**Carrot Diseases**

**Black root rot**
Two fungi cause black root rot: *Thielaviopsis basicola* (*Chalara elegans*) and *Chalaropsis thielioides*. Roots affected by black root rot have large black superficial patches on them. These patches are often circular and sometimes surrounded by a matt white halo.

**Disease cycle**
The fungi that cause black root rot have a wide host range and occur in soil. Carrots are likely to be contaminated with these fungi in the field before harvest.

After harvest the fungi infect carrots through wounds or abrasions. They develop rapidly on carrots stored at 25°C and in high humidity.

**Control**
- Avoid planting sequential side-by-side crops
- Remove volunteer carrots and harvested carrot crops promptly
- Use a fallow period to break the infection cycle

**Common post-harvest diseases**

**Bacterial soft rot**
This is a soft, slimy, orange rot that can occur on any part of the carrot, although it is often associated with the eyes. The rot can penetrate deeply. It does not usually smell unpleasant unless there is secondary infection caused by other bacteria.

Soft rot is caused by either *Erwinia carotovora* subspecies *carotovora* or *E. carotovora* subspecies *atroseptica*.

**Disease cycle**
*Erwinia* spp. are common soil bacteria that survive on crop residues. Carrots are likely to be contaminated with soft rot bacteria in the field before harvest. However, these bacteria are readily spread in washing water during post-harvest handling.

Soft rot bacteria enter carrots through wounds, but they can also be forced into the eyes if warm carrots are dumped into deep cold water tanks. Once the bacteria are in the carrot root they cannot be killed by sanitisers such as chlorine.

**Control**
- Losses caused by soft rot bacteria can be minimised by cooling carrots as soon as possible after harvest and then storing them at 0°C
- Minimise mechanical damage during harvesting and in the packing shed

**Sclerotinia rot or cottony rot**
See Sclerotinia above.

**Further Information**
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**Acknowledgements**
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**Symptoms of black root rot.**

**Symptoms of bacterial soft rot.**

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**Common leaf diseases**

**Leaf blight**
Leaf blight is an extremely common, quickly spreading fungal disease that initially occurs as patches within crops. The symptoms of leaf blight are small brown, dead spots on the leaves and petioles (leaf stalks). These spots grow rapidly and eventually join so that the leaf yellows and dies. The petioles also break during harvesting.

There are two types of leaf blight, *Alternaria* and *Cercospora*. *Alternaria* leaf blight is caused by *Alternaria dauci* and/or *A. radicina* and usually first appears on the oldest leaves. *Cercospora* leaf blight is caused by *Cercospora carotae* and appears on the youngest leaves first.

**Disease cycle**
Both *Alternaria* and *Cercospora* can be carried on carrot seeds and once introduced into an area will survive on carrot debris. They can spread easily during rain or irrigation and can also be carried on machinery.

**Control**
- Disease control is difficult on farms where carrots are planted sequentially
- Some carrot varieties are more tolerant of leaf blight than others

**Symptoms of leaf blight.**
Disease cycle
Root knot nematodes are difficult to control because they have wide host ranges. They are more usually a problem in sandy soil. Root knot nematodes survive between crops on alternate hosts and in egg masses in the soil.

When conditions are suitable, the eggs hatch and juvenile nematodes penetrate root tips. Female nematodes mature within the roots and a gall develops around the nematode. These females lay eggs into a gelatinous matrix on the root surface. The eggs either hatch immediately or become dormant.

Control
• Soil sampling to assess nematode numbers before seeding is not always a reliable indicator of whether a nematicide needs to be applied
• Preplant fumigation with 1,3-dichloropropene, 1,3-dichloropropene + chloropicrin, fenamiphos or metham sodium. Minimise use due to the potential for enhanced microbial degradation

Carrot virus Y (CarVY)
CarVY is a serious disease, spread by aphids and occurring throughout Australia. It infects carrots at any stage and is most severe where carrots are grown all-year-round.

The leaves of infected plants develop a mild feathery mottle. The most severe symptoms are stunted and distorted roots, which occur when young plants are infected. CarVY is difficult to control on farms where carrots are planted sequentially all year because infected volunteer carrots and adjacent crops provide inoculum sources for new crops. CarVY is spread non-persistently by aphids, i.e. the aphids acquire the virus rapidly when feeding on infected leaves, but rapidly lose it when feeding on healthy plants.

If slightly infected carrots are harvested the rot continues to develop during storage and can spread to adjacent carrots.

These carrots then develop a soft, watery, slimy rot at the crown. A white cottony fungus develops from this rot; it often contains small black sclerotines that look like mouse droppings.

Cavity spot caused by Pythium sulcatum is most severe in summer and autumn harvested crops, while cavity spot caused by Pythium violae is most severe in winter harvested crops.

Control
• Sample soil to assess nematode numbers before seeding to determine whether a nematicide needs to be applied
• Preplant fumigation with 1,3-dichloropropene, 1,3-dichloropropene + chloropicrin, fenamiphos or metham sodium. Minimise use due to the potential for enhanced microbial degradation

Sclerotinia is a common and widespread soil borne pathogen, with a host range that includes both commercial crops and weeds. Black, hard sclerotines form on infected plant debris and these persist in the soil for up to five years.

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Signs of root knot nematode.
Disease cycle

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When conditions are suitable, the eggs hatch and juvenile nematodes penetrate root tips. Female nematodes mature within the roots and a gall develops around the nematode. These females lay eggs into a gelatinous matrix on the root surface. The eggs either hatch immediately or become dormant.

Control

• Preplant fumigation with 1,3-dichloropropene, 1,3-dichloropropene + chloropicrin, fenamiphos or metham sodium. If these chemicals are used frequently they may become ineffective because of enhanced microbial degradation

• Soil sampling to assess nematode numbers before seeding is not always a reliable indicator of whether a nematicide needs to be applied

• Preplant fumigation with 1,3-dichloropropene, 1,3-dichloropropene + chloropicrin, fenamiphos or metham sodium. Minimise use due to the potential for enhanced microbial degradation

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Disease cycle

CarVY is difficult to control on farms where carrots are planted sequentially all year because infected volunteer carrots and adjacent crops provide inoculum sources for new crops.

CarVY is spread non-persistently by aphids, i.e. the aphids acquire the virus rapidly when feeding on infected leaves, but rapidly lose it when feeding on healthy plants.
CarVY only infects carrots and closely related plants e.g. parsnip, coriander and chervil.

Control
- Avoid planting sequential side-by-side crops and separate crops by planting non-hosts, such as brassicas, between them
- Remove volunteer carrots and harvested carrot crops promptly
- Use a fallow period to break the infection cycle

Common post-harvest diseases

Bacterial soft rot
This is a soft, slimy, orange rot that can occur on any part of the carrot, although it is often associated with the eyes. The rot can penetrate deeply. It does not usually smell unpleasant unless there is secondary infection caused by other bacteria.

Soft rot is caused by either Erwinia carotovora subspecies carotovora or E. carotovora subspecies atroseptica.

Disease cycle
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Soft rot bacteria enter carrots through wounds, but they can also be forced into the eyes if warm carrots are dumped into deep cold water tanks. Once the bacteria are in the carrot root they cannot be killed by sanitisers such as chlorine.

Control
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Common leaf diseases

Leaf blight
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Disease cycle
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Control
- Disease control is difficult on farms where carrots are planted sequentially
- Some carrot varieties are more tolerant of leaf blight than others

Sclerotinia or cottony rot
Sclerotinia is a common fungal disease that affects many vegetables. It affects carrots both in the field and in storage and is caused by the fungus Sclerotinia sclerotiorum.

In the field, the first symptoms are water-soaked spots at the base of the petioles and at the crown. The outer leaves redder and wilt. There is often a white, cottony fungal growth in the surrounding soil. Eventually the top of the carrot becomes soft and slimy.

Management of Carrot Diseases

Black root rot
Two fungi cause black root rot: Thielaviopsis basicola (Chalara elegans) and Chalara thielavioides. Roots affected by black root rot have large black superficial patches on them. These patches are often circular and sometimes surrounded by a matt white halo.

Disease cycle
The fungi that cause black root rot have a wide host range and occur in soil. Carrots are likely to be contaminated with these fungi in the field before harvest.

After harvest the fungi infect carrots through wounds or abrasions. They develop rapidly on carrots stored at 25°C and in high humidity.

Control
- Losses caused by black root rot can be minimised by rapid cooling of harvested carrots and storing them at 0°C
- Minimise mechanical damage during harvesting and in the packing shed

Sclerotinia rot or cottony rot
See Sclerotinia above.

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The Bottom Line
- Fungal, nematode, viral and bacterial diseases can affect carrots at any stage of the crop, from seedlings to cold storage
- Root and post-harvest diseases affect marketability of carrots, while foliar diseases affect the yield of crops
- For export, growers should ensure that chemical use complies with the maximum residue limits of the importing country