Charcoal Rot — A Disease of Strawberry and Blueberry

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The Disease

Charcoal rot is a major disease of strawberry with the potential to cause significant plant deaths and devastating crop losses. Charcoal rot disease is caused by the fungus Macrophomina phaseolina.

The disease has recently emerged in strawberry fruit crops in Victoria, Queensland and Western Australia, following cessation of the practice of soil fumigation with methyl bromide. Adequate disease control is difficult to achieve with existing management practices.

M. phaseolina attacks many plant species, including multiple grain crops, vegetable crops, weeds and some tree crops. The fungus also attacks blueberry, however it is not known to attack Rubus berries. The fungus survives in soil and crop residues as microsclerotia, which serve as the primary source of inoculum for future infections.

Charcoal rot is a soil-borne disease, however infection through the foliage has been reported in strawberry.

Symptoms of charcoal rot consist of wilting and collapse of the leaves. Interior symptoms include dark brown or reddish-brown necrotic areas in the vascular tissue of the strawberry crown.

Initial signs of disease development are similar to water stress. Infected plants eventually die and plant losses can be significant.

Outbreaks of charcoal rot are easily confused with plant deaths from Fusarium, Verticillium, or Phytophthora because of the similarity in symptoms.

Therefore, it is important that growers have affected plants diagnosed at an accredited laboratory to confirm which disease is involved.

Figure 1. Strawberry plant deaths from charcoal rot

Project Research Activities

A collaborative research project between Hort Innovation, Department of Agriculture and Fisheries (DAF), and Victorian Strawberry Industry Certification Authority (VSICA), is developing improved management practices that reduce the crop losses from charcoal rot disease in strawberry farms.

The three year project is scheduled to finish in October 2020. The research team of Apollo Gomez and David Oag (DAF) will be focusing on sources of inoculum and its survival, whilst Dylan McFarlane, Scott Mattner, and Frank Greenhalgh (VSICA) will concentrate on soil fumigants and application techniques to improve the control of charcoal rot.

Understanding the fungus is important for developing management practices that will be effective in providing control in the paddock. A study at Nambour (Qld) showed the fungus can survive in buried strawberry crowns for at least 6 months.

A subsequent study established that infected strawberry crowns buried alongside newly planted runners lead to the death of all new plants by 6 months, irrespective of the number of infected crowns in the soil. Infected strawberry crop debris retained in the paddock is a major source of inoculum, causing charcoal rot disease and plant death in the following crop.

Figure 2. A typical strawberry paddock where crop debris is returned to the soil

Low-density polyethylene (LDPE) plastic film has traditionally been used when fumigating strawberry beds, however leakage of soil fumigants through LDPE does occur. Totally impermeable film (TIF) has an additional layer that prevents the leakage of soil fumigants.

TIF retains the chemical fumigant in the soil for a longer period and at a higher concentration, than is possible with LDPE. TIF improves the effectiveness of soil fumigants in reducing the amount of M. phaseolina in the soil, leading to less plant death and more harvested fruit.

Figure 3. Measuring fumigant gas concentration under totally impermeable film (TIF)

Over the next three years, this project aims to develop integrated chemical and cultural options for strawberry growers to manage charcoal rot. Research will evaluate better ways of applying existing and new soil fumigants to reduce the pathogen in soil. Other research in the project will identify alternative hosts of M. phaseolina within strawberry production systems, and establish the impact of major sources of inoculum on disease level in subsequent strawberry fruit crops. The project team will compile information on best practice information from the research into integrated management systems for the control of charcoal rot in strawberry crops. The effectiveness of a combination of TIF plastic mulch, chemical fumigants and removing infected crop debris, in controlling charcoal rot disease, is currently being tested in field trials on strawberry farms.

This will enable the project team to compile best practice information for the control of charcoal rot using an integrated system of management practices.

Benefits for Industry

The project has been designed to deliver new information and practices that will benefit strawberry growers, through:

- Decreased plant deaths and increased productivity from the control of M. phaseolina with the more effective application of chemical fumigants,
- An ability to reduce inoculum of M. phaseolina on strawberry farms with effective cultural practices for managing inoculum sources, and
- Guidelines for on-farm hygiene practices that minimise the risk of spreading M. phaseolina.

Advances to date

Totally impermeable film retains the fumigant at a higher concentration and for a longer period of time, compared to LDPE film.

The reduction in the amount of M.phaseolina in the soil following fumigation is significantly greater where TIF plastic is used, and this leads to less plant death and more fruit harvested.

The fungus survives for at least 6 months inside strawberry crowns buried during cultivation.

Infected strawberry crowns retained in the paddock are a major source of inoculum, and lead to the infection of new runners, the development of charcoal rot disease and plant death.

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