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report on
PLANT
DISEASE

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RHIZOCTONIA DISEASE OF CABBAGE AND RELATED CROPS

The fungus *Rhizoctonia solani (Thanetophorus cucumeris* synonym *Pellicularia filamentosa)* causes damping-off and wirestem of cabbage, cauliflower, and other crucifer seedlings in the seedbed; bottom rot and head rot of older plants in the field and storage; and root rot of turnip, radish, rutabaga, and horseradish. Losses occur as reduced stands and lowered yield and quality.

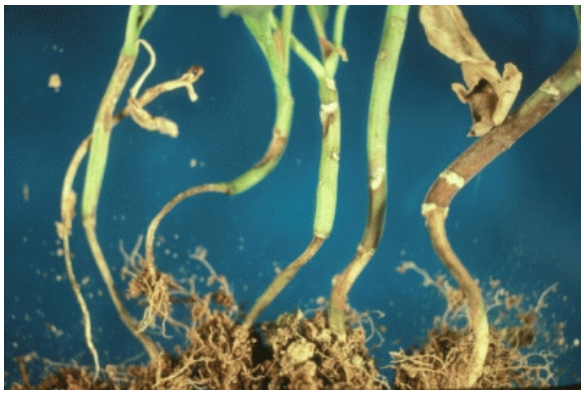

Figure 1. Wirestem of cabbage.

Figure 2. Rhizoctonia head rot of cabbage.

SYMPTOMS

1. Damping-off. Seeds may decay, especially in cold, wet soils. Stems of young seedlings become light brown and water-soaked near the soil line. Affected seedlings quickly wilt, topple over, and die. Damped-off plants commonly occur in circular patches in plant beds or along sections of rows. A number of other common soil-borne fungi produce the same symptoms. Damping-off develops most rapidly at temperatures of 75°F (23°C) and above in wet soils following heavy rains or over-irrigation.

2. Wirestem. Wirestem is the most common and destructive phase of Rhizoctonia disease. The stem above and below the soil line shrivels and darkens, becoming tough and woody or wiry. Generally, infected plants do not fall over but remain erect. In wet soil, the decayed outer tissues of the stem may slough off when the plant is pulled (Figure 1). Growth of diseased seedlings aftr transplanting to the field or garden is usually slow. Severely diseased plants soon die. Even if the plants are able to produce new roots above the affected stem after transplanting, they are generally stunted, unthrifty, and they produce small heads.

3. Bottom rot. This midseason disease is often a carryover from wirestem or from new infections that occur when the outer leaves touch damp, infested soil. The lower leaves droop, decay, and turn black, but remain attached. Some plants may recover and produce heads. In cabbage, bottom rot usually develops into head rot.

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4. Head rot. A firm to slimy dark decay of the bases of the outer leaves and heads of cabbage develops between early head formation and maturity. The outer leaves of the head wilt, become pale, and turn brown to black near the main stem (Figure 2). As leaves are killed, they dry at the base and remain held in place by the margin of the blade that folds over the top of the head. Foliage leaves die and drop off, exposing the stem beneath the head. A cobwebby brown mold (mycelium) of *Rhizoctonia solani* may be conspicuous on decayed tissues and between the head leaves in damp weather. Small brown sclerotia may develop and be visible on parts or the whole surface of the head. Dark brown sunken spots are produced inside the head. A firm, persistent, dark decay continues to develop in transit and storage. Secondary rot-producing bacteria commonly invade the diseased tissue and rapidly turn an infected head into a slimy, foul-smelling mass.

5. Root rot. Turnip, radish, rutabaga and horseradish roots may decay in the field and in storage. The rot is usually dark brown, slightly sunken, and semi-watery to spongy. Horseradish root tissue is light yellow to grayish tan and usually rather dry. Infected tissue separates easily from the advancing edge of the rot (Figure 3). A cobwebby, creamy-white to brown surface mold and irregular, chocolate-brown sclerotia help to distinguish *Rhizoctonia* from other root rots. The fungus may enter through leaf scars, injuries, or rootlets.

Figure 3. Horseradish roots infected by Rhizoctonia.

DISEASE CYCLE

The *Rhizoctonia* fungus is widely distributed throughout the world in practically all soils suitable for plant growth. No soils in Illinois are known to be free of the fungus. It attacks hundreds of different kinds of plants and produces a wide range of disease symptoms on the same host plant depending on the time of infection. The most important vegetable hosts, besides cabbage and related plants (crucifers), include beet, beans, carrot, celery, cress, cucumber, eggplant, lettuce, onion, pea, pepper, rhubarb, spinach, tomato, and sweet potato.

The fungus can be subdivided into strains based on the isolates host or tissue preference and optimum temperature to cause disease. For example, strains of *Rhizoctonia* that attack potato do not normally attack crucifers, and vice versa. The strains that infect cereals differ from those that cause disease in sugar beets, legumes, and most vegetables. The strain of *Rhizoctonia solani* causing bottom rot and head rot of cabbage grows at temperatures ranging between 48° and 91°F (8° to 32°C). Cabbage may become infected at temperatures ranging between 53° and 90°F (11° to 32°C) with an optimum between 77° to 80°F (25° to 26°C). A strain exhibiting a host preference for turnip causes disease when temperatures range between 53° and 90°F (1° to 32°C) with an optimum of 66° to 77°F (18° to 25°C). Another subdivision of *Rhizoctonia solani* is based on the ability of mycelia from different isolates to fuse or anastomose. Isolates that demonstrate this compatibility form an anastomosis group. Isolates within the same anastomosis group are more similar than isolates from different groups.

The fungus survives indefinitely in the soil, passing through unfavorable conditions primarily as small, hard, chocolate-brown, kernel-like bodies called sclerotia. The sclerotia are extremely resistant to cold, heat, drought, and most chemicals. They germinate in damp weather by forming delicate threads, or mycelium, that spread through the soil for several inches and penetrate roots and leaves of susceptible

plants with which they come in contact. Sufficient moisture on the surface of the host is required for penetration through natural openings, wounds, or intact tissues to be successful. Once *Rhizoctonia* has penetrated the plant, it proceeds to invade other tissues regardless of external moisture. However, high moisture and humidity are conducive to accelerated disease development in the field and in storage. After the fungus has depleted nutrients in the host's tissue, or as other environmental conditions become unfavorable, the mycelium produces sclerotia to complete the life cycle.

The fungus is also capable of infecting the seed without exhibiting symptoms. It remains in the seed in a quiescent state until the seed begins to germinate; the fungus then attacks the seed. Crucifer seed infected with *Rhizoctonia* is also a primary source of inoculum; mycelium radiating from a colonized seed infects adjacent seeds and seedlings causing seed decay and damping-off.

CONTROL

1. When plants are grown in a hotbed, coldframe, or flat, disinfest the soil before seeding. Use steam or a soil fumigant. Carefully follow the manufacturer's directions regarding timing and method of application. A number of soil fumigants are restricted-use chemicals and must be applied by a person licensed to purchase and handle the chemicals. Avoid recontamination of steamed or fumigated soil with nonsterile soil.

2. Grow plants in well-drained, fertile soil. Fertilize based on a soil test and suggestions given in Illinois Extension Circular 1354, Illinois Homeowner's Guide to Pest Management. Avoid over-watering, deep planting, overcrowding, and overfertilization with nitrogen. Alteration of the sowing date will reduce the risk of infection from soilborne inoculum for crops where the seed requires high temperatures for germination.

3. Before seeding, treat all crucifer seed with hot water, or plant seed already treated. In addition, treat the seed with a registered seed-protectant fungicide.

4. In plant beds that have not been disinfested, control can be achieved by thoroughly incorporating a fungicide dust into the upper three inches of soil before planting or applying a fungicide soil drench after planting. For information on the current fungicide recommendations, refer to Circular 1373, Midwest Vegetable Production Guide for Commercial Growers.

5. When transplanting, discard all seedlings with discolored stems and roots.

6. Do not plant crucifers for at least three years in fields where bottom rot, head rot, and root rot have occurred.

7. Cultivate the soil as soon as possible after heavy rains to aerate it and thus make conditions less favorable for infection. Avoid covering parts of leaves with soil when cultivating. Banking soil around plants creates conditions favorable for development of bottom rot and head rot.

8. Harvest crucifer root crops when the soil is comparatively dry so that a minimum of soil will adhere to the branch roots.

9. Discard cabbage, turnips, rutabagas, radishes, and horseradish that show severe Rhizoctonia infection. Healthy or slightly affected produce may be stored for a month or slightly longer without excessive

loss if the temperature is held at 32° to 34°F (0° to 1°C) and the humidity is kept as low as practical without causing wilting or shriveling.

10. A reduction in the inoculum level of *Rhizoctonia* has been reported following cropping with cereals and incorporating the crop residue into the soil.

11. The development of resistant varieties of crucifers to *Rhizoctonia* is slow. For the latest information on recommended cultivars for growing in the Midwest read Circular 1373, Midwest Vegetable Production Guide for Commercial Growers, available from Information Technology and Communication Services, University of Illinois, P345, 1917 S. Wright St., Champaign, IL 61820. Also consult current seed catalogs and trade publications.