14 Parsnip

BACTERIAL DISEASES

▶ 14.1 Scab *Fig. 6.4*

Streptomyces scabies (Thaxt.) Waksman & Henrici (syn. *Actinomyces scabies* (Thaxt.) Güssow)

Scab is a minor disease of parsnip in Canada. Symptoms on parsnip roots are similar to those seen on carrot (see Carrot, 6.4). Overall growth and yield are not adversely affected by this disease, but quality and marketability may be reduced. For more information on the causal agent, disease cycle and management of scab, see Potato, 16.5.

(Original by R.J. Howard and R.F. Cerkauskas)

FUNGAL DISEASES

▶ 14.2 Itersonilia canker *Figs.14.2a-c*

Itersonilia perplexans Derx

Itersonilia canker has been reported on parsnip in Canada and the United States. A similar disease caused by *Itersonilia pastinacae* Channon has been reported in Great Britain. *Itersonilia pastinacae* differs from *I. perplexans* by its more abundant formation of chlamydospores and specificity to parsnip. However, some strains pathogenic to parsnip may not form chlamydospores and some strains of *I. perplexans* may have chlamydospores. The phenetic separation of the two is gradual. *Itersonilia perplexans* is widespread as a leaf surface saprophyte and is pathogenic on parsnip, chrysanthemum, sunflower, several other cultivated plants, and some weeds.

Symptoms Roots, leaves, petioles, inflorescences, and seeds may be affected. In roots, cankers may form at the bases of small lateral roots, although the crown and shoulder are generally the major areas affected. These cankers are reddish-brown with a roughened surface, later often turning a darker color *(14.2a).* Cankers do not extend deeply into roots, except in advanced cases. Secondary invasion by other organisms may follow and cause a decay of the whole root system. On leaves, small, 1 mm diameter, brown or orange-brown necrotic lesions are often surrounded by pale green halos *(14.2b).* Lesions may coalesce to form large necrotic areas. Petiole bases may have extensive gray to black lesions, while the inflorescence may be rotted completely.

Causal agent *Itersonilia* is characterized by dikaryotic mycelium with clamp connections at most septa and the production and discharge of binu- cleate, kidney-shaped ballistospores from upright, narrow sterigmata *(14.2c).* The hyphae are thin to slightly thick-walled, usually straight, septate at 50- to 120-µm intervals, and regularly branched. The hyphal forms develop a yeast phase when growing submerged in water. Ballistospores germinate either to form a mycelium or a secondary ballistospore. Ballistospores are 10 to 16 by 6 to 10.5 µm. Isolates vary in production of chlamydospores, which are 13 to 20 by 10 to 13.5 µm, nearly hyaline to deep golden-brown, thin to thick-walled, and single or in terminal clusters on short lateral branches of the mycelium. Appressoria form from germinating ballistospores and on solid surfaces are stalked and elongate and ovoid or semicircular in outline. Yeast cells occur in strains of *I. perplexans* and *I. pastinacae* and may be ellipsoidal, fusiform, cylindrical, allantoid or lunate. The cells are thin or slightly thick-walled, hyaline and vacuolated. Buds are sessile, borne on short denticles or on distinct sterigmata. Ballistospores are infrequently produced by yeast strains, but are more common in reverted hyphal forms.

To isolate *Itersonilia* from infected parsnip tissue, small pieces should first be dipped in 0.6% sodium hypochlorite to remove surface contaminants, then attached with vaseline to the lid of a petri dish over malt- extract agar. After incubation at 20°C for five to seven days, the ballistospores fall to the medium and initiate colonies. Colonies on most media are slow-growing (about 80 mm diameter in two weeks) and have some hyphal development beneath the surface of the agar. Colonies on malt-extract agar are appressed with thin white mycelium initially and later become gray-white and slimy. They occasionally have weak radial grooves with a sharply delimited margin that may be slightly zonate. The colonies have a weak, somewhat unpleasant odor.

Disease cycle *Itersonilia perplexans* overwinters as mycelium in infected parsnip roots or as chlamydospores in soil. Spread within the field is by wind-borne ballis- tospores, which can infect the foliage. New spores produced on the foliage can fall to the ground, contact the roots, and give rise to root infections, or they can be blown to other plants. The fungus can also be spread through infested seed.

Disease development generally begins late in the growing season but may occur earlier if favorable environmental conditions occur. The fungus requires a cool, wet season with an optimum temperature of 20°C. Disease development is limited by hot, dry conditions.

Management Control of the carrot rust fly (see carrot rust fly, 14.5) is important, because the larvae can predispose parsnip roots to *Itersonilia* infection, which usually occurs at the crown and other points where larvae have penetrated.

Cultural practices — High ridging to cover the shoulder of parsnip roots with soil throughout the season is effective because ballistospores are rapidly lysed by soil microorganisms. Long rotations and good soil drainage are also useful. Measures such as deep plowing, which enhances the decomposition of parsnip crop residues and exposes the fungus to the lytic action of soil microorganisms, are effective in reducing inoculum levels. Removal and destruction of cankered parsnip roots at harvest will eliminate the source of long-term carry-over of the fungus. The eradication of weeds will reduce other possible sources of inoculum.

Resistant cultivars — The cultivar Andover is resistant to itersonilia canker and has good horticultural characteristics.

Chemical control — Seeds suspected of harboring *Itersonilia* should be treated with a registered fungicide.

Selected references

Boekhout, T. 1991. Systematics of *Itersonilia:* a comparative phenetic study. *Mycol. Res.* 2:135-146.

Channon, A.G. 1963. Studies on parsnip canker. I. The causes of the disease. *Ann. Appl. Biol.* 51:1-15. II. Observations on the occurrence of *Itersonilia pastinacae* and related fungi on the leaves of parsnips and in the air within parsnip crops. *Ann. Appl. Biol.* 51:223-230.

Channon, A.G. 1969. Infection of the flowers and seeds of parsnip by *Itersonilia pastinacae. Ann. Appl. Biol.* 64:281-288.

Smith, P.R. 1967. The survival in soil of *Itersonilia pastinacae* Channon, the cause of parsnip canker. *Aust. J. Biol. Sci.* 20:647-660.

Sowell, G., Jr. 1984. A biological study of *Itersonilia perplexans*, the cause of parsnip leaf-spot and canker. Ph.D. thesis, Cornell University, Ithaca, New York.

(Original by R.F. Cerkauskas)

▶ 14.3 Phoma canker *Figs. 14.3a-d*

Phoma complanata (Tode:Fr.) Desmaz.

Significant losses in field and storage have occurred since the first report of this disease in 1984 from the Bradford region of Ontario. The disease is equally severe on parsnip growing in muck and mineral soils. Phoma canker is specific on parsnip and does not affect other vegetables. The cow-parsnip weed *Heracleum lanatum* Michx., which occurs throughout Ontario in meadows and edges of moist woods, is mildly affected by *P. complanata.*

Symptoms Leaf spotting, blighting and cankers on petioles and roots are the main symptoms and may vary in intensity among cultivars. At first, leaf spots are dark tan or brown, but yellow-green halos develop around the lesions three to four days later. Lesions on leaves vary in size and shape, but generally they are 1 mm or less in diameter. Under severe disease conditions, lesions appear five days after infection has occurred. As these lesions develop, they may coalesce, leading to yellowing, withering and dying of the leaves. These symptoms are known as leaf blighting *(14.3b).* Two weeks after infection, the coalesced lesions are pale brown or purplish-brown with dark, pepper-like fungal fruiting bodies in the center.

On the petioles *(14.3a),* light brown, elliptical lesions form four days after initial infection. Lesions darken to a brown-black color and coalesce, leading to canker formation about two weeks after infection. Cankers may occur anywhere along the petioles, and petioles frequently bend at the canker site, followed by yellowing, withering and dying of the leaf above the site of the canker. When cankers form on the upper part of the petiole, a characteristic “shepherd’s crook” is formed *(14.3c).*

Root cankers *(14.3d)* are buff or dark brown to black, often with the small, black, pepper-like fruiting bodies of the fungus on the surface or embedded in the tissue. Cankers are frequently found on the shoulder and crown of the root and occasionally on the shank, and they may penetrate to the inner part of the root. Secondary organisms, such as bacteria and other fungi, are often associated with the root canker and can contribute to further decay. Roots with phoma canker have a distinct, sweet, cinnamon-like odor, and their commercial value is reduced.

White to buff-colored spore masses may be observed on well-developed lesions on diseased leaves, petioles and roots with the aid of a magnifying lens. The presence of fruiting bodies and the production of numerous spore tendrils from these fruiting bodies distinguish phoma canker from itersonilia canker.

Causal agent A scheme based on the behavior of isolates *in vitro* and *in vivo* (host substrate) has been used for the identification of *Phoma* species. The characteristic thick pycnidial wall *in vivo* and *in vitro,* the extent of mycelial growth, cultural characteristics on oatmeal agar, and its occurrence on parsnip distinguish *P. complanata* from other *Phoma* species.

Pycnidia in root tissue are scattered or aggregated, immersed or partly immersed, spherical with a dark brown to black outer wall, and lack setae. Pycnidia in host tissue are unilocular with one ostiole and range in diameter from 165 to 373 µm with an average of 250 µm. On oatmeal agar, pycnidia are superficial, immersed or partly immersed, and initially flesh-colored, but later they turn dark brown to black with a diameter of 228 µm (range 176 to 286 µm) and produce conidia abundantly. The pycnidia have thick walls (35 to 49 µm), which consist of about six layers of pseudo- parenchymatous cells.

Aseptate conidia exude in cirrhi from pycnidia on parsnip petioles, on root tissue, and in oatmeal agar cultures. They are hyaline, ellipsoid, cylindrical, fusiform or globose, often with polar guttulae. Aseptate conidia are 7.4 (5.0 to 10) by 2.4 (2.0 to 3.0) µm. Pycnidia in stored root tissue often contain many swollen, dark, septate conidia. One-septate, hyaline conidia with dimensions of 27.2 (22 to 34) by 8.1 (6 to 10) µm are present in older cankers or cultures.

In culture, *P. complanata* is readily distinguished from *Itersonilia perplexans* by the presence of pycnidia in culture media, the differences between the conidia (*P. complanata)* and ballistospores (*I. perplexans),* and the lack of clamp connections on the mycelium of *P. complanata.* The fungus is readily isolated on potato-dextrose agar or oatmeal agar. Colonies on oatmeal agar are regular, not scalloped, and they lack concentric zonation. Colonies are white to light gray or olivaceous-gray with dense aerial mycelium. The reverse side is light brown. Chlamydospores, sclerotia and an *Epicoccum* state are absent in this *Phoma* species.

Disease cycle In Ontario, phoma canker appears in mid- August. The disease often develops from a few, randomly scattered infected plants. As the season progresses, the affected areas enlarge and may coalesce. Canker development is favored by moderate temperatures and rain or high humidity. Secondary spread in the field is aided by wind- driven rain, heavy dew formation and insects. During rain or heavy dew, the large numbers of spores produced in the petiole cankers are carried down the petiole to the crown, where root infection may occur. Root cankers develop in the field or during cold storage. Cankers developing in cold storage arise from field infections and may be small and visible only after two cuts, perpendicular to each other, are made at the crown. Yield losses can be as high as 100% because of root canker formation and breakage of cankered petioles during harvesting.

The fungus can survive over winter for at least five months in parsnip residue in muck or mineral soil, regardless of the depth of incorporation. The fungus is seed-borne and may affect seed germination and seedling emergence.

Management

Cultural practices — The removal of diseased parsnip residue from the field and a one-year-mini mum rotation with other crops will reduce levels of the fungus in affected fields. Infected seed will show reduced vigor and germination. Workers should avoid direct skin contact with diseased plant tissues when harvesting, because high concentrations of photocarcinogenic furocoumarins are produced in such plants. These compounds, which also occur in carrot, celery and parsley at lower concentrations, produce severe skin rashes and blisters upon exposure of affected skin to sunlight.

Resistant cultivars — Harris Model is highly susceptible to the disease, while Hollow Crown Improved and All America are moderately resistant. The latter two cultivars are not widely grown in Ontario, because the extensive shoulder on the root reduces acceptability to packers and consumers. The control of phoma canker can be improved by harvesting these two cultivars before excessive shoulder development occurs. The cultivar Andover, bred for resistance to itersonilia canker, also has good resistance to phoma canker.

Selected references

Cerkauskas, R.F. 1985. Canker of parsnip caused by *Phoma complanata. Can. J. Plant Pathol.* 7:135-138.
Cerkauskas, R.F. 1987. Phoma canker severity and yield losses in parsnip. *Can. J. Plant Pathol.* 9:311-318.
Cerkauskas, R.F., and M. Chiba. 1990. Association of phoma canker with photocarcinogenic furocoumarins in parsnip cultivars. *Can. J. Plant Pathol.* 12:349-357.
Sutton, B.C. 1980. *The Coelomycetes.* Commonw. Mycol. Inst., Kew, Surrey, England. 696 pp.
Channon, A.G. 1963. Studies on parsnip canker. I. The causes of the disease. *Ann. Appl. Biol.* 51:1-15.

(Original by R.F. Cerkauskas)

NEMATODE PESTS

▶ 14.4 Northern root-knot nematode *Fig. 6.20*

Meloidogyne hapla Chitwood

Symptoms Like carrot, parsnip is very sensitive to low numbers of this nematode. Mature roots may be deformed, short and branched, and secondary roots abnormally branched and hairy *(6.20).* For a complete description and management strategies, see Carrot, 6.20; see also Management of nematode pests, 3.12.

INSECT PESTS

▶ 14.5 Carrot rust fly *Figs. 6.23a-e*

Psila rosae (Fabricius)

Carrot rust fly (see Carrot, 6.23) is one of the principal insect pests of parsnip in Ontario and Quebec. In areas of eastern Newfoundland, where high populations of rust fly exist, parsnip crops have been damaged extensively.

Damage Rust fly damage on parsnip is similar to that on carrot (*6.23 a,b*), but the damage is rarely as severe.

Management Rotation and avoidance of areas with high rust fly populations are the only feasible strategies for most growers, because no insecticides are registered for rust fly control on parsnip in Canada.

Monitoring — Parsnip crops are often grown on mineral soil or shallow muck soil, where rust fly populations are usually low. Nevertheless, adult rust flies (*6.23e)* can be monitored with sticky-board trapping techniques described for carrot. In Ontario and Quebec, areas with high populations of rust fly have been determined, but growers in new areas may have to estimate rust fly populations.

Cultural practices — Growers should practice crop rotation and avoid areas known to have high rust fly populations.

(Original by M.R. McDonald)

▶ 14.6 Carrot weevil *Figs. 6.24a-d*

Listronotus oregonensis (LeConte)

Carrot weevil (see Carrot, 6.24) is one of the main insect pests of parsnip in Ontario and Quebec.

Damage Carrot weevil larvae (*6.24d*) cause economic damage to parsnip in the same manner as on carrot *(6.24a,b).* However, they do not cause as much damage to parsnip, possibly because most parsnip crops are grown on mineral or shallow muck soil and parsnip crops are usually rotated with non-host crops.

Management Crop rotation is the only feasible strategy for most growers, because no insecticides are registered for carrot weevil control on parsnip in Canada.

Monitoring — Where parsnip crops are grown in the same field after celery or carrot, monitoring should be done throughout the field in the spring, because the adult weevils

(6.24c) will have overwintered in the field under crop residue. If a non-host crop was grown the previous year, then carrot weevils may have overwintered in the weeds and grasses along the headlands and ditches. In this case, monitoring traps should be concentrated at the edge of the field (see Carrot, 6.24, for procedures).

Cultural practices — Rotations of up to three years with a non-host crop can be an effective means of reducing carrot weevil populations and consequent crop damage, especially in fields distant from one another.

(Original by M.R. McDonald)

▶ 14.7 Other insect pests *Fig. 14.7; see text*

Black swallowtails *Papilio* spp.
Cutworms
Wireworms

Black swallowtails are butterflies (family Papilionidae), several species of which occur in Canada. Their larvae *(14.7),* which are called ragworms, celery worms or parsley-worms, feed on the foliage of parsnip. In southwestern Ontario, larval populations can become sufficiently large to cause defoliation. Farther north and in other parts of Canada, larval numbers are rarely sufficient to cause economic loss. However, in eastern Newfoundland, larvae of the short-tailed swallowtail *Papilio brevicauda* Saunders have on occasion completely defoliated parsnip grown in home gardens.

Cutworms (see Carrot, 6.25; and Tomato, 18.35) Cutworms *(6.25a-c; 18.35a-g)* may feed on young parsnip plants. Eggs are laid at the base of the plants, and the larvae feed on seedlings at ground level. A significant reduction in plant stand can result when the young petioles are chewed off at or near the soil surface. Close inspection will reveal that leaves and seedlings have been severed. Insecticides applied in the evening, when the cutworm larvae are feeding, can effectively reduce further damage.

Wireworms (see Maize, 12.21) Wireworms *(12.21a,b)* may feed on parsnip roots. They penetrate directly into the root, leaving one or more circular holes on the surface. The root must be cut open to reveal the extent of the interior tunneling. In Ontario, damage is rarely extensive enough to cause economic loss.

(Original by M.R. McDonald)

MITE PESTS

▶ 14.8 Two-spotted spider mite *Figs. 22.36e,f*

Tetranychus urticae Koch

The two-spotted spider mite (see Greenhouse cucumber, 22.36) can often be found on parsnip crops in Ontario.

Damage Under hot, dry conditions, the two-spotted spider mite can cause a stippling of the leaves, which leads to overall chlorosis. When first observed where the plants are dusty, mite damage can be confused with magnesium deficiency, but close examination of the underside of the leaves will reveal high mite populations.

Management Cultural practices that reduce mite populations are the only feasible strategy, because no miticides are registered for use on parsnip in Canada.

Cultural practices — Overhead irrigation helps reduce the mite population, but irrigation is not often used in parsnip production. During hot, dry weather, growers should avoid practices that throw dust onto the leaves.

(Original by M.R. McDonald)

ADDITIONAL REFERENCES

Guba, E.F. 1961. Parsnip diseases in Massachusetts. *Mass. Agric. Exp. Stn. Bull.* 522. 35 pp.