Agronomic Spotlight

Seminis
grow forward

Root Diseases of Carrot

- Black rot, cavity spot, and root knot are three important diseases of carrot roots and crowns.
- Diseases of carrot roots and crowns directly impact the harvested product.
- Management focuses on sanitation and cultural practices to lower inoculum levels and minimize disease development.

Black Rot

Black rot, caused by the fungus *Alternaria radicina*, occurs worldwide in most carrot-producing regions. While the disease mainly affects the crown and upper taproot, the pathogen can also cause seedling damping-off and blighting of the leaves and umbels.[1,2]

Black rot causes necrosis of the roots and crown, and infection usually starts where the leaf petioles attach to the crown. Small, chlorotic spots first appear on the petioles. The spots enlarge, and the affected tissues darken and decay. The infected petioles can break off when the carrots are mechanically harvested, leaving the taproot in the ground, thus reducing yield. Some fields are abandoned before harvest if disease severity is high.[1,2,3] The dark rot spreads to the crown and the upper part of the taproot. The rot can continue to spread downward on the root, with black, sunken lesions developing below the soil surface. The black lesions reduce the marketability of the harvested roots.

Figure 1. Moderate to severe black rot symptoms on carrot roots.

The black rot fungus can be seedborne, mainly on the seed surface. The fungus can also survive for several years in infested crop debris and in the soil.[1,2,3] Carrot plants can be infected at any stage, but young seedlings are particularly susceptible. Infection is favored by wet conditions (rain or overhead irrigation) when temperatures are over 68°F (20°C). Older, senescing tissues are also very susceptible to infection.

A primary method for managing black rot is to plant disease-free seeds. This is especially important when planting in fields with no history of the disease to prevent the introduction of the pathogen into the field. Treating seeds with fungicides, such as iprodione, can also help eliminate seedborne inoculum.[1,2,3] Once the pathogen is present in a field, three to four-year rotations to non-host crops can help lower inoculum levels and prevent a buildup of the pathogen. Prompt destruction of crop debris after harvest can help speed the decomposition of the infested tissue and help lower inoculum levels. Burying inoculum through deep tillage can help lower rates of infection. Fungicides can be applied to plants in the field; however, the applications are often only marginally effective because of the difficulty in reaching the target areas of the plant with the fungicide sprays. Carrot varieties with some resistance to black rot are available.

Cavity Spot

Cavity spot is caused by the water mold organisms *Pythium violae, Pythium sulcatum*, and other *Pythium* species. *P. violae* is the most common and has a broader host range than *P. sulcatum*. Cavity spot can occur in fields with no prior history of carrot cultivation. The disease may not have a major impact on total yield, but it can reduce marketable yield resulting in substantial economic losses. Incidence rates of 10 to 20% can cause whole loads to be rejected during grading, and severely affected fields are sometimes abandoned.[1,2]

Cavity spot symptoms start as yellow, pinpoint spots on the taproot about twelve weeks after planting. These spots develop into elliptical or irregular, depressed lesions that are a half-inch or larger in diameter and oriented across the taproot. The lesions can develop on any part of the taproot, but they most commonly occur on the upper third of the root. Initially, the lesions appear gray but become darker as they enlarge and develop into cavities. Secondary pathogens can colonize the affected tissues and increase the size of the cavities.[1,2,3] There are no foliar symptoms, and the disease may not be detected until the roots are near marketable size, as the roots must be pulled and examined to see the symptoms.[1,4] Sometimes lesions are not visible when the carrots are harvested but may cause losses later on in storage. Disc-shaped lesions can also enlarge during storage.

Figure 2. Elliptical lesions of cavity spot.

The cavity spot pathogens can survive in the soil for many years, and they can infect other plants, including tomato, cotton, watermelon, corn, and potatoes. Wet soil conditions favor infection. Heavy rains, flooding, and poor soil drainage are associated with increased disease levels. The disease is favored by temperatures below 68°F (20°C).[1,2,3]

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To help manage cavity spot, avoid fields with a history of the disease, and avoid planting in fields with poor drainage. Manage irrigation to prevent flooding. Deep cultivation between rows may help reduce the severity of cavity spot. Disease severity can be higher in fields with acidic soils, so adjusting soil pH levels to between 7 and 7.5 can help manage the disease. Plant when soil conditions are not overly wet and harvest as soon as carrots are mature, as the incidence of cavity spot tends to increase later in the season as older roots are more susceptible. Long-term crop rotations (three to five years) may help lower inoculum levels of the pathogens. Fungicides effective against water molds, such as *Pythium* and *Phytophthora*, may help manage the disease. Recommended fungicides include phenylamide fungicides (metalaxyl and mefenoxam), fenamidone, cyazofamid, and fluopicolide. Applications of metalaxyl or mefenoxam are usually most effective when first applied at planting or shortly after emergence. Two applications may be needed in some situations. Pre-plant applications of the fumigant metam sodium, may also help reduce inoculum levels and lower disease incidence. There is some variation in susceptibility to cavity spot among carrot varieties, but commercial varieties with high levels of resistance are not currently available.[1,2,3,4]

Root Knot

Root knot is caused by several species of root knot nematodes (RKN), including *Meloidogyne arenaria, M. chitwoodi, M. fallax, M. hapla, M. incognita,* and *M. javanica*. There are several races within some of these species. RKN species occur worldwide and have wide host ranges. Species of *Meloidogyne* are sedentary, endoparasites, which means that they set up permanent feeding sites within the root.[1]

Root knot can cause substantial damage to carrot roots. Galls (round to spindle-shaped swellings) develop on the feeder roots. The size and shape of the galls vary depending on the nematode species. Infected roots tend to be short with fewer feeder roots. A forked taproot can form if the tip of the taproot is damaged. These roots can be stunted and distorted, making them unmarketable. Above-ground symptoms include yellowing, stunting, and a predisposition to wilting. Reduced stands and lower yields are often associated with fields infested with root knot nematodes.[1,3,4]

Figure 3. Roots distorted from root knot nematode infection. Robert Wick, University of Massachusetts.

RKN survive as eggs in crop debris and in the soil. Juveniles (larvae) emerge from the eggs, enter roots near the root tip, and set up feeding sites within the root where they develop into male and female adults. Root damage is correlated with nematode population levels, and damage tends to be more severe in fields with sandy or muck soils.[1,3]

Collecting soil samples and sending them to a diagnostic lab for analysis can provide information on the RKN species present and population levels. Because any detectible level of RKN in the soil can result in some yield loss, some situations may warrant a zero-tolerance threshold for these nematodes in the soil.[1,3] If RKN are detected, some strategies can be used to help reduce population levels or at least slow the buildup. Keeping fallowed fields weed-free can help lower RKN populations because larvae will have nothing to feed on. Crop rotation to non-host crops can also be helpful; however, because many of the RKN species have wide host ranges, including many vegetable crops, effective crop rotations can be difficult to achieve. Sanitation practices, such as cleaning farm tools and equipment between fields, are important for preventing the spread of RKN into non-infested fields.[3,4]

Pre-plant soil treatments can be applied to help reduce RKN populations. The application of soil fumigants, such as metam sodium, 1,3-dichloropropene, and chloropicrin, can be used to help lower populations. Non-fumigant nematicides, which can be pre-plant broadcast and incorporated or applied in-furrow, are also available, as are a couple of bio-control agents.[3,4] Adjusting planting time to avoid times when juveniles are most active can help prevent infection of young roots. Recommended temperature ranges for planting depend on the RKN species present. Planting when temperatures are below 59° to 64°F (15° to 18°C) can help delay infection of taproots by several of the RKN species. However, for fields with *M. hapla*, planting when temperatures are below 55° to 57°F (13° to 14°C) is required. Effective resistance for root knot nematodes is not available in commercial carrot varieties.[1,3,4]

Sources:

[1] Davis, M. and Raid, R. 2002. Compendium of Umbelliferous Crop Diseases. The American Phytopathological Society. St Paul.

[2] Koike, S., Gladders, P., Paulus, A. 2007. Vegetable diseases: A color handbook. Academic Press. Boston.

[3] UC IPM Pest Management Guidelines: Carrot. UC ANR Publication 3438UC. http://ipm.ucanr.edu/PMG/selectnewpest.carrots.html.

[4] Reiners, S., Bihn, E., Curtis, P., Helms, M., McGrath, M., Nault, B., Seaman, A., and Sosnoskie, L. 2022 Cornell Integrated Crop and Pest Management Guidelines for Commercial Vegetable Production. Cornell Cooperative Extension.

Websites verified 7/6/2022

For additional agronomic information, please contact your local seed representative.

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