

Diseases of carrots

Field Vegetables

Powery mildew (*Erysiphe heraclei*)



- Symptoms start as sparse white fungal colonies usually on older leaves and petioles.
- The white fungal growth spreads to younger leaves resulting in extensive colonisation of the blight.
- Severe infection causes leaf twisting, deformity and early foliar senescence.
- Common in most years, especially in hot dry summers, if not controlled by fungicides.

Cercospora leaf blight (*Cercospora carotae*)



- Early symptoms are dark angular flecks on leaflets (1-3mm diameter).
- Later symptoms are grey-brown circular spots (3-5mm diameter) sometimes with darker margins and yellow haloes.
- Brown elliptical lesions with a paler centre often develop on petioles (in contrast to Alternaria leaf spot).
- Causes premature leaf death and weakens the petioles needed for effective top-tilting.
- Infected seed is a source of inoculum.

Sclerotinia (*Sclerotinia sclerotiorum*)



- Tufts of white 'cotton wool' mycelium containing black sclerotia (resting bodies) develop in dense blight. Affected foliage becomes slimy, collapses and forms a dense mat on the soil surface.
- Root infection may be found in the field or develop post-harvest.
- Symptoms are a brown water-soaked lesion or soft rot on the crown or side of root, sometimes with black sclerotia attached to the root surface.

Fusarium rot (*Fusarium* spp.)



- Common soil fungi – often opportunistic 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 Purslip yellow fleck virus has killed the growing point of plants.

Cavity spot (*Pythium violae* and *Pythium sulcatum*)



- Water-soaked, sunken elliptical lesions (5-10 mm) on the root surface, beneath which can be found a cavity. Usually seen in crops from 12 weeks after sowing.
- Secondary fungi including other *Pythium* species can cause extensive rotting.
- 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.
- Infection is favoured by high rainfall and poor drainage.
- Similar lesions have been associated with *Cylindrocarpum* sp.

Carrot Motley Dwarf (CMD)



- Complex of carrot root and leaf virus (CRLV) and carrot motley virus (CMV) transmitted by yellow-carrot aphid. Both viruses are aphid transmitted but while CRLV may be transmitted alone, CMV is only transmitted when both viruses are present in the same plant.
- Symptoms are stunting, reddening of the older 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.

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.

Bacterial soft rots (eg *Pectobacterium carotovora*, *Pseudomonas* spp.)



- Wet silty roots may occur on developing roots in the field, especially after warm wet weather.
- Can also occur as secondary rots following cavity spot and other diseases.
- Rapid development during packing or transport or if stored at high ambient temperature.

Liquorice rot (*Mycosclerotinia acerina*)



- Foliar symptoms are 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.

Grey mould storage rot (*Botrytis cinerea*)



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

Crater rot (*Rhizoctonia carotae*)



- Storage disease, uncommon in the UK.
- Sparse white mycelium over root surface with small depressions, which enlarge into progressively deeper craters.
- 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.
- Mycelium spreads between roots in storage and can spread to roots in storage bins, from which new infections are initiated.

Invertebrate pests of carrots & parsnips

Field Vegetables

Carrot fly (<i>Psila rosae</i>)	Cutworm (<i>Agrotis segetum</i>)	Willow-carrot aphid (<i>Cavariella aegopodii</i>)	Tarnished plant bug & capsids (<i>Lygus rugulipennis</i> & <i>Lygocoris pabulinus</i>)	Spider mite (<i>Tetranychus urticae</i>)
				
				
Plant symptom	Plant symptom	Plant symptom	Plant symptom	Plant symptom
<ul style="list-style-type: none"> • Adult fly (6-8 mm) dark and shiny with reddish-brown head, yellowish legs and iridescent wings. • Adults monitored using orange sticky traps and timing of generations predicted using weather-based forecast. • 2-3 generations per year. 1st generation flies emerge late Apr-Jun, 2nd generation Jul-Sep, 3rd generation Sep-Nov. • Seedlings can be stunted or killed by larvae feeding on the roots. Larvae tunnel into larger roots forming mines. 	<ul style="list-style-type: none"> • Turnip moth adults emerge from late Apr-Jun and females lay eggs on several species of weed and crop. • 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 at, 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. 	<ul style="list-style-type: none"> • Transmits potato yellow fleck & carrot motley dwarf virus. • Wingless forms are green or yellowish-green whilst winged forms are darker and have black patches on their back. • 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. A day-degree forecast to predict the start of the migration is also available. • The colour and small size of wingless forms make them hard to find on the foliage. 	<ul style="list-style-type: none"> • Adult tarnished plant bugs (5-6mm) are brownish green with dark markings. Feeding by both adults and nymphs affects plant growth. • Tarnished bugs overwinter as adults and start feeding Mar-Apr. Eggs laid in May, adults emerge Jul. 2nd generation Aug-Sep. Adults very active and fly when disturbed. • Common green capsids overwinter as eggs on woody host plants, hatch Apr-May, migrate to herbaceous plants and develop to adults Jun-Jul. 2nd generation Aug-Sep. • Monitored by tapping plants over a white tray or card. 	<ul style="list-style-type: none"> • Characteristic bronzing or reddening of leaves, more common on parsnip. • Check for fine webbing on foliage. • More likely to occur when conditions are warm. • Weakened plants lead to reduced crop yield.
Description	Description	Description	Description	Description

Diseases of parsnips

Field Vegetables

Ramularia leaf spot

(*Ramularia pestinacae*)



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

Phloeospora leaf spot

(*Phloeospora heraclei*)



- 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 give extensive leaf death and defoliation.

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.
- 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.

Parsnip canker

(*Verticillium pastinacae*)



- 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.
- Late-harvested crops may be severely affected.

Black cankers

(*Mycocentrospora acerina* and other pathogens)



- 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.

Rhizoctonia

(*Rhizoctonia solani*)



- Occurs in most soils.
- May show sclerotia (resting bodies) that may resist normal root washing procedures.
- Causes coarse black scarring mainly around the crown of the root.

Violet root rot

(*Helicobasidium brebissonii* = *H. purpureum*)



- Purple superficial lesions and fungal strands visible on the root surface.
- Less common on parsnips than carrots.
- Wide host range.
- Requires early lifting if problems are detected.

Parsnip Yellow Fleck Virus

(PYFV)



- Virus spread by aphids; requires a 'helper' virus for successful 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.

Nutrient deficiencies of carrots & parsnips

Field Vegetables

Nitrogen (N)



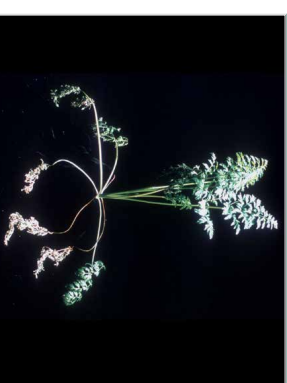
- Carrot foliage 'fall' due to fineness of leaflets.
- Parsnips weak, spindly growth and small roots are noticeable.
- Plants grow slowly and can appear stunted. Common on sandy soils where leaching or waterlogging has occurred.
- Can be caused by cold weather, drought and root damage, eg free-living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

Phosphorus (P)



- Rarely found.
- Reduced growth rate, particularly soon after emergence.
- On acid soils, calcareous soils or peats.
- Temporary deficiencies on cold, wet soil.
- Similar to carrot fly so check taproots for milking.
- Similar to carrot mottle/dwarf virus but younger leaves are yellow.

Potassium (K)



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

Magnesium (Mg)



- On acid soils, on soil with very high extractable potassium/magnesium ratios or on very sandy soils subject to leaching after heavy rainfall.
- Mg deficiency can occur as a result of restricted root growth, commonly due to soil compaction or wetness. Also frequently associated with low spring temperatures.
- Easily confused with N deficiency and carrot mottle/dwarf virus.

Sulphur (S)



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

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 neck virus can give similar symptoms.

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 Mg and K in that the chlorotic areas are light green rather than yellow and whole plant being uniformly affected.

Boron (B)



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

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.

Physiological disorders of carrots & parsnips

Field Vegetables

Waterlogging



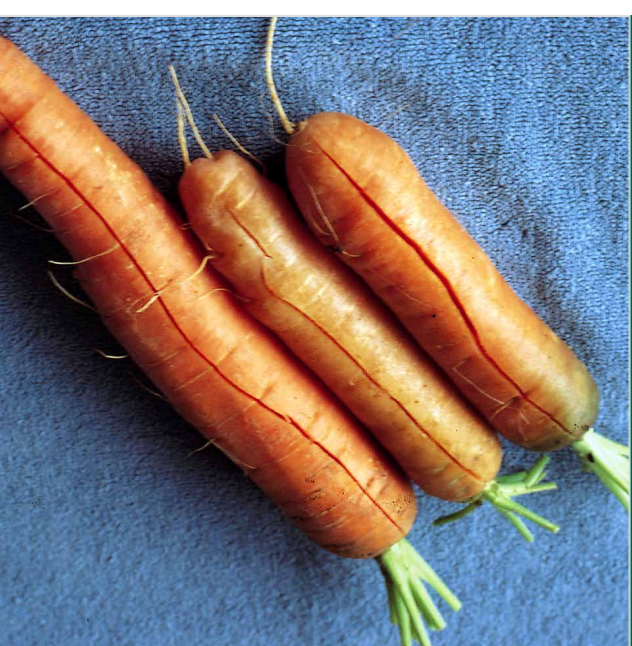
- Plant stress results in poor foliage and root growth.
- Often no initial colour change to foliage.
- Secondary rots often result.

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.

Mechanical damage



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