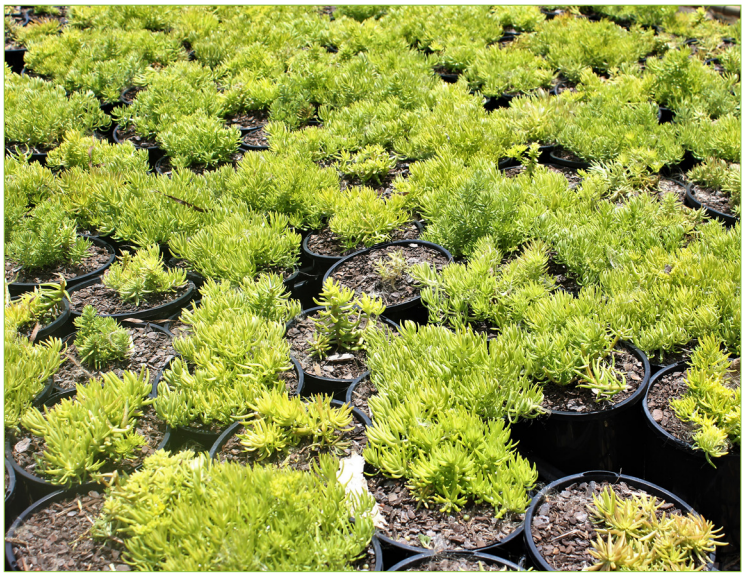
Vascular wilt and crown rot disease management plan for production nurseries

Vascular wilts and crown rots (including heart rot) are among the most destructive plant diseases that occur in production nurseries. They are very important because their presence can go undetected for relatively long periods, they almost always result in plant death and fungicides cannot eradicate infections. Environmental conditions that favour plant growth also favour these pathogens.

Pathogens responsible for vascular wilts and crown rot are usually soil-borne and water-borne bacteria, fungi and oomycetes (e.g. Pythium) and all produce similar symptoms. Since infected plants cannot be cured or sold, it is recommended to remove and dispose of affected plants followed by disinfection of the associated growing areas and equipment. Preventative actions and strategies designed to break the lifecycle and reduce spread are very important for managing these pathogens. Some of the most important management strategies are to grow resistant stock where possible, grow under optimal conditions (because healthy plants are more resistant to disease) and to regularly use cultural practices that reduce the risk of pathogens entering the nursery. No one action can be used to manage vascular wilt and crown rot diseases.



Fusarium vascular wilt of sedum in the nursery.

In this management plan the biology of each disease and the symptoms they cause will be described, including non-pathogenic disorders that sometimes cause similar symptoms. In particular, the differences between vascular wilt and crown rot pathogens are outlined. Detailed strategies are provided to reduce risk of entry into the nursery and break the life cycle should an infestation occur.

Hort Innovation Strategic levy investment | NURSERY FUND | Greenlife Industry Australia | Queensland Government

VASCULAR WILT VS CROWN ROT DISEASE

Vascular wilt and crown rot symptoms can be similar, but the way symptoms are produced are quite different. A few pathogens can cause both crown rot and vascular wilt disease (e.g. *Fusarium*, *Pythium* and *Erwinia*). In most instances, however, the two diseases are caused by different pathogens.

Both diseases essentially cut the flow of water between the above-ground and below-ground plant organs leading to wilting and eventual plant death. The main differences between crown rots and vascular wilts are how this physically occurs and the pathogens that cause it. For crown rots, the tissue at the soil line physically rots and disintegrates. This interrupts the movement of water and nutrients from the roots to the above ground organs as both the phloem and xylem transport systems are disrupted. This is very similar to what occurs when a plant is girdled.

In contrast, the crown remains intact for vascular wilt diseases, and it is primarily the xylem vascular tissue that is affected. Vascular wilt infections restrict the movement of water and solutes by physically blocking the xylem vascular system internally. This can be caused by the pathogen directly or products produced by either the pathogen or host plant in response to infection. In most cases, the stem appears relatively healthy externally.

Vascular wilt disease is limited to those organisms capable of colonising the xylem tissue. Whereas crown rot pathogens are more generalised pathogens capable of infecting young vulnerable tissues and any wounds that may be present.

Vascular wilt of Capsicum caused by *Ralstonia solanacearum* showing a healthy looking crown and stem exterior, but discolouration of the internal vascular tissues

Pseudomonas crown rot of lettuce. Note the crown (base) of the plant is completely rotten but the leaves are still green in the early stages of the disease

SYMPTOMS

All vascular wilts and crown rots have certain symptoms in common. Symptom development varies with the pathogen and host plant, but in general, plants will appear wilted as water is cut off to the upper part of the plant. The leaves on parts of infected plants can lose turgidity, become flaccid and lighter in colour (green to greenish yellow), leaves can droop and finally wilt but remain attached to the plant in most cases, unlike water stress symptoms where the plants drop their leaves. Eventually the leaves turn yellow, then brown and die.

Plants with a vascular wilt infection can also appear stunted in growth or lacking vigour in the early stages. Some, but not all, vascular wilt pathogens cause root rot. In some cases, plants become symptomatic from the bottom up, in other cases they may become symptomatic from the top down. Furthermore, some diseases cause one side of the plant to become chlorotic and die while the other side remains healthy. These observations can greatly assist with the diagnosis of the disease in some cases.

A key symptom for vascular wilt pathogens is discolouration of the internal tissues of the stem. When cut open, stem vascular tissues often look water soaked (glassy) and/or discoloured, ranging from brown to black or sometimes purple. Note though, the cut stem of many plant species can oxidise once cut, turning brown over a short period of time (similar to cut apples). It is therefore important to assess vascular discolouration immediately after cutting the stem.

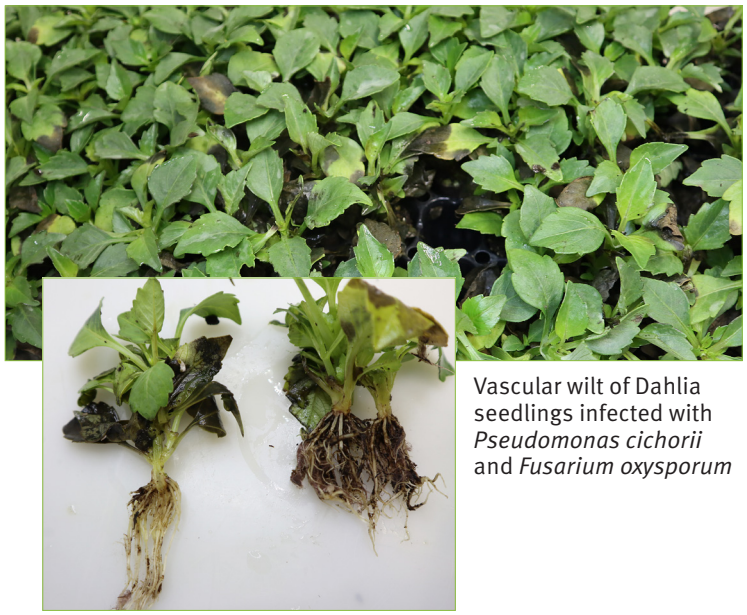
Some bacterial vascular wilt pathogens produce a distinctive milky looking ooze from the infected tissues when placed in water. Notably, bacterial wilt (*Ralstonia solanacearum*)

produces so much ooze that it can often be observed cascading from cut infected stems in water. Not all bacterial pathogens cause this level of ooze and most require trained diagnosticians to detect it using a compound microscope.

Milky looking *Ralstonia* cells streaming out from a cut capsicum stem when placed in a cup of water

When a plant is infected with a crown or heart rot pathogen, symptoms tend to appear quickly since both the water (xylem) and nutrient (phloem) vascular systems are cut off and the crown loses physical integrity. As the crown rot progresses, the entire plant will begin to wilt. The stem just above the ground may; change to a dark colour, appear water soaked, develop lesions, have fungal mycelium present or feel mushy depending on the host and pathogen involved. Root rot is often associated with crown rot which is why this disease is often referred to as root and crown rot.

Regardless of the disease, plants infected with crown rot or vascular wilt pathogens will inevitably die and cannot be cured with fungicides.



Vascular wilt of Dahlia seedlings infected with *Pseudomonas cichorii* and *Fusarium oxysporum*

DETECTION AND DIAGNOSIS

Vascular wilt and crown rot pathogens produce symptoms that are easily confused with other diseases (e.g. root rot, ring barking caused by beetles or cutworm, severe water stress or sometimes even herbicide damage). Many pathogens can cause similar symptoms (as will be discussed below) but their management may differ. Therefore, testing at a diagnostic laboratory is required to correctly diagnose plants with these diseases. This involves traditional plate culturing from symptomatic tissues to isolate a pure culture of the pathogen(s) and identifying it/them to the genus level based on morphological characters.

Molecular testing is usually needed to identify species and can be completed in several ways. Some species have had a diagnostic PCR developed to detect a particular genus or species. In other cases, particular gene regions can be sequenced. Some laboratories have equipment and perform this task inhouse, but most outsource their sequencing to specialised commercial laboratories. The DNA sequence results are then compared to sequences online stored in publicly accessible databases. If the sample sequence is an exact match for one stored online, it is assumed they have the same identity. However, some groups of pests have not been well studied or characterised, and consequently there are no sequences online for them yet. Such pests cannot be identified in this way or may only be identified to a higher taxonomic group, e.g. to genus or family level.

All production nursery businesses receive 6 free samples per year through Grow Help Australia until the end of 2025 as part of a nursery levy, Hort. Innovation and Queensland Government funded project (NY20000).

GENERAL BIOLOGY

While both crown rot and vascular wilt pathogens produce similar symptoms there are some key differences in their biology, particularly between fungal and bacterial pathogens. Therefore, the general biology of the major pathogens known to cause vascular wilt and crown rot in production nurseries will be described separately. Note also, in many instances multiple pathogens can be present and work together as a complex to produce these disease symptoms.

VASCULAR WILT PATHOGENS

Vascular wilts occur as a direct result of the physical presence and activities of the pathogen in the water transport system of the plant known as the xylem vascular tissues. The high structural integrity of the xylem cells combined with the low nutrient status within the vascular tissues make it a difficult environment for pathogens to invade and colonise, so only a few specialised pathogens are capable. Below, the most common fungal and bacterial pathogens will be described individually.

FUNGAL VASCULAR WILT PATHOGENS

The mycelium, spores and polysaccharides produced by the pathogens effectively block and clog the xylem vascular system preventing water and solutes from reaching tissues beyond them. Entire plants or plant parts above the point of vascular invasion by the pathogen may die within a matter of days or weeks once symptoms are first observed. In certain perennials, however, death may not occur for several years after infection. The pathogen continues to spread internally through the xylem vessels as mycelium or spores until the entire plant is killed.

There are four main groups of fungi that cause vascular wilts in plants:

- ***Fusarium*** is the most common fungal vascular wilt pathogen found in production nurseries where it causes vascular wilts of annual vegetables and flowers, herbaceous perennial ornamentals, plantation crops, seedlings, and many other plant species grown by the nursery industry. Most of the vascular wilt-causing *Fusarium* pathogens belong to the species *F. oxysporum*, though others also occur in Australia. Different host plants are attacked by special forms or races of this fungus. *Fusarium* wilts are favoured by warm wet soil conditions that are found in most production nurseries. For more information refer to the *Fusarium* factsheet.

Note internal vascular tissue discolouration. Fusarium vascular wilt of sedum

- ***Verticillium*** is the second most common fungal vascular wilt pathogen found in production nurseries. It also has a wide host range including annual vegetables, flowers, crop plants, perennial ornamentals, fruit trees and forest trees. Verticillium wilt occurs with two species, *V. albo-atrum* and *V. dahlia*, causing wilts and losses of varying severity in production nurseries. *Verticillium* wilts are more important in temperate zones as they are more tolerant of lower temperatures than *Fusarium*.
- **Botryosphaeriaceae** fungi. Although not strictly considered vascular wilt pathogens as they mainly invade vascular tissues of stems as opposed to the crown, they do represent the third most common fungal vascular problem in nurseries, colonising the tissues of woody hosts causing dieback and sometimes wilting. These fungi are considered latent pathogens as they are already present and living in many hosts as endophytes, only becoming pathogenic when the host becomes stressed or under conditions that are particularly conducive to their growth.

Botryosphaeriaceae dieback of hoop pine seedlings

Poinsettia infected with *Neofusicoccum parvum* (a Botryopsphaeriaceae fungus) causing wilt and dieback

- The fourth group are vascular wilt pathogens of trees which can have consequences for nursery mother stock. ***Ophiostoma*** (vascular wilt of elm trees) and ***Ceratocystis*** species that cause Dutch elm disease (*C. ulmi*), oak wilt (*C. fagacearum*) and cocoa wilt (*C. cacaofunesta*). These Ceratocystis wilt species are not present in Australia. Other species of *Ceratocystis* are present and do cause disease in *Eucalyptus* and closely related species.

BACTERIAL VASCULAR WILT PATHOGENS

Some bacterial vascular wilt pathogens enter host tissues passively, via wounds, cracks, or natural openings such as stomata and hydathodes, while others are directly delivered into the xylem by insect vectors. Once present they interfere with the translocation of water and solutes resulting in wilting and death of the above ground parts of the plants. In these respects, bacterial vascular wilts are like the fungal vascular wilts caused by *Fusarium* and *Verticillium*. However, fungal wilt pathogens tend to remain almost exclusively in the vascular tissues until the death of the plant, while the bacteria often destroy (dissolve) parts of the xylem cell walls or cause them to rupture early in the disease development. Subsequently they can quickly spread and multiply in adjacent cells.

Vascular wilts caused by bacteria affect mostly herbaceous plants such as some vegetables, field crops, ornamentals, and tropical plants, though notable exceptions occur. Common hosts that can get bacterial wilt in nurseries include *Dahlia*, *Heliconia*, Alexandra palm, *Strelitzia* and *Zinnia*. Seven bacterial genera contain vascular wilt pathogens, with the most commonly found in the nursery being those that can infect a wide host range and these include *Ralstonia*, *Xanthomonas*, *Pseudomonas* and *Erwinia*. There are also a number of other bacteria that are very host specific, e.g. *Clavibacter* on tomato, *Curtobacterium* on bean. Examples are given in more detail below:

- ***Ralstonia solanacearum***, causing bacterial wilt in a wide host range, particularly in the Solanaceae family but also other hosts including banana, *Bracteantha*, *Dahlia*, *Kalanchoe* and *Verbena*. *Ralstonia* enters the plant mostly via the roots through wounds and junctions where roots emerge or branch. Stem infections can also occur via wounds through contact with infested potting mix or irrigation water. The taxonomy of bacterial wilt is complex with different strains having a different host range. Some strains are exotic to Australia.

Ralstonia solanacearum wilt of Verbena

Bacterial wilt, *Ralstonia solanacearum*, causing wilt and dieback on *Bracteantha*. Note the dark vascular discolouration of cut stems

- ***Pseudomonas***, causing vascular wilt of carnation (*P. caryophylli*) and of zucchini (*P. syringae*). Many *Pseudomonas* species are seed borne and can survive ubiquitously in the environment on, or in, living plants (including weeds) and plant debris. It spreads via water splash from rain or other sources and enters the host via natural openings and wounds.
- ***Xanthomonas*** causing black rot or black vein of crucifers and other hosts such as mango and *Anthurium* (e.g. *X. campestris pv campestris*). *Xanthomonas* species are seed-borne and can be found on the seed surface or internally from the infected mother plant. They can also enter the host through natural openings and wounds.
- ***Erwinia***, causing vascular wilt of cucurbits (*E. tracheiphila*) and vectored by the cucumber beetle, Stewart's wilt of corn (*E. stewarti*), and fireblight of pome fruits (*E. amylovora* — not present in Australia) which enter the host via natural openings.
- ***Clavibacter*** causing vascular wilt of alfalfa (*C. michiganense* subsp. *insidiosum*) and bean (*C. flaccumfaciens*), ring rot of potato (*C. michiganense*

subsp. *sepedonicuym*), and bacterial canker and vascular wilt of tomato (*C. michiganense* subsp. *michiganense*). All enter the host via the roots, natural openings and wounds.

- ***Curtobacterium*** is an emerging vascular wilt pathogen of edible legumes in Australia, including French bean. This is a seed borne pathogen that can also enter via natural openings and wounds on the host.
- ***Xylella fastidiosa*** vascular wilt of fruit and landscape trees and vines. This is Australia's number one National Priority Plant Pest and is vectored by the Sharp-shooter leaf hoppers; it is not known to be present in Australia.

Phytophthora heart rot of Dracaena

OOMYCETE VASCULAR WILT PATHOGENS

Pythium is the only oomycete genus that contains vascular wilt pathogens. Oomycetes (also known as water moulds) are not true fungi even though they have some fungus-like characteristics such as mycelium and sporangia (a type of fruiting body). Unlike fungi, they produce mobile spores that can swim in thin films of water allowing them to actively seek out host plant roots. These pathogens mainly infect seeds or seedlings causing pre-emergence or post-emergence seedling damping-off disease of young and juvenile plant tissues. Pythium species often have a very wide host range and are favoured by cool, wet conditions. For more information refer to the Pythium factsheet.

Tray of Iris seedlings with *Sclerotinia* crown rot. Note the brown shrunken crown and necrotic roots

CROWN ROT PATHOGENS

Unlike vascular wilts, crown rots are caused by a wide range of bacterial, fungal and oomycete plant pathogens and can affect many types of plants. The cells at the soil-line become infected, die and disintegrate. The pathogen can infect at the soil line or through the roots, growing up the plant to the crown. Herbaceous plants are particularly vulnerable, but it can also be a problem with trees and shrubs. Plants with roots and stems that remain succulent for an extended period are the most susceptible. Common crown rot pathogens found in the nursery are *Fusarium*, *Sclerotium*, *Rhizoctonia*, *Sclerotinia*, *Colletotrichum*, *Pestalotiopsis*, *Rhizoctonia*, *Calonectria (*previously *Cylindrocladium*) and the oomycetes *Pythium*, *Phytophthora* and *Phytopythium*.

Bacterial crown rot, also known as heart rot, is more of a problem with field crops (i.e., pineapple, artichoke, rhubarb, and rice) and mature trees (Papaya). But there are a few bacteria that can also pose a threat in the nursery. For example, bacterial crown rot of *Lisianthus* caused by the bacterium *Burkholderia gladioli*.

Environmental conditions significantly influence the development of root and crown rot. Cool temperatures (10–15°C) that slow germination of seeds and growth of cuttings keep the plants in a vulnerable, succulent condition for a longer period. When the soil is soddened with moisture for extended periods, soilborne pathogens like *Fusarium*, *Pythium*, *Phytopythium* and *Phytophthora* are more active and infect plants. Drier soil conditions, but with high relative humidity, are favourable for pathogens like *Rhizoctonia*.

Crown and root rot of Brussels sprout caused by the pathogens *Pythium* and *Fusarium*. Note the disintegration of the crowns and the sparse and necrotic of roots.

J-root raspberry after planting out in the field. Led to stunted growth and *Rhizoctonia* crown rot

NON-PATHOGENIC DISORDERS

It is important to note there are non-pathogenic disorders that can produce symptoms like those of vascular wilts and crown rot, but unlike a disease, once identified these can often be rectified and plants are safe to sell. These disorders include:

- Hypoxia/anoxia is a physiological condition resulting from a low level of oxygen reaching the roots and crown. This can occur as a result of planting too deeply, very high-water content in the growing media or too low air-filled porosity. All of these can lead to root death and wilting. This condition can also predispose plants to infection by root rot pathogens.
- Root bound or J-rooted plants leading to a restriction of the water and nutrient supply as the plant gets bigger. Plants may appear unaffected when young, but these disorders can result in wilting symptoms when the canopy is larger and there is a greater demand for water and nutrients. J-roots may not be rectifiable, and it is important to manage early nursery stock such that root structure is healthy.
- Phytotoxicity and burn from causes such as herbicide damage, sun/heat, excess nutrients, high levels of water disinfectant products in irrigation water, phytotoxicity due to pesticide/fungicide application or an interaction between these factors. Sometimes irrigation or product application during very hot conditions can lead to burn that causes leaves to turn brown, die and drop from plants. In certain cases, these factors may lead to symptoms like those caused by crown and wilt pathogens including leaf drop, root burn, wilt and deformed or unusual foliar growth.

Viburnum with suspect herbicide damage. Note distorted and wilted new growth

- Water stress can cause leaves to wilt, die, and drop from plants. It can also cause roots to die and under severe conditions can cause plant death. When minor water stress conditions occur, plants should rehydrate and become turgid. If plants remain wilted after media has been sufficiently wetted it may indicate that the plants have disease. It is still important to avoid overwatering following water stress events.

DISPERSAL AND SPREAD

While the biology and life cycle of the pathogens responsible for vascular wilt and crown rot diseases are different, they all produce specialised structures, or spores, for spread and overwintering and are dispersed in the nursery in similar ways. In general, these pathogens spread short distances through the direct contact of plants, water pooling in growing areas, water splash, wind and by infested growing media and equipment (e.g., cutting knives, benches, polytunnels, containers, shoes, hands, and growing areas). They spread long distances by contaminated irrigation water, infected transplants (that may appear asymptomatic) and seed. Seedborne pathogens may be present inside the seed itself or may be present on the seed coat. Staff and equipment can also spread pathogens from touching infected plants followed by healthy plants. Certain bacteria can also be spread by insect vectors in a similar fashion.

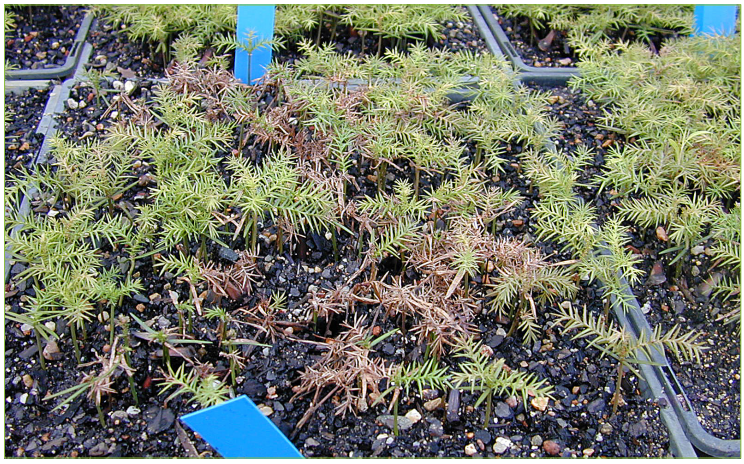
Most plant pathogens can live as saprophytes or saprobes, which means they can survive on dead and decaying organic matter. In most cases, once introduced into soil they quickly become established and can survive for a long time until a susceptible host is available, which is why growing nursery stock in-ground is relatively high risk. In addition, some species can survive and multiply on non-hosts. Therefore, selling plants infested with pathogens can have long-lasting consequences for the soil into which they are planted.

SPREAD OF FUNGAL PATHOGENS

Most crown and wilt fungal pathogens are soil-borne and infect plants through the roots, which they penetrate directly or through wounds. They overwinter in the growing media, plant debris and sometimes even in the growing area environment (e.g. on benches, polytunnels and surfaces) as thick-walled resting spores or mycelium that are resilient in harsh environmental conditions. The names and types of these spores and resting structures may be different for various groups, but they are all designed to aid the spread of the pathogen and ensure it survives to infect a new host. Consequently, fungi can remain in the nursery environment indefinitely if left unchecked.

SPREAD OF BACTERIAL PATHOGENS

Bacterial plant pathogens can survive quite well in the environment even though they do not form resistant spores in the same way as fungi. Active cells may be present on plants as epiphytes or in plant root zones (rhizoplane and rhizosphere), and less active cells survive within the plant as endophytes without causing symptoms. They survive in plant debris on the soil surface and may be soilborne. The extent to which different bacterial pathogens can survive in the soil varies considerably between species or even between different pathovars of the same species.



Rhizoctonia crown rot spreading through a Hoop pine seedling tray

SPREAD OF OOMYCETE PATHOGENS

Oomycete pathogens (*Pythium*, *Phytopythium* and *Phytophthora*), also known as water moulds, produce small mobile spores capable of swimming in thin films of water, actively seeking out susceptible hosts in close vicinity. They survive by producing resistant structures called chlamydospores and oospores in dead plant tissues. When favourable conditions occur, these structures germinate and produce the mobile spores which then actively seek out host roots.

MANAGEMENT

Vascular wilts and crown rots cannot be eradicated once plants are infected, and it is not recommended to sell plants known to be infected (even if symptoms are not yet obvious). Management therefore focuses on preventing disease by using best management guidelines to produce high health plants that are better equipped to resist infections. This includes providing optimal growing conditions as much as possible, e.g. environmental conditions, irrigation and fertiliser regimes. Recommendations specific to preventing vascular wilt and crown rot diseases in nurseries include the following practices.

- Only propagate from healthy plants.
  - Only propagate from devoted mother stock plants that are healthy and without any signs of disease. Renew them periodically.

- Do not take cuttings from general stock plants.
- Take cuttings when plants are dry.
- Disinfest cutting knives and secateurs regularly.
- Dipping cuttings in fungicide has been shown to spread certain diseases, therefore care must be taken with this method of protecting cuttings.
- Use fungicide treated seed or certified disease-free seed.
- Heat treat seed where possible

» Grow pathogen resistant varieties, where possible.

» Pasteurise growing media and only use clean pots and equipment.

- Store media appropriately to avoid contamination.
- Do not reuse growing media.
- Store new and clean containers undercover and in such a way as to stop contact with water and organic matter, including dust.
- Ensure that containers that are reused are disinfested appropriately. Remove all organic matter prior to disinfestation. Chlorine is ineffective if any organic matter is present. Use heat to disinfest containers, trays etc.

» Optimal fertilization — Avoid excess fertilizer applications, especially quick release nitrogen. This practice stimulates spindly, succulent growth that prolongs the period during which young plants are most vulnerable to these diseases.

» Ensure irrigation water is adequately disinfested (refer to factsheet on water disinfestation) and do not overwater plants or let pots sit in water as this will favour these pathogens. Also, group plants based on their need for water; plants with different water requirements should not be grown together.

» Do not apply fungicides to cure plants of these diseases. There are no known fungicides that will cure plants of these diseases. If sold, such plants will only serve to spread disease and potentially infest areas that otherwise did not have a pathogen present.

» It is not recommended to grow plants in-ground.

» Grow plants off the ground wherever possible. If crops cannot be raised off the ground, ensure that plants do not come in contact with soil. In other words, use best practice management to build growing beds on gravel and or other materials that stop direct contact with soil.

» Keep growing areas clean. Remove organic matter, weeds, and other debris promptly and on a regular basis.

» Regularly disinfest growing areas, equipment, tools, footwear, and pathways with an appropriate disinfectant and especially between crop cycles.

» Last, but certainly not least, regularly monitor plants for signs of root rot, crown rot and general plant health including symptoms described above. Early detection can assist in reducing the amount of stock loss.

REMEDIAL ACTION

If you experience crop symptoms consistent with those caused by a root rot, crown rot or vascular wilt disease, it is recommended to send a sample for diagnostic testing to confirm what has caused the plant decline. It may also be worthwhile quarantining plants suspected of having a pathogen present while waiting for test results to prevent spread to healthy plants. All production nurseries receive 6 free samples per year at Grow Help until the end of 2025.

If your plants are diagnosed with a vascular wilt or crown rot disease the following recommendations apply:

» Remove diseased plants as soon as possible.

» If a substantial portion of the consignment is symptomatic, consider discarding the entire consignment.

» Do NOT discard diseased plants or infested organic matter in a compost pile as this increases the risk of the pathogen reinfecting nursery stock.

» It is recommended to discard plants via deep burial, e.g. most council waste services.

» Remove and discard all crop organic matter including dead leaves and media that has spilled.

» Clean and disinfest growing areas with an appropriate disinfectant after the infested consignment has been removed.

» It is not recommended to collect seed or cuttings from consignments that have had disease symptoms (even if the remaining plants appear healthy) unless the pathogen involved has been identified and is not seedborne.

» It is not recommended to reuse containers, trays and flats that have had plants infested with soil and water borne pathogens; discard such containers. Break the lifecycle in the nursery before resuming recycling of containers, trays and flats.

» Fungicides should only be used as protectants of healthy plants. In research trials azoxystrobin, which is upwardly systemic, has provided some protection of *Fusarium* vascular diseases in the nursery when used as a drench

treatment on healthy plants after diseased plants have been removed.

- Control insects, particularly fungus gnats, and other pests as they can act as vectors or wound plants and increase the risk of infection.

Selling infected plants will only spread disease. *Xanthomonas campestris* wilt in Brassica

BIOSECURITY

There are a number of pathogens mentioned in this factsheet that are present overseas but are not known to occur in Australia (e.g. Xyella, fireblight, ***Ceratocystis*** species that cause Dutch elm disease (*C. ulmi*), oak wilt (*C. fagacearum*) and cocoa (*C. cacaofunesta*)). Due to the increased international trade in the ornamental and vegetable sector, the Australian nursery industry is at considerable risk from incursions of exotic pathogens, particularly from illegal importations.

Once introduced the eradication of exotic pathogens requires early detection. Continuous and thorough disease monitoring is essential for proactive management of nursery crops. If anything unusual is observed it is recommended to send a sample to a diagnostic laboratory for identification, e.g. Grow Help. If you suspect an exotic plant pest is present in your nursery, call the Exotic Plant Health Hotline on 1800 084 881.

FURTHER READING

- *Fusarium*
- *Pythium*
- *Phytophthora*
- *Rhizoctonia*
- Bacteria
- Non-pathogenic disorders
- Management of soilborne root pathogens
- Preventing diseases in nursery propagation areas
- Managing disease transmission in production nurseries
- Clean and disinfect the greenhouse
- Cleaning and disinfesting the greenhouse
- Webinars on various topics including the management of root rot, preventing diseases and producing high health crop

This document was prepared in 2022 by Sarah Dodd and Andrew Manners (Queensland Department of Agriculture and Fisheries - DAF) as part of the Hort Innovation, Levy and Queensland Government funded project 'Resourcing, supporting, and assessing biosecurity in nursery production' (NY20000).