The biology and management of Colletotrichum diseases in production nurseries

Diseases caused by the fungus *Colletotrichum*, particularly leaf spots, are very common in plant production nurseries. This pathogen attacks a very wide range of ornamental, fruit and vegetable species, causing the disease commonly known as "anthracnose". Leaf spot diseases caused by a range of fungi other than *Colletotrichum* (e.g. *Elsinoe*, *Phyllosticta* and *Phoma* species) are sometimes referred to as "anthracnose" as well. It can sometimes be difficult to distinguish between leaf spots caused by *Colletotrichum* and these other fungi.

Causal agents

Colletotrichum gloeosporioides is the predominant species causing "Colletotrichum" anthracnose in nurseries, particularly in tropical and subtropical regions. It has a very wide host range, although in some cases, host specific strains can occur which will only infect a particular plant host species (or only cause very mild symptoms in other "non" hosts). In many cases however, an isolate of *Colletotrichum gloeosporioides* from a particular host plant species will be capable of causing anthracnose in a different host plant species.

Many fungi are characterised by having both a "sexual" and an "asexual" stage. In the case of *Colletotrichum gloeosporioides* (asexual stage), the sexual stage is known as *Glomerella cingulata*. The two stages can be distinguished by the types of fruiting bodies and spores which they produce on diseased host material. In some hosts of the anthracnose pathogen, the sexual stage (*Glomerella cingulata*) is rarely encountered, whereas in other hosts, both stages of the fungus can be found. The asexual stage is generally more important in the dispersal of the pathogen. *Glomerella cingulata* is sometimes reported as the primary causal agent of anthracnose in a number of ornamental plant species.

A range of *Colletotrichum* species other than *Colletotrichum gloeosporioides* can also cause anthracnose in nursery plants.

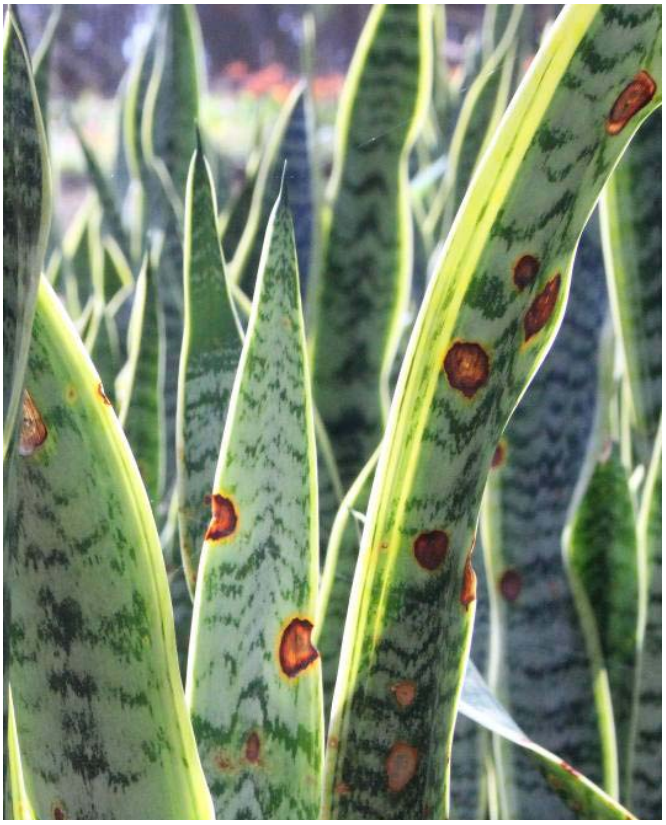

Fig. 1. Leaf spot symptoms caused by *Colletotrichum* sp on mother-in-law's tongue, *Sansevieria trifasciata*.

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Fig. 2. Leaf spot symptoms caused by Colletotrichum sp. on a) pansy, note that flowers have no spots, b) *Cissus Antarctica* (kangaroo vine), c) *Tolmiea* sp. (piggy back plant), d) *Syngonium* sp. Note that some symptoms have a yellow halo and others do not.

Symptoms

Leaf spots (Figs. 1-2) are the most common cause of production losses due to “Colletotrichum” anthracnose in nursery situations, although the disease can also present as a leaf blight, spot, dieback or canker of stems, shoots and twigs, as a rot of cuttings, a blight or spot of flowers or fruit rot (Fig. 3). Symptom expression is highly dependent on the host plant species, but often lesions initially appear as small water-soaked circular areas. With time, lesions enlarge and become tan to dark brown or black in colour, circular or irregular in shape, and may be surrounded by a bright yellow halo in some hosts (Fig. 2c, 4). Lesions may also become slightly sunken with time, often leading to a raised rim on affected foliage, flowers, buds, stems and fruit. In advanced stages of lesion development, and under favourable environmental conditions (i.e. high humidity), fruiting bodies may be observed on dead tissue in the centre of spots. When the asexual stage of the fungus is present, rings of fruiting bodies (acervuli) exuding slimy salmon-coloured spore masses may appear. When the sexual stage of the fungus is present, globose fruiting bodies (perithecia) may be produced by the fungus.

Young growth on new season leaf flushes is the most susceptible to infection by *Colletotrichum* species. Foliar symptoms of “Colletotrichum” anthracnose in nurseries can easily be confused with leaf spots caused by other species of fungi.

Some examples of similar symptoms caused by other fungi are shown in Fig. 5. Often laboratory identification is needed to confirm the presence of the disease.

Fig. 3. Symptoms of anthracnose caused by *Colletotrichum* species on (a) orchid flower, b) grape, c) stem rot symptoms on oleander cuttings and d) *Protea scolymocephala* stem lesion.

Disease cycle and spread

Warm, humid and wet conditions favour infection, disease development, sporulation and spread of *Colletotrichum* species. Spores (conidia) produced by the asexual stage of the fungus are produced in large numbers on diseased plant tissue, and this includes dead and decomposing leaf litter which gathers at the base of plants. The spores are embedded in a slimy matrix and are readily spread to neighbouring plants by splashing water. Spores of the fungus will germinate in the presence of free moisture and if conditions of temperature are favourable. Different species of *Colletotrichum* vary in their temperature requirements for optimal growth and infection, but most are favoured by warm temperatures. Once germinated, spores typically produce an infection structure (appressorium) on the surface of the plant tissue. From this infection structure, the fungus produces an infection peg which can directly penetrate the intact cuticle of plant tissue. The fungus can also enter plant tissue via wounds, and in some hosts such as *Camellia,* this mode of infection is very important. Once the fungus has penetrated the outer cell layer of the plant tissue, it then proceeds to colonise surrounding tissues. Under favourable conditions (e.g. high humidity) the fungus will produce fruiting bodies in the centre of lesions which erupt through the surface of the plant tissue, thus completing the disease cycle.

In the case of fruit rots there is generally a quiescent stage in the disease cycle before symptoms begin to develop. This stage occurs when the infection structure (appressorium), which is produced on unripe fruit, enters a dormant phase until fruit ripening commences. During fruit ripening, dormancy of the appressorium breaks, and so the fungus resumes activity and colonises the fruit tissue, leading to the development of symptoms. While quiescence is mostly a characteristic of *Colletotrichum* infections in fruit, it can also occur on other plant organs (e.g. leaves or stems) in some hosts and under certain conditions.

The sexual stage of the fungus, *Glomerella,* produces spores (ascospores) which can also infect some hosts and cause symptom development. However, it is generally thought that the *Glomerella* stage is not as important as the *Colletotrichum* stage in the dispersal of the pathogen. Dispersal is primarily via asexual spores (conidia) produced by *Colletotrichum*. The pathogen can also be spread through infected plant material, including seed produced in infected pods.

Fig. 4. Colletotrichum leaf spot symptom on an orchid leaf – note yellow halo around lesion.

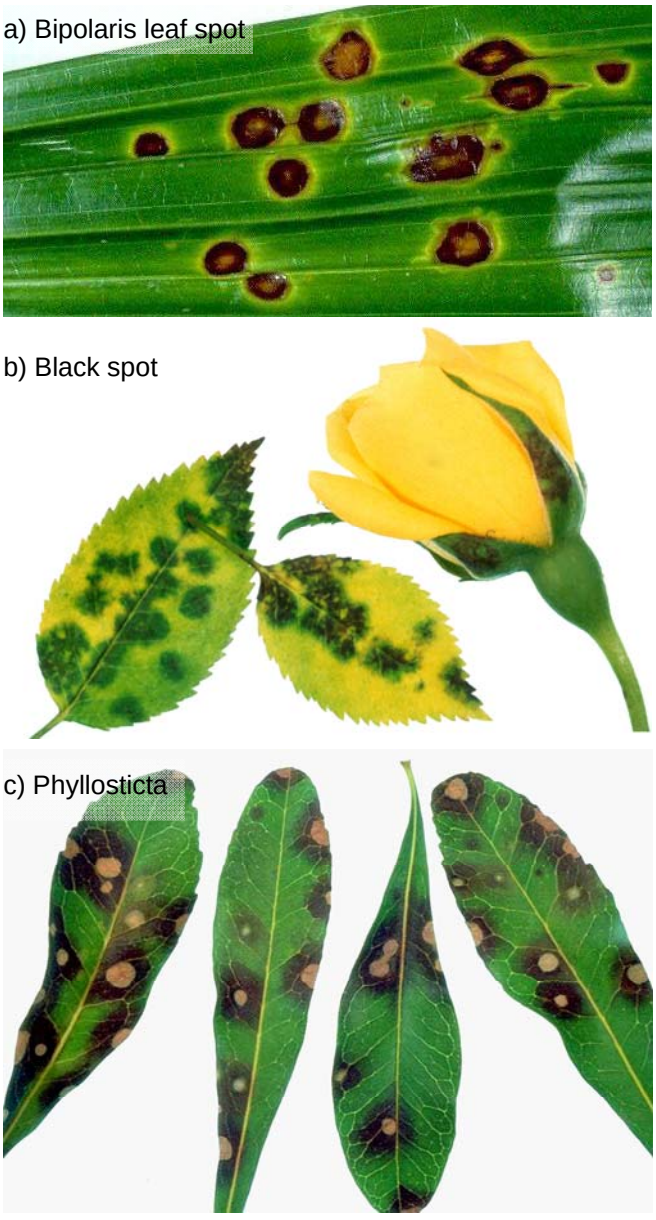

Fig. 5. Leaf spots that can easily be confused with *Colletotrichum* (a) *Bipolaris* leaf spot symptom on a palm leaf – note yellow halo around lesion, (b) black spot on rose caused by *Diplocarpon rosae*, and (c) *Phyllosticta* leaf spot on waratah.

Host range

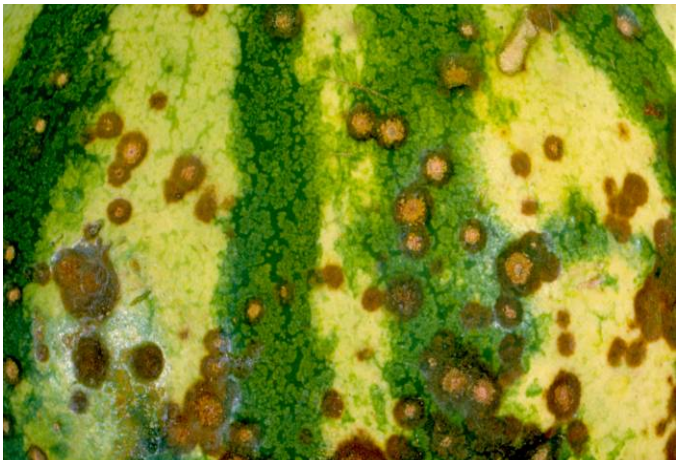

Fig. 6. *Colletotrichum* fruit rot on watermelon.

"Colletotrichum" anthracnose affects a wide range of plant species grown in nurseries, including ornamentals, fruits and vegetables. According to Chase (2011)[i], many plants grown outside of greenhouses, such as woody ornamentals and tropical foliage plants, are particularly affected by this disease. Ornamental plants commonly affected by "Colletotrichum" anthracnose include *Aglaonema*, *Alpinia* (ginger-lilies), *Anthurium*, *Araucaria* (Norfolk Island pine), azalea, birch, cacti, *Camellia*, *Cissus antarctica, Cordyline*, croton, cyclamen, *Dieffenbachia*, *Dionaea* (Venus fly trap), *Dracaena*, *Epipremnum, Euonymus*, *Fatsia, Fatshedera, Ficus,* flowering pear, *Hosta, Hydrangea*, ivy, *Ligustrum*, *Lomandra, Magnolia*, *Nandina*, oleander, orchids, *Osmanthus*, orchids, palms, pansy, *Peperomia, Pinus*, *Polyscias, Protea*, *Sanservaria,* snapdragon, *Syngonium, Tolmeia* (piggyback plant), *Vinca minor,* violet, *Yucca* and *Zinnia*. A wide range of fruit and vegetable crops are also affected by anthracnose, including asparagus, avocado, banana, bean, breadfruit, capsicum, carambola, cherimoya, citrus, coffee, cucurbits, durian, fig, grape, guava, lettuce, lychee, mango, papaya, passionfruit, potato, rambutan, spinach, strawberry and tomato. In many of the fruit and vegetable hosts of *Colletotrichum,* the greatest economic damage generally results from losses due to fruit rots in the field or after harvest, although the pathogen can also cause leaf spots in some of these hosts during the nursery production phase (e.g. mango anthracnose – see Fig. 7).

Disease management

Adoption of appropriate nursery hygiene practices is the key to effective management of anthracnose in production nurseries. Control measures can be specific for particular crops, but there are some basic principles which generally apply for most hosts.

- As spores are spread by water splash, avoid overhead irrigation or exposure to rainfall if possible.
- If possible water early in the day so that foliage dries out before evening
- Promote air circulation and reduce periods of leaf wetness by thinning plant canopies and avoiding close packing of plants/cuttings
- Do not handle plants when wet
- Avoid injuries and control insect/mite pests
- Separate healthy and diseased plants
- Remove and discard severely affected plants
- Prune out and discard diseased twigs, shoots and leaves and remove any leaf litter accumulating at the base of plants to minimise the build up of spores
- Propagate from disease free stock only
- If possible, avoid high temperatures and humidity
- Minimise plant stress (e.g. water and temperature stress)
- To aid recovery of plants affected by leaf spots and blights, fertilise and water well
- Where possible, use resistant cultivars and species.

Use fungicides only when necessary as they can mask after-sale symptoms. In some cases however, it may be appropriate to apply a protectant fungicide (e.g. mancozeb, chlorothalonil and copper-based fungicides) to prevent infection from occurring in the first place. Where possible, avoid or minimise the use of systemic fungicides with post-infection activity in nurseries. In some cases it may be necessary to pre-treat cuttings and scion material with a fungicide prior to grafting.

[i] http://www.greenhousemag.com/gm1011-colletotrichum-common-plant-disease.aspx

If you need to use a fungicide, always check that the product is appropriately registered or has a current permit for use on the crop you are intending to treat by searching the APVMA (www.apvma.gov.au) or Infopest (www.infopest.com.au) databases.

Biosecurity threats relating to Colletotrichum diseases

Most diseases of nursery crops caused by *Colletotrichum* species are commonly found throughout the world and therefore pose little or no biosecurity threat to Australian production nurseries. There are however some specific cases such as citrus postbloom fruit drop (caused by a slow-growing strain of *Colletotrichum acutatum*) and coffee berry disease (caused by *Colletotrichum kahawae*) that are considered to be significant biosecurity threats to Australia. While these pathogens cause damage to fruit/berries and are therefore primarily a field problem, their first point of entry into the country could be via a production nursery.

The classification of species within the genus *Colletotrichum* is currently undergoing extensive taxonomic revision. *Colletotrichum gloeosporioides* in particular is a very broad and highly variable species, and many taxonomists are creating a number of new species from within this group. New biosecurity issues could emerge in the future as a result of these taxonomic changes.

Fig. 7. All of the above symptoms were caused by *Colletotrichum* on mango. All plant parts can be affected and have varying symptoms.

This document was prepared by Lindy Coates, Tony Cooke and Leif Forsberg (Agri-science Queensland, Department of Agriculture, Fisheries and Forestry, Ecosciences Precinct, GPO Box 267, Brisbane QLD 4001) as part of NY11001 Plant health, biosecurity, risk management and capacity building for the nursery industry. Thanks go to Andrew Manners, John Duff and Ken Pegg for providing comments on earlier versions of this factsheet. Unless otherwise indicated, photographs were provided by Leif Forsberg and Tony Cooke (Department of Agriculture, Fisheries and Forestry).