

Carrot & Parsnip





Every year a significant proportion of the UK carrot and parsnip crops would be lost to insect pests and diseases if growers didn't monitor their crops and employ effective crop protection strategies.

This Crop Walkers' Guide is aimed at assisting growers, agronomists and their staff in the vital task of monitoring crops. It is designed for use in the field to help with accurate identification of pests, diseases, nutrient deficiencies and disorders within a crop.

Images of key stages in the life cycles of pests and diseases are included along with short easy-to-read comments to help with identification.

As it is impossible to show every symptom of every pest or disease, growers are advised to familiarise themselves with a range of symptoms that can be expressed and be aware of new problems that may occasionally arise.

This guide does not offer any advice on the measures available for controlling these pests or diseases as both chemical active ingredients and their approvals frequently change. However, having identified a particular pest or disease in their crop, growers can refer to other AHDB Horticulture publications which contain information on various control measures.

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CROP WALKERS' GUIDE

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Carrot & Parsnip

SECTION 1 Invertebrate Pests





- Adult fly (6–8mm) dark and shiny with reddish-brown head, yellowish legs and iridescent wings.
- Adults monitored using yellow sticky traps and timing of generations predicted using a weather-based forecast.
- 2–3 generations per year.
1st generation flies emerge late April–June, 2nd generation July–September, 3rd generation September–November.
- Seedlings can be stunted or killed by larvae feeding on the roots. Larvae tunnel into larger roots forming mines.

Caterpillars

eg Silver Y Moth (*Autographa gamma*)



- Foliage may be damaged by feeding caterpillars, from several species of moth or butterfly – typically from May–September.
- Caterpillars may be difficult to locate.
- Frass (droppings) and larvae can contaminate fresh produce.
- Pheromone traps are available to monitor Silver Y Moth, this is a migrant species that overwinters abroad, arriving in spring.



- Turnip moth adults emerge from late April–July and females lay eggs on weeds, crops and debris in the soil.
- Pheromone traps are available to monitor numbers of adult male turnip moths. Risk of damage by turnip moth can be predicted using a weather-based forecast.
- Newly hatched caterpillars feed on foliage and then descend to feed on, or just below, the soil surface, damaging carrot roots. Heavy rain/irrigation soon after egg hatch kills young caterpillars.
- Overwinter as larvae in the soil and form pupae in spring.

Spider mite

Tetranychus urticae



- Characteristic bronzing or reddening of leaves, can also cause stippling of leaves. More common on parsnip.
- Check for fine webbing, primarily on the underside of foliage.
- Weakened plants lead to reduced crop yield.
- Favoured by warm, dry weather.

Nematodes – Free-living

Various species



- Nematodes live in the soil and attack plant roots.
- Most species cannot be seen with the naked eye and can only be identified by a trained nematologist using a microscope.
- Populations are likely to be highest on light sandy soils.
- Damage may manifest itself as plant stunting, premature wilting and root fanging.
- Nematodes may also transmit viruses.

Tarnished plant bug and capsids

Lygus rugulipennis and *Lygocoris pabulinus*



- Adult tarnished plant bugs (5–6mm) are brownish-green with dark markings. Feeding by both adults and nymphs affects plant growth, seriously reducing marketability.
- Tarnished plant bugs overwinter as adults and start feeding March–April. Eggs laid in May, adults emerge July. 2nd generation August–September. Adults are very active and fly when disturbed.
- Common green capsids overwinter as eggs on woody host plants, hatch April–May, migrate to herbaceous plants and develop to adults June–July. 2nd generation August–September.
- Pheromone traps are available for monitoring adult tarnished plant bugs. Blue rather than yellow sticky traps should be used for monitoring.



- Transmits carrot yellow leaf virus (CYLV), parsnip yellow fleck virus (PYFV) and carrot motley dwarf (CMD).
- Winged forms usually migrate to new crops in May–June. The timing of migration depends on weather conditions.
- Information on captures of winged forms in suction traps is available from the Rothamsted Insect Survey and the AHDB Horticulture Pest Bulletin. A day-degree forecast to predict the start of the migration is also available.

Willow-carrot aphid – continued

Cavariella aegopodii



- Wingless forms are green or yellowish-green while winged forms are darker and have black 1.2mm–6mm long patches on their back.
- The colour and small size of wingless forms make them hard to find on the foliage.
- Direct feeding by the aphid damages carrot and parsnip plants. Severe infestations can kill seedlings.

SECTION 2 Diseases on Carrots





- Initial symptoms are small, yellow, angular leaf spots.
- These expand under warm wet conditions to form irregular brown, often water-soaked, lesions with a yellow halo, commonly on leaf margins or tips. Brown lesions may also extend along petioles.
- The disease is transmitted via seed then spread via rain splash or irrigation.
- Optimum temperatures for disease development are 25–30°C.
- The disease may survive over winter on carrot debris.
- Avoid confusion with *Alternaria* or *Cercospora* leaf spots.

Bacterial soft rots



eg *Pectobacterium carotovora*, *Pseudomonas* spp.



- Wet slimy rots may occur on developing roots in the field, especially after warm, wet weather.
- Foliage often turns yellow and wilts.
- Can also occur as secondary rots following diseases such as cavity spot or damage to the carrot.
- Rapid development during packing or transport or if stored at high ambient temperature.



- Common in the UK; can be seed-borne and may cause seedling death.
- On older leaves, dark brown angular lesions, sometimes with a yellow halo, affect individual leaflets.
- Development is favoured by above-average rainfall.
- Severe symptoms resemble natural senescence, with general yellowing of foliage then shrivelling and death of leaves, giving a 'blighted' appearance.
- May be confused with Cercospora or bacterial leaf blight.

Black mould or black root rot



Thielaviopsis basicola, *Chalaropsis thielavioides*



- Light to dark grey fungal growth develops on the surface of the carrot root.
- The fungal growth becomes black and irregular in outline.
- Root tissue below remains firm unless there is secondary colonisation by bacteria.
- Causes post-harvest problems when washed roots are not stored properly.

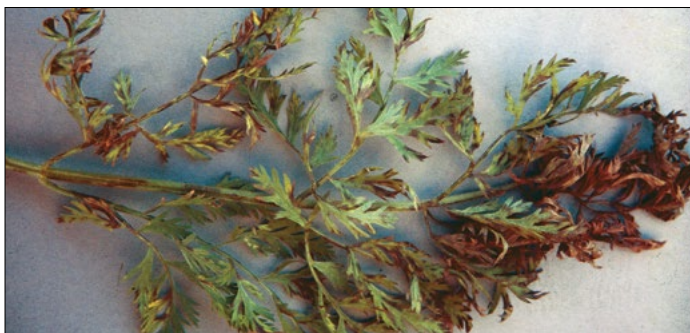


- Foliar lesions are similar to those of *Alternaria* leaf blight. Lesions usually begin at the base of the petiole then spread to the crown.
- In the field, crown symptoms comprise black lesions that extend below soil level.
- Infection is favoured by high soil temperatures and moist soil.
- During storage dry, black, sunken lesions with sharply defined margins develop.
- Root-to-root spread can occur during extended storage.
- Infected seed is a source of inoculum. Spores may also survive in soil or crop debris.

Cercospora leaf blight



Cercospora carotae



- Brown elliptical lesions with a paler centre often develop on petioles (in contrast to *Alternaria* leaf spot).
- Infected seed and crop debris, and wild carrot relatives are sources of inoculum.
- Early symptoms are dark angular flecks on leaflets (1–3mm diameter). Young foliage is most susceptible.
- Later symptoms are grey-brown circular spots (3–5mm diameter), sometimes with darker margins and yellow haloes.
- Causes premature leaf death and weakens the petioles needed for effective top-lifting. This reduces the plants capacity for photosynthesis, so reduces yield.



- Storage disease, uncommon in the UK.
- Initially small white then brown sclerotia are produced on the surface of rotted roots.
- Infection occurs in the field but symptoms develop in storage, particularly after several weeks of refrigeration.
- Sparse white mycelium develop from dark brown lesions on the root surface. Small depressions enlarge into progressively deeper craters.
- Mycelium spreads between roots in storage and can persist in wooden storage bins, from which new infections are initiated.

Fusarium rot



Fusarium spp.



- Common soil fungi – often opportunist secondary colonisers of plant tissues.
- Dry rot lesions (dark brown or black) develop on crown or roots. The lesions may be slightly sunken or cracked. Avoid confusion with *Alternaria* black rot.
- Thought to be favoured by damage or drought periods.
- Also commonly found where parsnip yellow fleck virus has killed the growing point of plants.



- Common on carrot roots following damage or dehydration in store.
- White mycelium with masses of grey spores and black survival structures (sclerotia) develop on the rotted plant tissue.
- Rotted roots appear as 'nests' in stored crops after spread by root-to-root contact.
- Survives as sclerotia in the soil, on plant debris and via airborne spores.

Liquorice rot



Mycocentrospora acerina



- Foliar symptoms rare but similar to *Alternaria* leaf blight.
- A storage disease but can colonise cavity spot or other lesions in the field. Development on stored roots can take several months. Soil-borne spores survive for up to two years.
- Lesions develop initially at the crown or root tips, then on other parts of the root.
- Lesions are watery, sunken, dark brown or black and penetrate deep into the root tissue.



- Symptoms start as sparse white fungal colonies usually on older leaves and petioles.
- The white fungal growth develops first on the upper leaf surface.
- It then spreads to younger leaves, resulting in extensive colonisation of the foliage.
- Can cause yellowing and severe infection causes leaf twisting, deformity, early foliar senescence and leaf loss.
- Common in most years, especially in hot dry summers, found from July onwards.
- The fungus can survive on overwintering carrots.



- Early infection of seedlings causes wilting and foliar yellowing, with rusty brown marks on the root and root hairs.
- There may be constriction and darkening of the stem base and crown.
- Affected mature roots may be fanged.
- As roots mature, *Rhizoctonia* spp. can produce a superficial skin blemish that can be confused with boron deficiency.

Streptomyces species including *S. scabies*



- No foliar symptoms.
- Corky lesions or raised warty growths (sometimes brown) on the root surface, elongated transversely.
- Sunken lesions are sometimes produced.
- Severe infections can cause numerous raised lesions lower down the root.
- Most serious in dry years on light alkaline soils.



- Symptoms on foliage initially appear as water-soaked, dark olive-green lesions, with collapsed tissue. Infected tissue then becomes covered in white cotton wool-like mycelium, subsequently black sclerotia (resting bodies) may develop. Plants may collapse and die.
- Root infection may be found in the field or develop post-harvest. The infection spreads from the foliage to the roots via the crown.

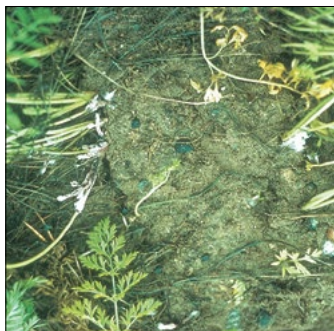


- Symptoms of root infection are water soaked lesions or soft rot on the crown or side of the root, commonly associated with white mycelium. Sometimes black sclerotia may be attached to the root surface.
- Disease favoured by wet weather and temperatures between 10–20°C in the field. It can survive in the soil as sclerotia for at least five years.

Violet root rot



Helicobasidium brebissonii = *H. purpureum*



- Foliar wilting appears in patches in the autumn.
- Violet spots develop, as well as purple fungal strands (mycelium) between the spots.
- Purple mycelium often visible on crown and soil surface.
- Resting bodies (sclerotia) form around lateral roots and stick soil to roots.
- Root symptoms are usually superficial but secondary organisms can cause extensive damage.



Cavity spot

Pythium violae and *Pythium sulcatum*



- Water-soaked, sunken elliptical lesions (5–10mm) on the root surface, beneath which a cavity can be found. Usually seen in crops from 12 weeks after sowing.
- As lesions merge, large areas of the root may be covered with a shallow soft rot. The cavities become raised greyish areas after steam peeling of canning carrots.
- Secondary fungi, including other *Pythium* species, can cause extensive rotting.
- Infection is favoured by high rainfall and poor drainage.
- Disease can survive in soil for at least three years.
- Similar lesions have been associated with *Cylindrocarpon* sp.

Phytophthora rot



Phytophthora species



- Occasional on UK crops; disease risk is increased with poor drainage and waterlogged soils.
- Lesions develop as brown water-soaked bands, rubbery in consistency, around the girth of affected roots.
- Infection occurs in the field and severe soft-rotting symptoms can develop if affected crops are strawed down.



- First symptoms are yellowing of foliage followed by senescence of foliage in patches of the field.
- Transmitted by aphids including the willow-carrot aphid and parsnip aphid.
- This virus is strongly associated with internal necrosis of carrots (see section 2.20).



- First symptoms in the field are patches of yellow or senescent foliage.
- Cutting the crown reveals small brown to black spots around the central core. These become progressively larger, encircling the core.
- Internal necrosis is linked to the carrot yellow leaf virus (CYLV).



Carrot motley dwarf (CMD)

Carrot red leaf virus (CtRLV) and carrot mottle virus (CMoV)



- Complex of carrot red leaf virus (CtRLV), carrot mottle virus (CMoV) and a third virus, carrot red leaf associated viral RNA (CtRLaVRNA). The viruses are transmitted by the willow-carrot aphid.
- The viruses need CtRLV to be present for transmission by aphids but may be found infecting plants independently of CtRLV.
- CtRLV alone is thought to cause mild symptoms, with multiple infections in plants causing a more severe disease.
- Symptoms are stunting, reddening of the outer leaves and a fine chlorotic mottle on the inner leaves typically seen as patches of affected plants within or at the edge of the crop.



- Virus spread by aphids; requires a 'helper' virus (Anthriscus yellow virus) for successful transmission, there is no direct carrot-to-carrot transmission.
- Early infection causes stunting and blackening of the growing point leading to death of seedlings and young plants.
- Affected plants are randomly scattered through the field and infection over the years is sporadic.
- Affected roots may assume a 'cigar' shape and develop brown/black patches within the tissue.
- Later in the season, larger plants may have mottled foliage with yellow flecks.

Acrothecium carotae = *Rhoxocercosporidium carotae*



- Causes severe problems in Scandinavia and the Netherlands but has not been reported in the UK.
- Foliar symptoms are rare; root symptoms are usually absent at harvest but develop later in cold storage.
- Roots have multiple slightly sunken, dark brown/black lesions that extend only a few millimetres into root tissue.



- Newly emerging disease on carrots in the UK.
- Symptoms of infection include curling, yellowing and reddening of leaves.
- Adventitious roots may develop.
- Disease infects a wide range of host plants and is transmitted by insects. The insect responsible for transmission in the UK is unknown.

SECTION 3 Diseases on Parsnips





- Similar symptoms to parsnip canker.
- Dark brown, black or purple-black lesions around the crown, upper root and bases of lateral roots.
- Lesions can extend deep into the root tissue.
- Well-developed lesions become coarse and secondary infections often develop.
- Late-harvested crops may be severely affected.
- Laboratory tests required to identify the causal organisms.

Downy mildew



Plasmopara species



- Rarely severe in the UK.
- Likely to be *P. crustosa* in Apiaceae.
- Foliar symptoms include brown spots 1–2mm in diameter with yellow haloes. Spots merge to give large necrotic areas.
- Angular leaf lesions, initially yellow then brown; lesion centres may fall out.
- White spore production occurs on the leaf underside.
- Can cause yellowing and early leaf loss.

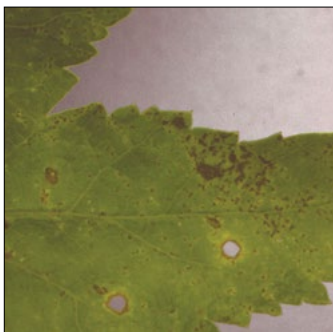


- Capable of complete crop loss.
- Orange/brown lesions similar in appearance to those of carrot cavity spot (see section 2.17).
- Occurs sporadically; adjacent fields may be affected.
- Causes are still unknown but parsnip blemish symptoms are currently under investigation.

Itersonilia pastinacae and *Itersonilia perplexans*



- Dark brown or black lesions around the crown, upper root and bases of lateral roots.
- Lesions usually superficial, extending only a few millimetres into the tissue.
- Larger roots with exposed crowns are more prone to infection.
- Well-developed lesions become coarse and secondary infections often develop.
- Cankers are associated with extended periods of rainfall. Optimum temperatures around 20°C. The pathogen is suspected to be seed-borne.
- Late-harvested crops may be severely affected.



- Can be confused with *Ramularia* but spots are smaller.
- Brown leaf spots (1–2mm) increase in number and merge to give grey/brown leaf tissue.
- White spore tendrils form characteristic white patches on leaf surfaces.
- Occurs from July and spreads rapidly in September and October to cause extensive leaf death and defoliation.
- Inoculum spread by splashing water and direct contact between leaves.
- Survives on infected debris and weed hosts.

Phoma canker



Phoma complanata



- Occasional foliar symptoms are circular brown leaf spots, with yellow haloes; black fungal structures may be visible within lesions.
- Major cause of large dark brown to black cankers on crowns and taproots.
- Affected roots are reported to have a sweet cinnamon odour.
- Careful root washing often reveals small black to brown fruiting bodies on lesion surface.
- A seed-borne pathogen; root infection can occur when spores are washed down from infected foliage, which can reduce seedling establishment.



- Symptoms start as sparse white fungal colonies usually on older leaves and petioles.
- The white fungal growth develops first on the upper leaf surface.
- It then spreads to younger leaves, resulting in extensive colonisation of the foliage.
- Can cause yellowing and severe infection causes leaf twisting, deformity, early foliar senescence and leaf loss.
- Common in most years, especially in hot dry summers, from July onwards.
- Early attacks cause significant yield losses.

Ramularia leaf spot



Ramularia pastinacae



- Common but minor problem.
- Small (3–7mm) brown leaf spots with darker margins and yellow haloes.
- Centre of spots may fall out and give a 'shot-hole' appearance.
- White spore production may be visible on the leaf underside.
- Several similar diseases requiring careful diagnosis.
- Favoured by warm, wet conditions.



- Occurs in most soils.
- Causes a damping-off of seedlings.
- Course black scarring, mainly around the crown of the root.
- May show sclerotia (resting bodies) that may resist normal root washing procedures.
- Also occurs on carrots (see section 2.12).

Violet root rot



Helicobasidium brebissonii = *H. purpureum*



- Purple superficial lesions and fungal strands visible on the root surface and also on soil surfaces next to such plants.
- Less common on parsnips than carrots (see section 2.16).
- Wide host range.
- Requires early lifting if problems are detected.
- Areas of severely affected plants may appear in autumn when foliage turns yellow and wilts.
- Severely affected roots usually show soft rot symptoms due to infection by secondary decay organisms.



Cavity spot

Pythium spp.



- Symptoms are sunken elliptical lesions on the root surface, beneath which there is a cavity.
- Less common in parsnip than carrot.
- Likely caused by the same *Pythium* species as in carrots but further work is needed to confirm this.

Parsnip yellow fleck virus



(PYFV)



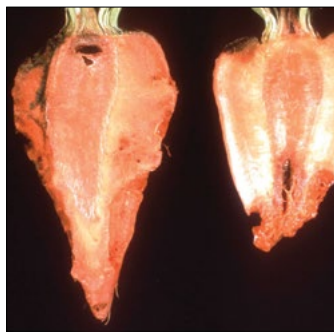
- Virus spread by willow-carrot aphids; requires a 'helper' virus (Anthriscus yellow virus) for successful transmission. There is no direct parsnip-to-parsnip transmission.
- Affected plants are randomly scattered through the field.
- First symptoms are bold yellow veins and vein netting on leaves.
- Foliage later shows yellow flecking and a yellow-green mosaic.

SECTION 4 Nutrient Deficiencies



Boron

(B)



- Leaflets reduced in size and die back. Older leaves curl backwards, giving prostrate habit. Growing point may die. Corky splits may occur on leaf petioles.
- In parsnips, new leaves are glossy, old ones pale, sometimes with a red margin.
- Roots may split and have a dark central core.
- Occurs on light soils when it is above pH 6.5–7.0.
- Boron is soluble and readily leached from sandy soils.
- Common following a wet winter and spring, and particularly in dry summers.

Calcium

(Ca)



- Necrosis of growing point and new leaves.
- Sudden appearance of short lengths of water-soaked area on petioles.
- Collapse and shrivelling of the upper leaf while green.
- On acid soils following leaching rains, on soils with very high potassium levels or on very dry soils. Associated with rapid growth in hot weather.
- Frost damage and parsnip yellow fleck virus (PYFV) can give similar symptoms.

- Visual deficiency rare but 'symptomless' deficiency may be more widespread.
- Youngest leaves dark green and fail to unfold. Older leaves wilted.
- Occurs on peats and occasionally loamy peats, mainly in the Fens.
- Deficiency also occurs on leached sandy soils, particularly reclaimed heathland.

Iron

(Fe)



- Very rare.
- Soil and plant analysis results are difficult to interpret due to the presence of other forms of iron within the tissue.
- Occurs on soil containing free calcium carbonate, particularly if poorly drained.



- On acidic soils, on soil with very high extractable K/Mg ratios or on very sandy soils subject to leaching after heavy rainfall.
- Easily confused with nitrogen deficiency and carrot motley dwarf virus (CMD).
- Magnesium deficiency can occur as a result of restricted root growth, commonly due to soil compaction or wetness. Also frequently associated with low spring temperatures.
- Old leaves become yellow. Red tint on leaf edges and backwards curling of leaflets may occur.

Manganese

(Mn)



- Patchy distribution of bright yellow areas in fields.
- Parsnips: striking interveinal chlorosis.
- Symptoms may disappear following rain.
- Frequently induced by over-liming.
- Organic and peaty soils with pH 6+. Sands and loamy sands pH 6.5+.
- Differs from magnesium and potassium in that the chlorotic areas are light green rather than yellow and whole plant being uniformly affected.



- Carrot foliage 'frail' due to fineness of leaflets. Older leaves become yellow, sometimes with red tints and shrivel.
- Parsnips: weak, spindly growth and small roots are noticeable.
- Plants grow slowly and can appear stunted. Common on sandy soils where leaching or waterlogging has occurred.
- Can be caused by cold weather, drought and root damage, eg free-living nematodes and carrot fly.

Phosphorus

(P)



- Rarely found in the UK.
- Symptoms include purpling of older leaves.
- Reduced growth rate, particularly soon after emergence.
- On acidic soils, calcareous soils or peats.
- Temporary deficiencies on cold, wet soil.
- Similar to carrot fly foliar symptoms so check taproots for mining.
- Similar to carrot motley dwarf virus (CMD), but younger leaves are yellow.



- Older leaves scorch and collapse beginning at leaf margins.
- Entire petioles acquire water-soaked appearance, dry up and collapse.
- On sandy soils with excessive leaching if potassium has not been applied.
- Parsnips: marginal and interveinal chlorosis of older leaves leading to scorch; margins of scorched leaflets roll upwards.
- Similar to chloride toxicity and wind damage.

Sulphur

(S)



- New leaves may appear frail.
- Parsnip leaves also stiff and slightly concave.
- Sulphur deficiency is rare but likely to occur due to decline in sulphur dioxide emissions from industry sources and lower atmospheric sulphur deposition.

- Extremely rare but, if seen, leaves become yellow.
- Associated with sandy soils that are high pH and phosphate status.

SECTION 5 Physiological Disorders





- Splitting, cracking and transverse root breakage during harvest can be common.
- Lifting too early in the day, when temperatures are still low, increases frequency.
- Audit crop lifting and handling systems to reduce damage.

Soil compaction



- Often caused by mechanical damage to soil structure during wet weather.
- Soils high in silt or clay may also compact upon drying.
- Check for angular roots with many flat surfaces.



- Foliage yellowing over time.
- Plant stress results in poor foliage and root growth.
- Secondary rots often result.
- Waterlogging can result in the leaching of nutrients from the soil and in root death as a result of oxygen starvation.
- Plants at the very least will appear stunted and deficient and at worse will die off completely.
- Long periods of waterlogging can lead to a deterioration of the soil structure.



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Section 2 – Diseases on Carrots

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