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FACT SHEET | DECEMBER 2024

FUSARIUM WILT OF MELONS

KEY MESSAGES

- Many species and strains of fungi and bacteria can cause melon plants to wilt
- One of the most destructive pathogens of melon plants worldwide is *Fusarium oxysporum*, a fungus affecting the vascular system of the host plant
- Symptoms include leaf yellowing, wilting runners, and browning of the vascular system, with eventual plant collapse
- Infection starts in the soil, spreads through the roots, and damages other plant parts, including causing dry fruit rot
- Fusarium can spread through the three s's (seeds, seedlings and soil)
- *F. oxysporum* has over 100 formae speciales (f.sp.) that attack different host species, with genetic traits for pathogenicity evolving through mutation and selection
- *F. oxysporum* has distinct races affecting melons, such as ***Fon*** (watermelons) and ***Fom*** (rockmelons, honeydews and watermelons). Races are classified by cultivar resistance, with no resistant varieties for races like ***Fon*** 3 and ***Fom*** 1.2
- While there are some management options, effective management begins with preventing its entry onto the farm

What are wilts and what causes them?

Wilting is the generalised loss of turgidity and drooping of leaves or shoots. Wilting can appear due to many different reasons, sometimes abiotic, such as insufficient water, and sometimes biotic, being the symptom of a pathogen attacking the plants and disrupting their vascular system. There are many different species and strains of fungi and bacteria that can cause melon plants to wilt, as shown in Table 1.

Hort Innovation RMCG ahr applied horticultural research MELONS AUSTRALIA

This project has been funded by Hort Innovation using the vegetable and melon research and development levies and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

Table 1. Pathogens that can cause wilt of melons

Disease/Causal Agent	Occurs in Australia
Fusarium wilt *(F. oxysporum, Fom and Fon)*	YES
Pythium root rot – several species	YES
Charcoal rot *(Macrophomina phaseolina)*	YES
Gummy Stem Blight – *(Didymella bryoniae (Stagonosporopsis citrulli, S. cucurbitacearum & S. caricae))*	YES
Sudden vine decline (*Plectosphaerella* spp.)	YES
Verticillium wilt *(Verticillium dahliae)*	YES
Sudden vine decline *(Monosporascus cannonballus)*	NO
Bacterial wilt (strains of *Ralstonia solanacearum*)	NO
Bacterial wilt *(Erwinia tracheiphila)*	NO
Phytophthora root & crown rot *(Phytophthora capsici)*	NO

What are wilts, their causes and symptoms?

One of the most destructive pathogens of melon plants worldwide is *Fusarium oxysporum*, a fungus affecting the vascular system of the host plant.

The key symptoms of Fusarium wilt include leaf yellowing, wilting of the runners, and browning of the vascular system (Figure 1). Wilting can initially be temporary and plants might recover through the night, but when the infection takes hold, it might become permanent, with plant collapse and ultimately death. Sectoring is a peculiar early symptom of the disease, with only one portion of the vine wilting, while other runners may appear asymptomatic.

Brown discolouration of the vascular system (Figure 2), starting from the crown and developing along the vines towards the growing points, is also a typical symptom. This might also show externally in the lower parts of the plant, with a soft rot developing near the crown.

Figure 1. Wilted runner of a watermelon plant

Sometimes affected seedlings wilt and die before the appearance of vascular discolouration.

The infection process of a true Fusarium attacking a plant and causing wilt always starts from the soil and through the roots, while when directly infecting fruit, Fusarium spp. can cause dry fruit rot. The mycelium of the fungus colonises the plant and its spores can be transported via the vascular system, germinating and developing in other parts of the plant, further from the roots.

Figure 2. Vascular browning at the base of the stem caused by *Fusarium oxysporum*

Sources of Fusarium

Fusarium can spread following various pathways. It is important to remember the three s's:

- **Seeds:** can carry Fusarium, mostly on the external surface rather than internally
- **Seedlings:** can carry Fusarium unnoticed as a latent infection
- **Soil:** spores can survive in soil for more than 10 years, even without a suitable host

Apart from surviving as resting spores, Fusarium can survive on volunteers, weed cucurbits, and possibly in the root system of other plants. Spores and other fungal material can be spread by dirty machinery, tools, and insects.

Fusarium specialisation and pathogenicity

Fusarium oxysporum has more than a hundred described **formae speciales** (special forms - f.spp. - singular **forma specialis** f.sp.) that attack different host species of agricultural and ecological importance. The genetic traits that cause a particular f.sp. to become pathogenic on a particular host species (or cultivar) are complex and subject to change through natural mutation and selection.

The two main subspecies of *F. oxysporum* attacking melons are:

- F.sp. niveum (***Fon***) – on watermelons
- F.sp. melonis (***Fom***) – mainly on rockmelons and honeydew, but also on watermelons

There is yet another level of specialisation. Some melon varieties show various degrees of susceptibility to different isolates of *F. oxysporum* (***Fon*** and ***Fom***). The lower the susceptibility, the higher the resistance, and vice versa.

These more specialised variants are linked to varieties of melons and watermelons and are called races. Races are classified depending on the resistance of commercial cultivars to the development of the disease symptoms.

- ***Fon*** has currently four described races: 0, 1, 2 and 3, with no resistance in commercial watermelon varieties for Race 3
- ***Fom*** has currently four described races: 0, 1, 2 and 1.2 (1-dot-2), with no resistance in commercial rockmelon or honeydew varieties for Race 1.2

The race with the highest number is conventionally the one for which no resistant varieties are known at the time, but breeders might eventually develop a resistant variety to that particular race. After that, if a new ***Fon*** or ***Fom*** isolate is discovered with no resistant varieties, that should be considered a new race (e.g. ***Fon*** 4) and so on.

Management options

The first step to effectively manage Fusarium is to prevent it from entering the farm altogether. Effective biosecurity measures and hygiene (clean machinery and personnel), coupled with disease-free seed and seedlings, can help keep out the pathogen.

When the pathogen is known to be present on farm then cultural practices can help with its management. Long crop rotations, growing non-host crops in between melon plants, can help 'starve' the pathogen, reducing its presence in the soil. Other useful practices are adding organic amendments, growing cover crops instead of leaving the land under fallow, and especially biofumigant cover crops.

Grafting onto non-susceptible or resistant rootstocks, whether gourds, pumpkins or resistant watermelons, is a very effective way to prevent Fusarium from infecting the plant, as long as the seedling is not transplanted too deep, allowing the pathogen to get in through the grafting wound or adventitious roots developing above the graft.

Some chemicals applied as soil fumigants, seed treatments, or seedling drenches, have been found to be effective in controlling Fusarium. None of the chemical drench treatments are currently approved for use in Australia.

Adding biological products to the system can also help. Fungi and bacteria such as *Trichoderma*, *Streptomyces* and some *Bacillus* species can suppress Fusarium by parasitising it, producing antibiotics to suppress it, out competing with it for nutrients, or by inducing plant resistance.

Nitrogen fertilisers need careful management. Elevated ammonium can decrease pH, and acid soils are known to be more favourable to Fusarium. On the other hand, when urea is applied in alkaline conditions, the gaseous ammonia that might be released can damage the roots, possibly increasing infection.

Current situation in Australia

The prevalence and distribution of *F. oxysporum* races across Australia are currently being investigated by the levy-funded project 'Identification and management of a fungal disease complex in melons' (VM22001)[1].

All isolates of ***Fom*** from NSW tested in 2016 were Race 1, while all isolates tested in 2023 were Race 1.2, for which there are no known commercially resistant varieties. This suggests there has been a shift in race prevalence.

A PhD study from 2018 (Dr Victor Puno, University of Sydney) has demonstrated both ***Fon*** Races 2 and 3 are present in Australia[2].

FAQs

What is the efficacy of chemicals and biologicals in controlling Fusarium? Will increasing soil carbon help?

There are currently no registered chemicals in Australia to control Fusarium. Group 3 fungicides have been found useful in the US, but there is limited specific research on chemicals for this particular issue and crop.

Biological products might need repeated applications to prevent Fusarium. Prevention needs to start at the nursery, and continue on seedlings, transplants and in early growing stages. Organic stimulants and biologicals can improve root development and resistance to Fusarium infection.

How transferable are the findings to other cucurbit crops?

Most cucurbits can have similar issues, with Fusarium f.spp. being a problem on cucumbers too, even though in Australia they are mainly grown in no-soil systems. Some f.spp. are not present in Australia but might become a major problem if introduced, since they are specific to gourds and other cucurbits used as rootstocks to graft melons.

Susceptibility to formae speciales – What are known resistant varieties?

Some publicly funded research develops pre-breeding programs, on the back of which seed companies can work to develop commercial varieties with resistance to formae speciales and races. Varieties can be described as highly resistant (HR), intermediately resistant (IR), or with no resistance, depending on symptom development (susceptibility).

Can Fusarium be spread or favoured by irrigation or floodwater?

Yes, even though Fusarium is not considered water-borne, but soil-borne, spores can be spread by water, while very wet soils can weaken the root systems and favour Fusarium.

Can Fusarium still infect grafted plants?

Some studies have shown that Fusarium can sometimes colonise the rootstock of a grafted plant and get into the scion without causing the disease. Other studies demonstrated that it could get directly into the scion through the grafting wound and cause the disease, especially if transplants are positioned too deep into the soil. Wild watermelon rootstocks are currently not known to have resistance to ***Fon*** Race 3, so they will not give a grafted plant any protection. If ***Fon*** Race 3 is known to occur in the field, only a pumpkin or gourd rootstock should be used.

Is it possible to test soil for Fusarium levels and use prediction modelling to classify risk in the paddocks?

Soil DNA testing is available for some diseases, but at this point in time it is not suitable yet for pathogenicity and Fusarium race identification. The genetic configuration of Fusarium that causes disease is very complex and might be picked up by complete genome sequencing in the future. Testing for pathogenicity and race requires a seedling test (bioassay), where the fungus is applied to seedlings of different varieties with known race resistance grown in pots and monitored for symptom development.

Further Resources

Table 2. Further learning resources for Fusarium wilt and other pests, diseases and disorders of melons

Resource	Link
Soil Wealth ICP **Fusarium wilt of melons (webinar recording)**	soilwealth.com.au/2024/09/fusarium-wilt-of-melons-webinar/
Soil Wealth ICP **Pests, diseases, and disorders of cucurbits: A field identification guide (ute guide)**	soilwealth.com.au/2024/05/cucurbit-ute-guide/

References

1. Identification and management of a fungal disease complex in melons (VM22001) (n.d.) Hort Innovation. Available at: https://www.horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/vm22001/
2. Puno, V.I. (2018) Fusarium Wilt of Watermelon in Australia: Biology and Management, Fusarium Wilt of Watermelon in Australia: Biology and Management . thesis. University of Sydney. Available at: https://ses.library.usyd.edu.au/handle/2123/18739