

Black Rot of Crucifers

Xanthomonas campestris pv. *campestris*

Hosts: The pathogen affects most plants in the family Brassicaceae (= Cruciferae), including cabbage, broccoli, cauliflower, most *Brassica* spp., radish (*Raphanus sativus*), stock (*Matthiola incana*), and leafy greens. Noncruciferous plants are not susceptible. Susceptible cruciferous weeds include birdsrape mustard (*Brassica rapa*), Indian mustard (*Brassica juncea*), black mustard (*Brassica nigra*), shortpod mustard (*Hirschfeldia incana*), Virginia pepperweed and other pepper grasses (*Lepidium* spp.), shepherd's purse (*Capsella bursa-pastoris*), wild radish (*Raphanus raphanistrum*), hedge mustard (*Sisymbrium officinale*), swinecress (*Coronopus didymus*), hairy whitetop (*Cardaria pubescens*), and others.

Disease common name: Black rot of crucifers; older names: blight, black stem, black vein, stem rot, and stump rot.

Pathogen: *Xanthomonas campestris* pv. *campestris*.

Disease Cycle

Inoculum: The principal inoculum source is infested seed. Secondary sources are infected transplants, infected cruciferous weeds, irrigation water, plant debris, and soil.

Transmission: The bacteria are spread by overhead irrigation and wind-blown rain. Bacteria also are spread by workers or machinery and occasionally by insects. Flea beetles can transmit *Xanthomonas campestris* pv. *campestris* but were ineffective vectors in New York. The diamondback moth (*Plutella xylostella*) also can transmit the disease in Hawaii but is considered an ineffective vector. Spread is rapid in transplant operations because inoculum may spread from latently infected seedlings, which do not manifest symptoms until transplanted into fields. Serious epidemics have resulted from contaminated seed when only 0.03% was infected.

Infection: Plants can be infected during any growth stage. Bacteria enter leaves through wounds or natural openings. Hydathode infection occurs when guttation fluids are colonized. Bacteria multiply in loosely packed parenchyma cells (the epithem) and then enter xylem elements, where they move downward into the stalk and upward to leaf margins. Warm, wet conditions favor black rot development and expression of symptoms. Rain, heavy fog or dew, and day temperatures of 24–35°C are very favorable. Under cool, wet conditions infection can occur without symptom development. Disease is not serious at temperatures below 15°C or during dry weather.

Symptoms and signs: Infected tissue is initially pale green and wilted. It then becomes yellow, turns brown, and dies, forming a characteristic V-shaped pattern at leaf margins (Figs. 1–4), accompanied by blackening of veins. Infected seedlings become yellow, drop lower leaves, and may die. Plugging of vessels with extracellular polysaccharides causes water stress, and melanins produced by the plant result in vein blackening (Figs. 5 and 6). Flowers of broccoli and cauliflower may show blight and rot (Figs. 7 and 8). Dwarfing, wilting, and misshapen plants that finally rot are symptoms of severe infection.

Survival: The pathogen can survive for several days on leaf surfaces and in infested crop debris until it is completely decomposed. Bacteria may survive free living in soil for 40–60 days. Neither soil nor plant debris appears to allow significant overwintering survival of the pathogen in the northeastern United States, but both are very important for the survival and perpetuation of the disease in the tropics.

Disease Management

An integrated, comprehensive program is needed to manage black rot successfully. Measures include use of pathogen-free seed, certified transplants, and resistant cultivars. Certification involves inspection of seed production fields and transplant operations, seed assays, and seed treatments, which commonly include immersion in hot (50°C) water for 20 min (cauliflower and broccoli) or 25–30 min (cabbage and Brussels sprouts). Seed is then immersed in cold water and spread in a thin layer to dry. Chemical disinfectants also are available. Treated seed should be retested for germination and vigor. It is risky to purchase transplants that have been clipped or “topped” by mowing because this practice can spread bacteria. For greenhouse-grown seedlings, new or sterilized flats and pathogen-free planting mix is essential. Seedbeds should be located away from production fields to areas where crucifers have not been grown for at least 2 years. Foliage should be dry when seedlings are transplanted. Care should be practiced to avoid wounding roots during transplant operations. Fields should be worked only when foliage is dry, and equipment and boxes should be decontaminated before entering other fields. Plants should not be irrigated early in the day when dew is present or so late in the day that foliage remains wet overnight. It is important to control insects and weeds. Weed control in the field is important because cruciferous weeds are hosts and the pathogen has been recovered from noncruciferous plants. Growers should refer to updated lists of available materials and follow label directions. Air-blast sprayers are more likely to spread bacteria than are boom sprayers. Fields should be plowed or disked soon after harvest to favor decomposition of plant residues.

References

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- Bradbury, J. F. 1986. Guide to Plant Pathogenic Bacteria. CAB International, Slough, U.K.
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- Schaad, N. W., and Alvarez, A. M. 1993. *Xanthomonas campestris* pv. *campestris*: Cause of black rot of crucifers. Pages 51-55 in: *Xanthomonas*. J. G. Swings and E. L. Civerolo, eds. Chapman and Hall, London.
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Figure 1. Cabbage seedlings with typical yellow, V-shaped wedges with necrotic areas at leaf margins. (Courtesy R. Gitaitis)



Figure 2. Cabbage leaf with typical V-shaped necrotic areas at leaf margin. (Courtesy A. Alvarez)



Figure 3. Cabbage with typical V-shaped necrotic areas at leaf margins. (Courtesy R. Campbell)



Figure 4. Cabbage with typical V-shaped necrotic areas at leaf margins. (Courtesy M. Goto)



Figure 5. Cabbage with black, necrotic vascular bundles in stem tissue. (Courtesy J. Cho)

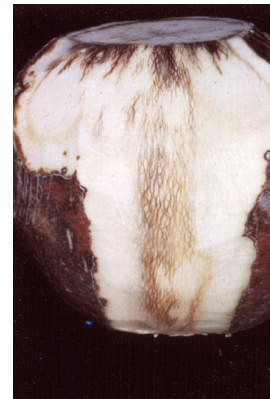


Figure 6. Rutabaga with vascular discoloration. (Courtesy M. Shurtleff)

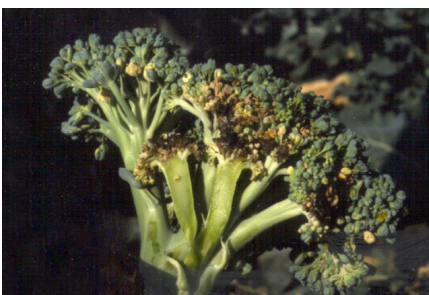


Figure 7. Broccoli with blight and rot of flower buds. (Courtesy M. Shurtleff)



Figure 8. Cauliflower with typical V-shaped necrotic area on leaf and rot of flower head. (Courtesy B. Jacobsen/M. Shurtleff)