New practices for Improved control of Charcoal Rot

Project update for 'Improved Management of Charcoal Rot in Strawberry' BS15005

David Oag & Apollo Gomez, DAF (Department of Agriculture and Fisheries) and Dylan McFarlane & Scott Mattner, VSICA (Victorian Strawberry Industry Certification Authority)

Over the past three years, the research team of the national charcoal rot project (BS15005) have made many significant advances that enable strawberry growers to more effectively manage this serious disease. Charcoal rot affects strawberries in all Australian states, and can cause plant losses on farms of up to 50%.

Figure 1. Plant death caused by charcoal rot of strawberry at a site in Coldstream, Victoria.
Photo credit: VSICA

The current research work has shown:

- Totally impermeable film (TIF) is a superior plastic mulch for soil fumigation
- Tri-Form® 80 and EDN Sterigas™ are equally effective in reducing the severity of disease
- Shank application of fumigants is more effective than drip irrigation application for control of charcoal rot
- The pathogen that causes charcoal rot (*Macrophomina phaseolina*) can survive in strawberry crowns in the soil for at least 10 months
- The pathogen surviving in crowns infects plants in the next crop

Totally Impermeable Film

TIF reduced charcoal rot of strawberry by 90%, by retaining chemical fumigants in the soil at higher concentrations for a longer period, compared with standard low-density polyethylene (LDPE) plastic mulch.

Income from the additional fruit harvested exceeds the additional cost of TIF, resulting in an increase in gross income ($6.91/m) over the season.

TIF is a superior plastic mulch for use with chemical soil fumigants and has been quickly adopted throughout the strawberry industry.

Fumigants

Tri-Form® 80 and EDN Sterigas™ reduced charcoal rot by up to 80% compared with untreated soil.

Crop termination was trialled for the first time in Australia. This practice involves killing strawberry plants at the end of the season with the fumigant metham sodium applied through drip irrigation. The practice is useful because it can also kill *M. phaseolina* in crowns and result in an additional 10% increase in fruit yield above the use of pre-plant fumigation alone.

Application of fumigants

Shank fumigation (when fumigant directly injected into the soil at depth) reduces charcoal rot by up to 60% more than drip fumigation (when fumigant applied through drip irrigation).

Fumigation of the entire paddock (broad-acre fumigation) increases control of charcoal rot by 35% over strip fumigation of just the plant bed.

Pathogen survival

The *M. phaseolina* fungus can survive in crowns retained in the paddock, for at least six months in a warm environment (Sunshine Coast, Qld) and 10 months in a temperate environment (Granite Belt, Qld). The field study in the Granite Belt will continue for a full year.

Cutting crowns into pieces, as would occur during soil cultivation, made little difference to how long the pathogen was able to survive (Figure 2).

Transmission of disease from crop residue to new plants

M. phaseolina surviving in infected crowns from the previous crop infect strawberry plants in the new season. Infection was shown to occur within weeks of planting and up to 50% of plants were dead after 8 weeks.

This makes infected strawberry crowns from the previous crop a major source of inoculum leading to outbreaks of charcoal rot in the following season.

Increasing the ability to manage charcoal rot

The progress to date still leaves several gaps in our knowledge of the biology of *M. phaseolina* and how best to manage charcoal rot. Once addressed, growers would have a comprehensive package of tools to manage charcoal rot very effectively across a range of farm situations.

The major areas of greatest benefit to growers include:

- A reliable diagnostic tool for predicting the disease risk on farm, and informing the most cost-effective choice of treatments
- Non-chemical soil treatments for reducing the amount of the pathogen before planting
- New treatments with the potential for managing charcoal rot outbreaks during the growing season
- Quantifying the soil and environmental conditions that trigger the disease
- Integrating the use of tolerant varieties with other treatments for more effective management of charcoal rot

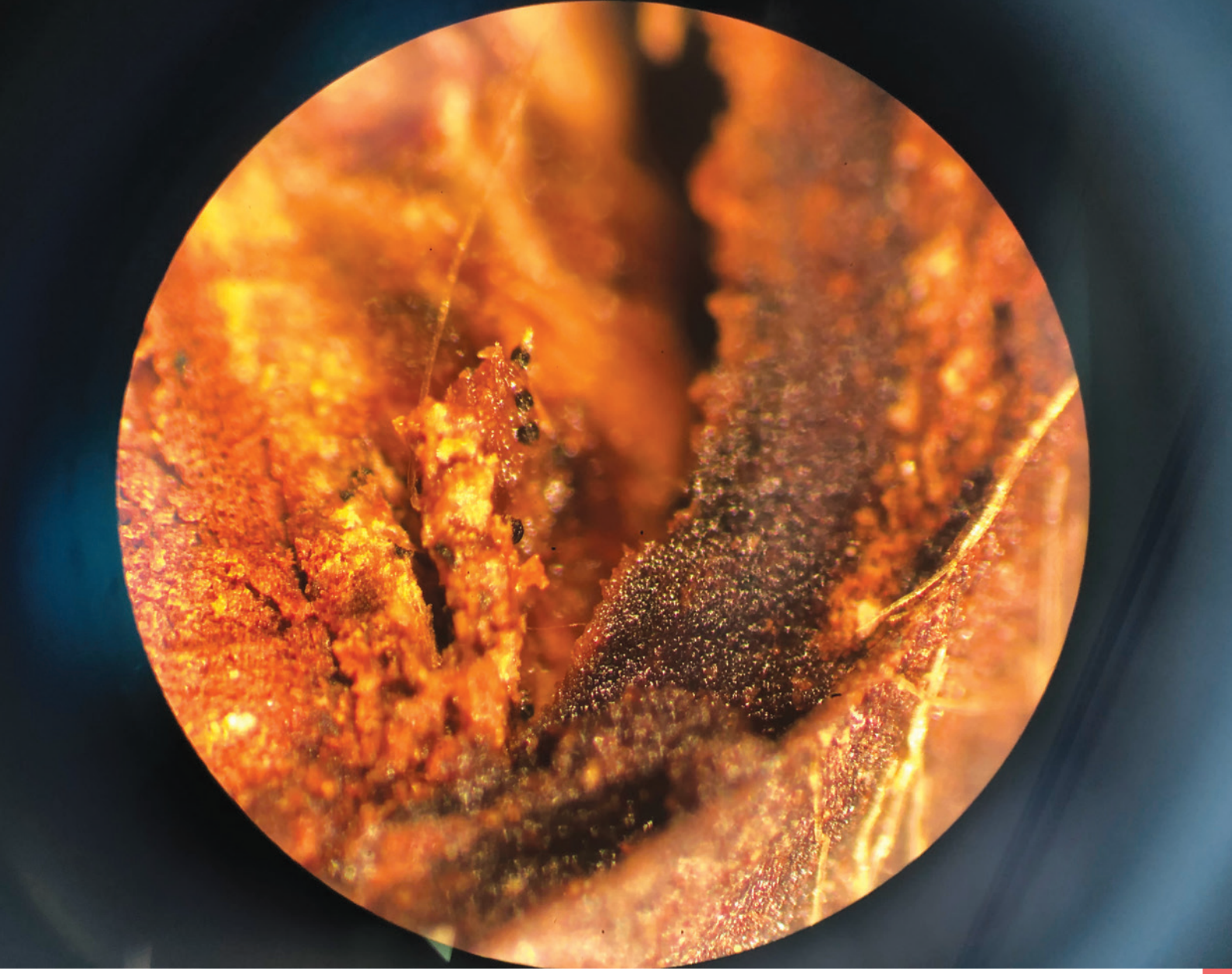

Figure 2. Microsclerotes of *M. phaseolina* in a strawberry crown.
Photo credit: DAF

Several diagnostic tests have been developed in Australia and overseas for monitoring the level of *M. phaseolina* in soil. Currently, however, it is not possible to predict the risk of disease using these tests. This is because results of *M.phaseolina* concentration in soil have not been correlated with the amount of disease to develop in a crop.

The ability to predict the level of disease risk would add precision and flexibility in managing charcoal rot. For example, in situations of low disease risk, the potential arises to reduce costs when high rates of chemical fumigants may not be necessary or by applying fewer control treatments.

The Australian strawberry industry is heavily reliant upon chemical fumigants for the control of charcoal rot. However, chemical fumigants do not provide complete control of the disease, and are under constant threat of registration review and withdrawal due to concerns over detrimental effects on human and environmental health.

Studies overseas have indicated several alternative treatments that reduce the pathogen in the soil to varying degrees, including: biofumigation with brassica crops, anaerobic soil disinfestation, high soil temperature by microwave or steam treatment, repeated removal of plant debris for the depletion of pathogen inoculum over the medium to long term, and crop rotation.

The suitability and effectiveness of these techniques in local strawberry production systems has yet to be proven.

Non-chemical treatments give industry the opportunity to reduce chemical usage and provide control options for organic growers. Non-chemical treatments may complement, offset or replace the need for chemical fumigants for controlling charcoal rot.

A healthy strawberry plant next to a plant killed by *M. phaseolina* is a common sight, but we currently lack the knowledge to explain why the fungus did not infect the nearby plants. Outbreaks of charcoal rot disease often occur after periods of extreme weather, however exactly what conditions (soil, environmental, plant health) trigger infection is not well understood.

Such information is vital for developing strategic treatments and technologies for managing the disease during the season.

Although immunity in strawberry to charcoal rot has not been found, research indicates varieties differ in their tolerance of the disease.

Quantifying the performance of tolerant varieties when grown in the field with the best practices for controlling charcoal rot, would confirm the effectiveness of such a multi-faceted strategy.

This project is funded by Hort Innovation using the research and development strawberry levy, and funds from the Australian Government. The Queensland Government, through the Department of Primary Industries (DAF), and the Victorian Strawberry Industry Certification Authority Inc. have co-funded the research. We also acknowledge the strawberry fruit growers who provided the field sites for the experimental trials.

The project team is David Oag, Dylan McFarlane, Apollo Gomez, Scott Mattner and Frank Greenhalgh. Please contact your local member of the project team for more information.

Hort Innovation Strategic levy investment | STRAWBERRY FUND | VSICA | Queensland Government