



BLACKLEG OF CABBAGE AND OTHER CRUCIFERS

In warm, wet seasons, blackleg, caused by the fungus *Phoma lingam* (sexual stage, *Leptosphaeria maculans*), is potentially one of the most serious and widespread diseases of cabbage (red, green, savoy, and white), broccoli, Brussels sprout, cauliflower, Chinese cabbage, collard, garden cress, kale, kohlrabi, mustards (black, leaf, and white), a few strains of radish, rape, some varieties of rutabaga, and some turnips. Other plants in the cabbage family (Cruciferae) that are hosts include charlock, Chinese and wild mustards, hedge-mustard, stock, sweet alyssum, candytuft (*Iberis*), wallflower, wild radish, wild turnip, and cardamine. Very resistant or occasionally immune crucifers include ball-mustard, false flax, horseradish, pennycress, peppergrass, shepherd's purse, and winter-cress or yellow rocket.

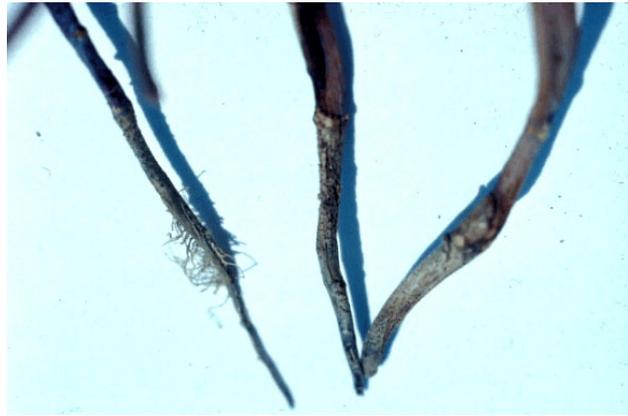


Figure 1. Pale gray lesions causing seedlings to die early.

Blackleg is less important now than formerly due to greatly improved seed quality and the general practice of treating crucifer seed with hot water. However, the disease can still be destructive in a seedbed from the sowing of infested seed, when optimum conditions for disease spread and development prevail.

SYMPTOMS

All parts of susceptible plants, both above and below ground, may be affected from seedbed to harvest and even during storage. The earliest conspicuous symptoms often occur in the seedbed two or three weeks before transplanting time.

1. **Seedlings.** Cotyledon infection, which appears as pale gray lesions, usually causes the seedlings to die early (Figure 1). This loss often goes unnoticed in the seedbed. The fungus produces a tremendous number of microscopic spores (conidia) on the hypocotyls, cotyledons, and first true leaves of prematurely killed seedlings, and thus is able to cause many secondary infections in the seedbed and field.
2. **Stems.** An elongated, light brown, sunken area or lesion with a purplish margin forms on the stem near the soil line. The lesion gradually extends upward and downward until the stem is girdled and turns black.

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Numerous, tiny, black, fungus fruiting bodies (pycnidia) soon form in the diseased area. Affected plants often wilt suddenly and die, or they topple over later as the head enlarges.

3. **Roots.** The root system is gradually destroyed, although plants may be kept alive in damp soil when new roots form above the diseased parts. Badly affected cabbage plants may survive until fair-sized heads are formed. The wilting leaves usually remain attached to the stem instead of dropping off, as is characteristic of *Fusarium* yellows and black rot (See Report on Plant Diseases No. 901, *Fusarium* Yellows of Cabbage and Related Crops, and No. 924, Black Rot of Cabbage and Other Crucifers). Dark cankers develop in the fleshy roots of rutabaga, turnip, and other plants. Dry rot may develop on fleshy roots in storage, where severe losses may occur. Pycnidia are common on the surface of all decayed tissues.
4. **Leaves.** Inconspicuous, somewhat circular, light brown to grayish spots form on the leaves. The lesions soon become well defined and develop ash gray centers in which a large number of speck-sized, black pycnidia are scattered (Figure 2). These spots may later tear or drop out.
5. **Heads.** Heads from late-infected plants may appear healthy at harvest but later in storage develop sunken black lesions around their base. The presence of abundant, minute pycnidia on the cotyledons, stems, leaves, and roots distinguishes blackleg from other crucifer diseases.



Figure 2. Close-up of leaf spot of cabbage caused by the blackleg fungus.

DISEASE CYCLE

The causal fungus can live for at least three years in the soil between crops in infected plant refuse and on or within infected seed. When crucifer plants are carried through the winter for seed production the following growing season, the seed pods may become infected. The fungus penetrates into the seed coat, where it remains dormant. Severely infected seeds shrivel and do not germinate.

When infected seed is planted, black, flask-shaped pycnidia of the *Phoma* fungus (Figures 2 and 3a) form in the hypocotyls and cotyledons as they are pushed above ground. Each pycnidium contains many thousands of one-celled, thin-walled, microscopic spores called conidia (Figure 3b) that exude in a gelatinous, pinkish “coil” when in contact with water. The conidia serve as the primary source of infection for nearby plants. Just a few infected seeds in a seedbed or field are enough to start an epidemic during warm, showery weather. The sexual stage, *Leptosphaeria maculans* (Figure 3c), is much rarer than the asexual *Phoma* stage. Black specks (perithecia), which closely resemble pycnidia, form in clusters on old blackened stems and leaves. The globose perithecia contain large numbers of cylindrical to club-shaped asci each containing eight cylindrical to ellipsoid, yellow-brown, ascospores with rounded ends which contain several cells (Figures 4d and e). The *Leptosphaeria* stage is believed to play little or no part in the disease cycle in the Midwest.

The causal fungus depends entirely on dew, rain, or irrigation water to promote discharge of spores. The spores are spread to healthy plants primarily by splashing water; also, in infested manure, on tools, on

cultivation and spray equipment, and perhaps by insects. New lesions will result in 10 to 14 days. Surface drainage water may carry spores from infected debris in fields to the seedbed. Large numbers of the young plants commonly become infected when they are pulled and either sprayed or dipped in water. If *Phoma* spores are present, every transplant may become contaminated.

CONTROL

1. Plant **only** seed produced in arid areas along the Pacific Coast.
2. Plant **only** crucifer seed that has been treated with hot water. Because of difficulties in treating seed at home, most growers prefer to buy seed that is already treated. For details on hot water seed treatment of cabbage and other crucifer seed, see Report on Plant Diseases No. 915, Vegetable Seed Treatment. Proper hot water treatment, followed by treatment with a protective fungicide, also eliminates seedborne infections of other diseases, such as black rot, *Alternaria* or black leaf spot, *Fusarium* yellows, downy mildew, and scab. Losses from blackleg and other seedborne diseases will be lower where direct seeding is used.
3. Plan at least a 4-year rotation between crucifer crops in both field and seedbed. Seedbeds should be located at least one-fourth mile from production fields in a fertile, well-drained soil and where they will not receive surface water from soil likely to be infested with the blackleg or black rot organisms. If a rotation of the plant bed is impossible, disinfest the soil with heat or a soil fumigant.
4. Do **not** plant crucifers in fields next to those where crucifers were grown the year before. Surface water and wind may spread infested crop refuse.
5. When watering plant beds, do not sprinkle the foliage. Careless sprinkling is a common way to disseminate the blackleg fungus.
6. Do **not** work the seedbed or cultivate fields when the plants are wet with dew or rain.
7. Do **not** use seedlings from blackleg-infested seedbeds. Seedbeds should be carefully inspected for disease every 7 to 10 days and especially 2 or 3 days before transplants are pulled.
8. Keep fields free of cruciferous weeds such as charlock, false flax, pennycress, pepperweeds, wild mustards and radishes, shepherd's purse, and yellow rocket. Follow current weed control

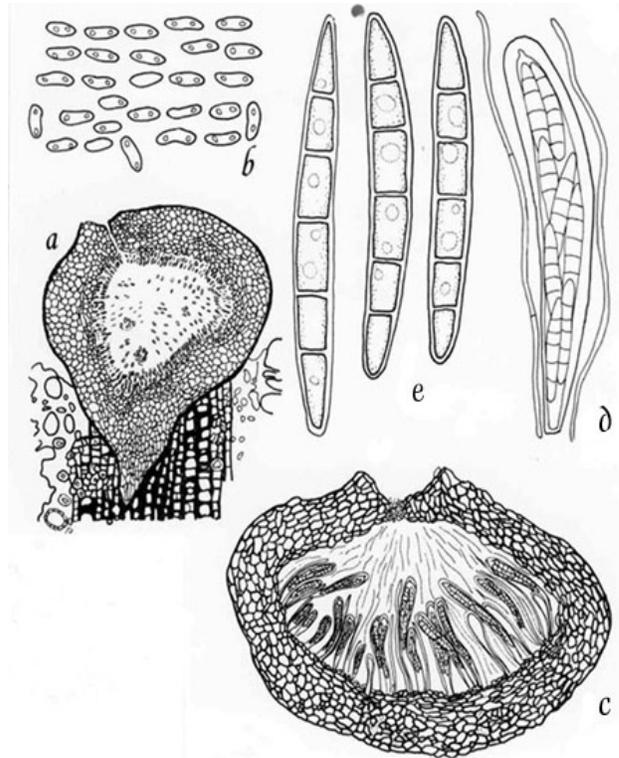


Figure 3. Blackleg fungus as it would be seen under a high-power laboratory microscope: (a) pycnidium of *Phoma lingam* stage; (b) one-celled conidia that emerges from a pycnidium in a gelatinous coil in moist weather; (c) perithecium of the sexual or *Leptosphaeria maculans* stage. The perithecium is filled with club-shaped asci; (d) an ascus containing eight multicelled ascospores; (e) three ascospores (drawing by Lenore Gray).

recommendations as given in Extension circular, Midwest Production Guide for Commercial Vegetable Growers (revised annually).

9. Where feasible, steam all farm equipment or wash it with water plus a disinfectant (such as 1 part Clorox or similar household bleach in 9 parts of water) and dry before moving it from a diseased to a healthy field.
10. Control cabbage root maggots, cutworms, cabbage worms, and other insects. Follow current recommendations in Illinois Agricultural Pest Management Handbook.
11. Clean up all crop debris and burn or plow it down deeply and cleanly after harvest.
12. Do not feed crucifer debris to livestock.
13. If transplants are purchased, be sure a phytosanitary certificate has been issued and be sure the transplants have been raised from hot-water treated seed, in accordance with the previously mentioned control practices.
14. Transplants should not be mechanically “topped” or chopped to toughen them or to reduce their size to fit the plants into shipment crates.
15. Only new crates, crates which have never been used for shipping cabbage, broccoli, cauliflower, mustard, turnip greens, and collard, should be used for shipping transplants.

Your nearest county Extension adviser can assist you in obtaining the publications mentioned above.