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College of Agricultural, Consumer and Environmental Sciences

report on
PLANT
DISEASE

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GRAY-MOLD ROT OR BOTRYTIS BLIGHT OF VEGETABLES

Gray-mold rot or Botrytis blight, caused by the widespread fungus *Botrytis cinerea*, affects most vegetable and fruit crops, as well as a large number of shrubs, trees, flowers, and weeds.

The disease is favored by cool moist conditions. Cool, damp, poorly ventilated greenhouses are ideal for the disease, and Botrytis blights are probably the most common diseases of greenhouse-grown crops, especially in the spring and fall when the vents of greenhouses are closed at night to prevent heat loss. In the greenhouse, gray mold is often said to be a disease of bad management. Gray-mold losses in the field are severe following prolonged periods of overcast skies, fogs, heavy dews, or light drizzly rains.

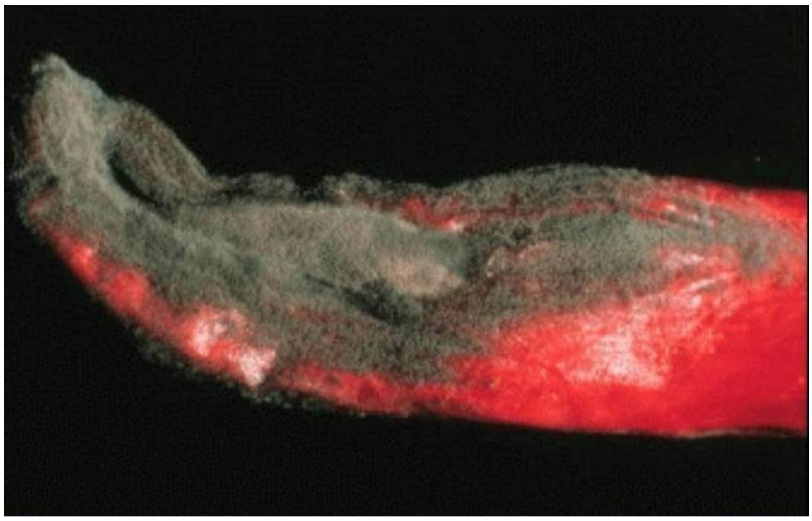

Figure 1. Botrytis fruit rot of pepper. Note the typical dense gray mold on the decayed area (courtesy A.O. Paulus).

Figure 2. Botrytis blight of tomato plant.

The fungus causes primarily blossom blights and fruit rots, but can also cause damping-off, bud rot, stem cankers or rots, leaf spots or blights, bulb rots, and tuber or root rots (Figures 1-7). *Botrytis* is also a problem on fruits and vegetables in cold storage and subsequent shipment because the fungus is able to function at temperatures just above freezing. With some possible exceptions, *Botrytis* mainly attacks tender tissues (flower petals, buds, or seedlings), weakened or injured tissues, and aging (senescent) and dead tissues. Actively growing tissues, other than flower petals, are seldom invaded directly.

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SYMPTOMS

Symptoms of Botrytis diseases vary greatly depending on the host and plant part attacked. Common symptoms include a gray to brown discoloration, water soaking, and a fuzzy whitish gray to tan mold (mycelium and spores) growing on the surface of affected areas.

Blossom Blights and Fruit Rots

Blossom blights often precede and lead to fruit and stem rots. Aging flower petals of beans, carrot, celery, eggplant, onion, pepper, squash, and tomato are particularly susceptible to colonization by *Botrytis* species, and under cool, humid conditions abundant mycelium and conidia (spores) are produced on colonized petals. The fungus often grows from the fading flower petals into the rest of the inflorescence, or into developing fruit and destroys part or all of the fruit.

Figure 3. Botrytis fruit rot of tomato. Note the dense gray mold on the affected fruits.

Fruit can also be infected by conidia entering through growth cracks, cuts, stem scars, insect wounds, or lesions made by other pathogens. Infected fruit develop water-soaked, yellowish green or grayish brown irregular lesions which can be somewhat soft and spongy in texture. When conditions are favorable, mycelium and conidia are produced on the lesion surface. The fungus can infect the fruit of many vegetables, including cucumber; squash; eggplant; pepper (Figure 1); tomato (Figure 3); snap bean (Figure 4), kidney, and Lima beans; and lentils.

Figure 4. Gray mold lesions on the pods of snap beans.

Leaf and Head Rots

Botrytis leaf infections can develop on some crops. Leaf symptoms first appear as small, soft, yellowish or tan spots. Later the spots become whitish gray or tan, and may enlarge and coalesce to the point where they can involve the entire leaf (Figure 2). Lettuce (Figure 5), escarole, endive, onion, and cabbage may be damaged severely. Botrytis first infects the lower, older leaves, often those in contact with the soil. Diseased areas become yellow and support a heavy growth of gray mold. Under cool, moist conditions, lettuce heads may be covered with fuzzy gray mold. The inner leaves commonly become a slimy mass. Under dry conditions, a firm brown-to-black decay rots the stem base, and the head breaks off and dries up. Sometimes there is no external evidence that the inner leaves have rotted. Leaf rot is also common on greenhouse-grown rhubarb and rape. Onion leaves damaged by ozone are particularly susceptible to *Botrytis* leaf infection with lesions developing directly on the ozone-damaged spots.

Damping Off

Seedlings collapse from a soft, tan-to-brown, water-soaked rot of the stem at or near the soil line. The typical gray mold soon develops on the decayed tissue. Damping-off of vegetable and flower seedlings

by *Botrytis* occurs primarily in cold frames where the humidity is high, but can also occur in the field if the seeds are contaminated with sclerotia or mycelium, or if *Botrytis* is present in the soil.

Stem and Bud Rots

Stems or stalks of tomato and many other plants can be infected in the greenhouse or field through leaf scars or wounds, or leaf infections can progress into stem tissue (Figure 2). Stem lesions are dark, sunken, and elongated with distinct margins, or they may spread throughout the stem. In cloudy, wet weather infected tissues become covered with the typical grayish brown mold (Figure 8), and hard, black sclerotia may be produced.

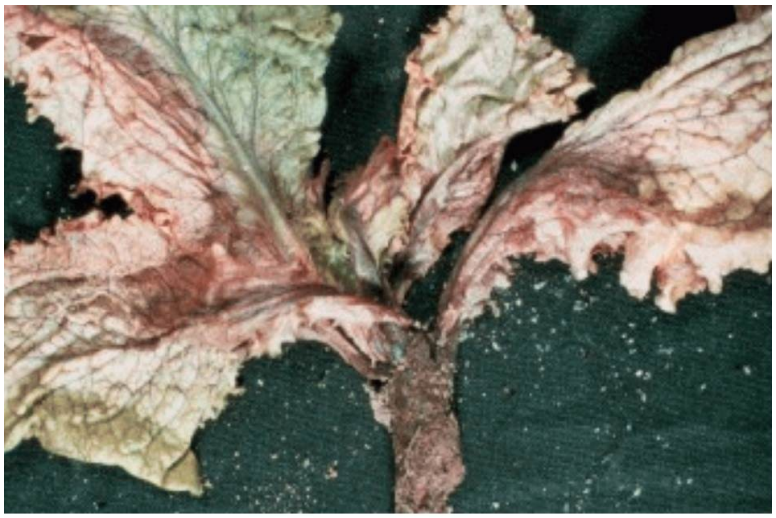

Figure 5. A lettuce plant killed by Botrytis blight.

Figure 6. Gray mold on carrot.

Bulb and Root Rots

Lesions can develop on any part of the root or bulb surface, but they are more likely to form at the crown, at wounds, or at the lower tip. Lesions usually appear soft, watery, and tan in color, later becoming somewhat spongy, and dark brown. Eventually affected tissues may dry to form a grayish, leathery decay. Pockets of mycelium may develop between decayed bulb scales or on the surface of root lesions. Black sclerotia can also form on and in decayed tissue, except at low temperatures, when only a fine white mold develops. Gray mold rot causes considerable damage on stored carrot (Figure 6), parsnip, mangel, beet, endive, chicory, turnip, and rutabaga, but usually affects only topped roots. The bulb rot phase is common on onion (Figure 7) and garlic, but also occurs on other bulb crops.

DISEASE CYCLES

Outdoors, *Botrytis* overwinters in the soil as mycelium on plant debris, and as black, hard, flat or irregular sclerotia in the soil and plant debris, or mixed with seed. The fungus is spread by anything that moves soil or plant debris, or transports sclerotia. The fungus requires free moisture (wet surfaces) for germination, and cool [60 to 77°F (15 to 25°C)], damp weather with little wind for optimal infection, growth, sporulation, and spore release. *Botrytis* is also active at low temperatures, and can

cause problems on vegetables stored for weeks or months at temperatures ranging from 32 to 50°F (0 to 10°C). Infection rarely occurs at temperatures above 77°F (25°C). Once infection occurs, the fungus grows over a range of 32 to 96°F (0 to 36°C).

Figure 7. Neck rot of onion caused by a *Botrytis* sp.

Masses of microscopic conidia (asexual spores) are produced on the surface of colonized tissues in tiny grape-like clusters (Figures 8 and 9). They are carried by humid air currents, splashing water, tools, and clothing, to healthy plants where they initiate new infections. Conidia usually do not penetrate living tissue directly, but rather infect through wounds, or by first colonizing dead tissues (old flower petals, dying foliage, etc.) then growing into the living parts of the plant.

Sclerotia are the primary means of survival in the field, and are viable within a temperature range of 39 to 131°F (4 to 55°C). The sclerotia generally produce conidia, and occasionally infection hyphae which can penetrate directly.


Figure 8. Typical dense mold of a *Botrytis* sp. on an infected garden plant.

DISEASE MANAGEMENT

1. Buy high-quality seed of recommended varieties. Treat the seed before planting.

2. Plant in a light, well-drained, well-prepared, fertile seedbed at the time recommended for your area. If feasible, sterilize the seedbed soil before planting, preferably with heat. Steam all soil used for plant beds at 180°F (82°C) for 30 minutes or 160°F (71°C) for one hour.

3. Avoid heavy soils, heavy seeding, overcrowding, poor air circulation, planting too deep, overfertilizing (especially with nitrogen), and wet mulches.

4. Strive for steady vigorous plant growth, not a soft luxuriant growth. Fertilize plants on the basis of a soil test.

5. Keep the greenhouse and seedbed soil somewhat dry after planting. Allow plants to get plenty of light. Keep the greenhouse, hotbed or cold frame glass clean. The glass sash should not leak water on the plants.

6. In greenhouses and seedbeds, provide for maximum air circulation, avoid excessive humidity, and do not allow water to form on the foliage. At night, maintain the greenhouse temperature higher than that outdoors, to prevent condensation of water on leaves. Some night heating may be necessary in Illinois through mid-June and starting again in early September.

7. Circulate the air with fans when heating greenhouses to keep warm, dry air in motion, and to prevent the development of stagnant air pockets. Botrytis will not be a problem if the humidity is kept below 90 percent.

8. Where possible, practice surface watering. Keep water off the foliage. Water plants early in the day to allow time for the foliage to dry before sunset.

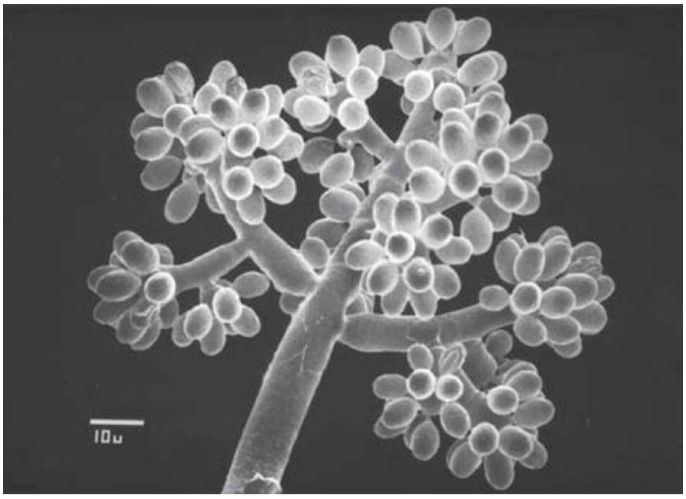

Figure 9. Conidiophore and conidia of *Botrytis* spp.

9. Apply recommended fungicides when conditions favor disease development. Fungicides should be used with caution because the gray mold pathogen is often quick to develop fungicide-tolerant races; fungicides then only serve to suppress natural competitors, often making the disease more severe. For the up-to-date recommendations on fungicide use for control of gray mold on vegetables, refer to the current edition of publication number C1373, "Midwest Vegetable Production Guide for Commercial Growers" (www.btny.purdue.edu/pubs/id/id-56/). This publication is available from ITCS, University of Illinois, 1917 S. Wright St., Champaign, IL 61820; or call 1-800-345-6087.

10. Where practical in greenhouses and gardens, carefully remove the first fruit infected with gray-mold rot from the growing area and burn or bury. Ideally, all diseased plants and plant parts should be removed and destroyed.

11. Avoid wounding or damaging the fruit during harvest and handling, and remove debris from storage areas. Store only blemish-free, clean vegetables in a cool environment where the humidity is high enough to prevent shriveling, but does not allow free moisture to form. The temperature for most vegetables should be as close to freezing as possible.

12. After harvest, where feasible, carefully collect, remove and burn, or cleanly plow under all crop debris.