.
- Table olives are a source of dietary fibre, which we know benefits our gut health. The fibre found in olives is a type of soluble fibre and has prebiotic properties.

Olive leaf extract and gut health

- Like extra virgin olive oil, olive leaf extract is rich in polyphenols. A study published in the Journal of Alternative & Complementary Medicine - New York showed that olive leaf extract had one of the highest antioxidant activities of 55 medicinal herbs tested, including green tea and milk thistle.
- The polyphenols found in olive leaf extract are different to those found in EVOO. While some are the same, each contain unique olive antioxidants.
- Olive leaf extract contains Oleuropein, a powerful anti-inflammatory and antimicrobial. Compounds such as polyphenols that have antimicrobial properties can be significant for gut health, as they help to reduce excess levels of bad gut bacteria.

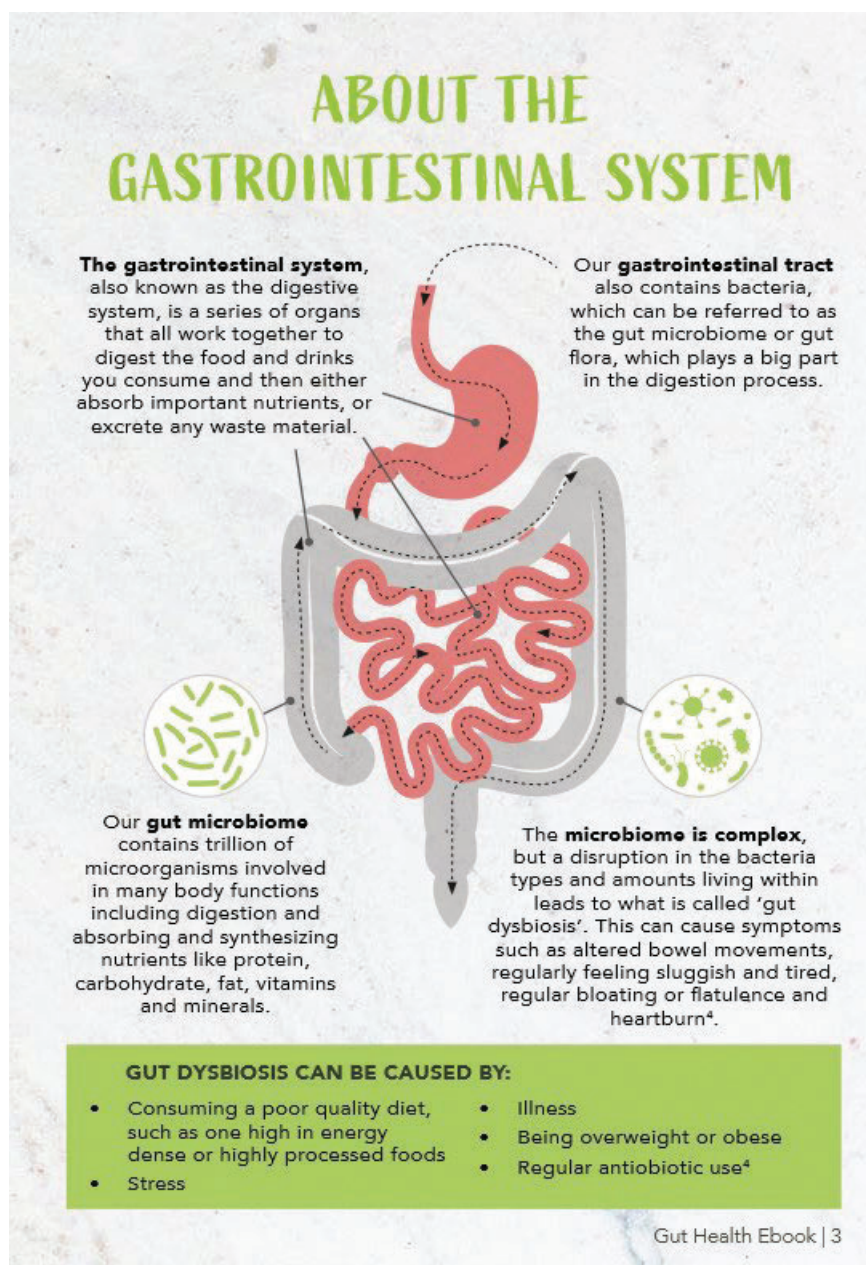
Mediterranean diet and gut health

Recognising the importance of discussing not only individual foods that are beneficial to the gut microbiome, the e-book also looks at the Mediterranean Diet and its myriad health benefits.

The overall dietary pattern has an even greater impact on improving gut health, with research showing that adherence to the Mediterranean Diet leads to increased gut microbiome diversity, higher levels of beneficial bacteria and reduced inflammation and chronic disease risk. This is primarily due to the high levels of dietary fibre, beneficial fatty acids and polyphenols.

Recipes for health

The e-book then finishes on a practical note with two recipes by Jessica Cox, a practicing accredited nutritional practitioner with a Bachelor of Health Science



(Nutrition): a delicious 10-minute beetroot and pickle dip, and a sweet potato, zucchini and tomato salad, ideal as either a light meal or a side dish. The salad is made even more healthy by the inclusion of olive leaf extract in the balsamic dressing.

Spread the word

Providing expert information in plain language, the Gut Health e-book is another great resource to share with customers, friends and your social media networks, to increase the conversation around the myriad health benefits of olive products.

It's also proof that when it comes to 'food as medicine' and a healthy diet, buying fresh Australian extra virgin olive oil, and high-quality locally-produced table olives and olive leaf

extract, provides the best value for money and the greatest health benefits.

The e-book is available for download from the OWI website - www.olivewellnessinstitute.org - under Resources.

The Olive Wellness Institute is partially funded by Hort Innovation, using the Olive Fund research and development levy and contributions from the Australian Government, through the strategic levy investment project Increasing awareness of the health benefits of Australian olive products (OL22001).



Once fruit damage appears it progresses quickly, so ongoing monitoring and proactive disease management are paramount to keep Anthracnose under control in your grove.

Act now to prevent Anthracnose infection during flowering

In the June edition, the pest and disease management spotlight was on Olive Lace Bug, which emerged as a major issue in groves across the country this year. With the crucial flowering and fruit set season not far off, we're shifting the focus to Anthracnose, a long-standing scourge in olive groves.

Anthracnose isn't a new issue for olive growers. In fact, for many years now it has officially been rated as the number one disease affecting our industry. But while we've got a handle on how and when it manifests, and theoretically how to deal with it, Anthracnose management continues to be a challenge for many growers.

Warmth and water welcome fungus

Olive industry pest and disease expert Dr Robert Spooner-Hart said he's visited several groves recently to look at other problems, and found Anthracnose also an active issue.

"The increased Anthracnose activity being seen is primarily associated

with the weather over the past two years," he said.

"Warmth and water are the key conditions for the fungus to thrive. We've had above-average levels of that combination in recent times, and wet summers and autumns almost guarantee that Anthracnose will be a major issue in olive groves."

Re-infection risk

Spooner-Hart said that one of the main problems with Anthracnose is that the pathogen can survive in a latent (inactive) form until suitable conditions arrive again, when new infections then occur at a rapid rate. One of the main carriers for re-infection is unharvested fruit.

"If you had Anthracnose in your grove last season it is imperative that you remove any fruit remaining on the trees after harvest, as mummified fruit will carry the fungal inoculum into the next season," he said.

Dr Len Tesoriero, a plant pathologist working closely with the olive industry, said that under warm, wet conditions the pathogen will initially infect flowers and young fruit, so protection of crops needs to occur during flower development - particularly if weather conditions are conducive to anthracnose (10-25C, optimum 17-20C, and wet).

"Correct application of an appropriate registered/permited systemic fungicide in the lead-up to flowering



will greatly reduce the risk of early Anthracnose infection, and therefore the fast-spreading secondary infections seen later in the season as the fruit ripens,” he said.

“These occur as fungal spores are produced on the fruit surface, and are spread by wind and rain splash, with new spores/infections forming within days.

Damage to trees and oil quality

“This fruit infection results in reduced oil quality, while early infection of leaves and twigs causes dieback, so diligent monitoring and treatment -preventative, as above - for previously infected groves, is a necessity for all growers when Anthracnose-conducive weather conditions occur.”

“Non-chemical management practices also recommended include



OLIVE ANTHRACNOSE, caused by certain species of the fungus *Colletotrichum* - sometimes referred to as species complexes of *C. acutatum* and *C. gloeosporioides*.

Biology and damage

Anthracnose is a globally important disease of olives - and many other fruit and vegetable crops. Olive losses are due to reduced yields and poor oil quality.

Colletotrichum spp. can survive on plant surfaces without infection - called epiphytic survival. Infected shoots, stems and leaves can be symptomless. In wet weather disease symptoms develop - drying and wilting of leaves, defoliation and dieback of branches. Severe infection can cause reduced tree vigour.

Spores spread with rain splash, while insects may also passively spread spores on their bodies.

Infection of flowers and young fruit occurs in spring (optimum temperatures 17-20C) in wet conditions (up to 48 hrs).

Fruit infections are superficial and remain dormant - latent infections. In wet autumns and as fruit ripens, sunken lesions develop and masses of conidia (spores) form -seen as greasy pink, orange or brown areas on the fruit surface and called ‘soapy olive or soapy fruit’.

Management

Prune to remove infected branches and to open tree canopies to air and sun. Remove or cover dropped leaves and fruit with compost; remove mummified fruit on trees.

Timing fungicide applications is important: preventative treatments in winter; preventative or eradicated products in spring, summer and autumn - depending on occurrence and duration of wet weather.

Grow less susceptible varieties.

Harvest fruit early, particularly if wet weather is expected or occurs near ripening.

Balance plant nutrition - avoid excess nitrogen and ensure calcium levels are adequate. Note: calcium becomes unavailable to plants under very wet or dry soil conditions, so regular watering or good drainage are important when fruit are developing to prevent deficiency.

pruning trees to a more open canopy for increased air movement and sunlight access.”

Olive industry IPDM resources

Growers impacted by Anthracnose can access a wealth of information on prevention and management in the industry IPDM (integrated pest and disease management) resources available on the OliveBiz website - www.olivebiz.com.au, including:

- **IPDM Flyers** - summaries of information on major olive

pest and disease topics: *Black scale, Olive lace bug, Weevils, Anthracnose, Peacock spot, Cercospora leaf mould, Olive wood rots and dieback, Exotic pests and diseases, and Current chemical options for key pests and diseases.*

- **IPDM Online Tutorials** - 10-15 minute tutorials on *IPDM, Monitoring, Biosecurity, Black scale, Olive lace bug, Apple weevil, Anthracnose, Peacock spot and Cercospora leaf spot.*



- **Revised Field Guide to Olive Pests, Diseases and Disorders**

- Australian plus new exotics, to assist in identification of pests, diseases and disorders, and beneficial natural enemies.

- **Best Practice IPDM Manual** - information on IPDM strategies, including pesticide selection and application.

- **IPDM Videos & Presentations** - information and experiential

learning from the AOA's 2018 Integrated Pest & Disease Management workshops, focused on *Black scale*, *Olive lace bug* and *Anthracnose*.

Where to find them

All of these -along with many more industry information resources and learning tools - are available on the AOA's OliveBiz website - www.olivebiz.com.au.

Correct use of chemicals for Anthracnose control

While the strategic use of pesticides can play an important role in many IPDM strategies, they should never be relied on as the only or first option. However, their targeted use at critical strategic times (such as around flowering for anthracnose management) may reduce the need for more substantial pesticide use later on.

Legal use of pesticides

When considering any pesticide for a specific use, it is important to confirm that it is registered and permitted for use against that pest or disease, and for use on olives.

The Australian Pesticides and Veterinary Medicines Authority (APVMA) regulates the use of pesticides in Australia. It evaluates the safety and performance of agvet chemicals to ensure that the health and safety of people, animals, crops, trade and the environment are protected. Part of the APVMA registration process for any chemical is approval of the product label, which includes information that identifies the product and explains how the product is to be used, stored, disposed of and managed in the event of poisoning.

As olives are a minor crop, a number of legally acceptable pesticides are the subject of APVMA Minor Use permits. This permit scheme allows for the legal use of chemicals in certain ways contrary to the label instructions or,

in certain circumstances, allows for the limited use of an unregistered chemical product.

It's important to note that the permits have expiry dates, and pesticides cannot be legally used if the permit has been surrendered or has expired.

Registered chemicals for Anthracnose on olives

There are currently three groups of chemicals registered for use on olives for Anthracnose management: Azoxystrobin (various trade names); Copper-based fungicides (copper oxychloride, copper hydroxide, cuprous oxide, tribasic copper sulphate); and Luna Experience (Tebuconazole + Fluopyram).

There are also currently two chemicals with minor use permit registrations:

PER87332 - Aero Fungicide (expires 31 May 2029);

PER88358 -Mancozeb (expires 31 May 2028).

Check before use

Full details on APVMA-registered chemicals for use on olives can be found by search the APVMA Public Chemicals Registration Information System (PubCRIS) database at www.apvma.gov.au. The Registrations and Permits dropdown will also allow you find registered

pesticides, as well as minor use and emergency use permits for chemical use on olives.

Golden rules

When the use of chemicals is deemed necessary for prevention and/or treatment of pests and diseases in your grove, always:

- check that the chemical is registered for Anthracnose (or other purpose) on olives;
- ensure usage according to label instructions when handling and applying chemicals;
- use only recommended rates and methods;
- adhere to mandatory spray/ buffer zone and wind condition regulations;
- ensure applicaationtiming accords with mandatory Withholding Periods; and
- comply with all workplace health and safety requirements related to storage and use of hazardous chemicals.

More information

There's more detail around the safe and legal use of agricultural chemicals in the Best Practice IPDM Manual, available for download from the OliveBiz website - www.olivebiz.com.au. Go to *Projects -Industry resources -IPDM Project*.