



KiwiTech Bulletin No. N40

Identifying Armillaria

Revised August 2009

Armillaria is a slow moving but potentially highly damaging root disease of kiwifruit. Early and accurate diagnosis is important if the appropriate control measures are to be effectively employed. This bulletin is intended to assist growers recognise *Armillaria* infections in their orchards. If doubts remain, expert advice should be sought. Once identified, regular orchard inspections should occur to monitor and manage the rate of infection. The first visual signs of infection may show up on shelter or kiwifruit vines and inspections should focus on areas adjacent to these sites.

Initial symptoms

Unless regular checks at the base of vine trunks are occurring the first symptoms growers will see is canopy wilting or yellowing. Its onset can seem quite sudden, but in reality the vine has probably been infected for many months. Vine death usually follows such symptoms if *Armillaria* is the cause. Similar symptoms can be caused by *Phytophthora* in poorly drained soils or by other root or crown rots, so wilting, yellowing or vine death alone are not sufficient to diagnose *Armillaria*.



Figure 1. Yellowing of canopy at advanced stages of *Armillaria* infection.

Above ground diagnosis

Cracking of bark at the base of the trunk (Figures 2 & 3)

Basal bark cracking is usually the first above ground symptom of *Armillaria*. However, cracking is often overlooked in the early stages before canopy symptoms are evident. The cracks are often roughly triangular in shape and associated with slight swelling. Cracking is caused by *Armillaria* killing the cambial and bark tissue as it advances up the lower trunk. Cracks often appear dark brown and wet, due to sap oozing from damaged tissue. Cracking and basal swelling can be due to other causes, so on its own is not sufficient to diagnose *Armillaria*.



Figure 2. Cracking of bark on lower trunk caused by *Armillaria* infection below bark.



Figure 3. Cracking of bark on lower trunk caused by *Armillaria* infection below bark. Note bleeding and dark discoloration.

under the bark. Fungal growth under the bark is likely to be evident on some roots connected to the crown and lower trunk lesions.



Figure 4. Bark cut away (same vine as Figure 3), to show white fungal growth and rotted tissue.



Figure 5. Bark cut away to show white fungal growth. Note the extensive white sheet of fungus.

Fungal growth under the bark

(Figures 4, 5 & 6)

When the cracked bark is cut away, dense white fungal growth is evident, especially at the leading edge of the infection.

This fungal growth can sometimes form dense white sheets beneath the bark. The leading edge of the fungal mat can sometimes have an appearance like white thumbnails. Active lesions are usually wet and mushy, with a very strong “mushroomy” smell. In older or healed lesions, the white fungal growth may have dried up, leaving “crispy” black sheets



Figure 6. Dense white fungal growth advancing up trunk beneath bark. Note leading edge (top) appearance like thumbnails.



Figure 7. *Armillaria* mushrooms on severely infected vine (occurs rarely).



Figure 8. *Armillaria* advancing beneath willow bark. Note thumbnail appearance at leading edge.

Mushrooms (Figure 7)

Armillaria mushrooms are rarely seen in kiwifruit orchards, but in some years they can appear on vines showing advanced stages of decay. The mushrooms are always attached to wood, and never appear directly from soil. They are usually in clusters. The cap is honey coloured, up to 12 cm diameter, with small brown scales near the centre. The stem is tough and leathery, brownish-purple, with a membranous ring one quarter of the way down from the top. Spores are white and appear like talcum powder. *Armillaria* mushrooms are very common in native forest, and are usually only seen from about April to July.

Below ground diagnosis

Bootlaces (Rhizomorphs) (Figures 9 & 10)

Bootlaces are specialised fungal structures that grow along roots or out through the soil from infected wood or roots. Bootlaces are usually 1-4 mm in diameter and have a black outer layer with a cream or light brown core. They look like black roots but regularly divide and have a slight flattening at each branch. The diameter remains constant after branching. Bootlaces are highly diagnostic of *Armillaria*. No other fungus has quite the same structure, so their presence gives certainty to the *Armillaria* diagnosis.

Bootlaces are common, and can almost always be found in soil around infected kiwifruit vines. However, an untrained eye can easily mistake them for roots, so care is needed.



Figure 9. Rhizomorphs (bootlaces) growing from infected kiwifruit root.



Figure 10. Rhizomorphs (black) growing on infected willow roots. Note white fungal growth below bark on lower root.

Patterns of infection

(Figure 11)

Diseased vines usually occur in patches; it is unusual to find single infected vines without spread to adjacent vines. Typical spread from centres of infection is at a rate of about one vine every year or two. Shelterbelts, old stumps or buried wood often act as centres of infection, and spread can be on almost any wood or roots in the ground. Spread will be more rapid where shelterbelt roots (especially willow) form a network throughout kiwifruit blocks.



Figure 11. Diseased patch due to *Armillaria* infection.

Shelterbelt symptoms

(Figure 12)

Many shelterbelt species are very susceptible to *Armillaria*, and shelterbelt symptoms can be the first indication of infection in an orchard. Matsudana willow is very susceptible, but casuarina, cryptomaeria and other shelter species are also infected. Symptoms on shelter species are similar to those on kiwifruit, with wilting, yellowing and death, cracking of bark, dense fungal growth beneath bark and rhizomorphs in the soil.

A number of other common shelter diseases (e.g. white crown canker) can show similar symptoms. Detection of rhizomorphs is the best way to be definitive about *Armillaria*.



Figure 12. Matsudana willow shelterbelt (centre of block) severely infected with *Armillaria*.

Avoid confusion with *Phytophthora*

Canopy yellowing, wilt and death symptoms in vines suffering from *Phytophthora* root or crown rot can appear similar to those caused by *Armillaria* (see Kiwitech Bulletin N38 on *Phytophthora*). Key discriminating features of *Armillaria* are:

- Dense white fungus growth beneath bark, with strong mushroomy smell.
- Rhizomorphs on the roots or in the soil (these are not found with *Phytophthora*).
- Can occur on any soil type (*Phytophthora* in kiwifruit is generally confined to heavy, poorly drained, or occasionally flooded soils).

Author

Ian Horner
Plant & Food Research

Zespri Contact Details

Grower Contact Centre: 0800 155 355

Email: opc@zespri.com

Website: www.zespri.com

