



## BACTERIAL DISEASES OF BEANS

There are three major bacterial diseases of common beans: common bacterial blight (and its variant, fuscous blight), halo blight, and bacterial brown spot. These diseases have had major impact on bean production.

In rainy and windy seasons it is not unusual to suffer a loss in yield of 10 to 20 percent or more from these diseases. However, the greatest loss is in a reduction in quality. When pods are infected only one percent "serious blemishes" are allowed for grade A cut beans. Processing beans are graded substandard when four percent is exceeded. Seriously diseased commercial crops are often not harvested.

In many situations, symptoms of the different bacterial blights appear very similar. For example, halo, common, and fuscous blights are difficult to distinguish at temperatures above 75 °F (24 °C). Laboratory isolation is nearly always necessary for positive identification of the bacterial species.

### COMMON BACTERIAL BLIGHT

Common bacterial blight, caused by the bacterium *Xanthomonas campestris* pv. *phaseoli*, affects green or snap, wax, field, and lima beans as well as the scarlet runner, mung, Tepary, urd, moth, hyacinth, and civet or Sieva beans, the Washington or white-flowered lupine, and fenugreek (*Trigonella*). Fuscous blight, caused by fuscous variant of the bacterium, occurs on field beans, civet, and scarlet runner beans. Common blight affects the foliage and pods of beans and causes significant losses in both yield and seed quality. The disease typically develops when contaminated seed is planted, when plantings are made in fields with a history of the disease, and when the climate is consistently hot and wet or humid.

### Symptoms

Common and fuscous blights are commonly first seen as small, angular, light green, water-soaked or translucent spots (lesions) on the leaves. During warm, wet conditions the lesions rapidly enlarge and merge. As they develop the centers become dry, brown, and surrounded by a distinct, narrow, zone of yellow tissue. In highly susceptible varieties, the lesions continue to expand until the leaves appear scorched or sun scalded (Figure 1). Such leaves soon become ragged and torn by wind and rain. Later, they wither and drop off.



Figure 1. Common bacterial blight of bean.

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Pod lesions start as round, water-soaked dots that enlarge, merge, dry, and form sunken, irregular, frequently reddish brown blotches (Figure 2). When severe, entire pods may be badly shriveled and die. Seeds in such pods either fail to develop or are shriveled. Seeds in less severely affected pods develop normally and show no signs of disease. Other seeds may become slightly wrinkled. When seeds containing the bacteria are planted, many fail to germinate. Those that do germinate produce seedlings with blight lesions on the cotyledons, stems, and first true leaves.

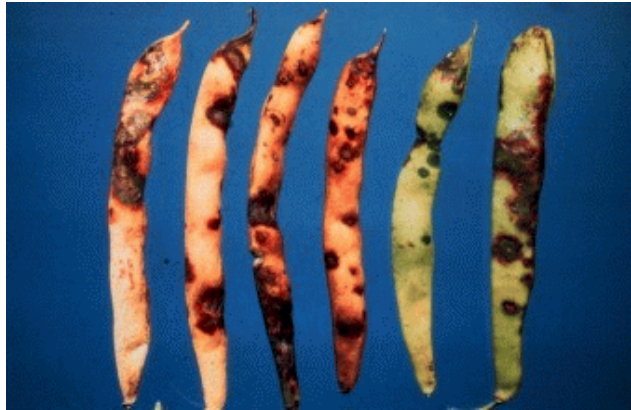


Figure 2. Common bacterial blight on pods..

The stems of seedlings may have water-soaked, sunken areas that enlarge and develop into reddish streaks. Any time during the season affected stems commonly crack and become girdled by water-soaked cankers or rot. The tops may break over during a rain or strong wind. In humid weather, a yellowish bacterial ooze, that later dries to form a crust, may be evident on the lesions on infected pods, leaves, stems, and cotyledons.

## HALO BLIGHT

Halo blight, caused by the bacterium *Pseudomonas syringae* pv. *phaseolicola*, affects green or snap, wax, lima, scarlet runner, and civet beans, and kudzu.

### Symptoms

Leaf symptoms appear several days after infection as small (1/8 to 1/4 inch, or 3mm), water soaked, tan brown, angular spots, each surrounded by a relatively wide, diffuse, pale green to yellow green tissue (halo). Halos do not develop or tend to disappear if the temperature is above 70° to 75°F (21° to 23°C). The spots then become reddish brown to brown, and dry. Infection foci generally remain small. In cases of severe leaf infection, plants develop a generalized systemic chlorosis. The systemic chlorosis is particularly pronounced at 64° to 73°F (18° to 23°C). Leaves with systemic infections lack halos. The intervinal tissues of these leaves are yellow, with the veins remaining dark green. At 7-10 days after infection, bacteria ooze from the sub stomatal cavities to give lesions a greasy, water-soaked appearance. Bacteria are thus available for secondary spread of the disease. Infected plants may defoliate, wilt, and die. Diseased plants may be dwarfed, with the upper leaves crinkled and mottled. Dark green, water-soaked areas may also be visible on the stems.



Figure 3. Halo blight of beans.



Figure 4. Left, Lesions and bacterial crust of halo blight on pod (courtesy A.W. Saettler); Right, Halo blight on pods (courtesy A.F. Sherf).



Young seedlings infected with halo blight develop a chlorosis (yellowing), which may be general or confined to the young trifoliolate leaves at the top of the plant. The chlorosis is caused by a toxin produced by the halo blight bacterium.

Pod infections develop rapidly under cool, wet conditions resulting in oval to circular, dark green, water-soaked, "greasy" lesions to 3/8 inch (9 mm) in diameter. Halos do not develop around pod lesions. As pods mature and turn yellow, pod lesions may remain green and may exhibit crusty bacterial ooze on the surface. Developing seed may be shriveled or discolored if lesions expand to involve the pod surface. With age the lesions become slightly sunken and reddish brown.

## BACTERIAL BROWN SPOT

Bacterial brown spot is caused by the bacterium *Pseudomonas syringae* pv. *syringae* (Figures 4 and 5). In addition to attacking lima, green or snap, and wax beans, the bacterium infects a wide range of host plants. These hosts include civet, hyacinth, yard-long, and broad beans, soybeans, cowpea, clovers, alfalfa, corn, sorghums, Sudangrass, buckwheat, kudzu, lilac, ash, poplar, Forsythia, wild and cultivate stone fruits (*Prunus* spp.), apple, pear, *Citrus* species, rose, flowering stock, hibiscus, jasmine, Florida velvetbean, and many others. Fortunately only bean isolates are highly virulent on beans.

### Symptoms

On lima beans, small, light gray spots with yellowish brown borders develop on the upper leaf surface. Water-soaking is not as pronounced as it is in common and halo blights. Later, the gray centers may crack open or drop out, leaving small holes. The veins on the under leaf surface turn red or reddish brown. The spots on the stems and pods are somewhat more elongated than those on the leaves. In severe cases much of the foliage may be killed.

On green and wax bean leaves, small (1/8 to 3/8 inch or 3 to 9 mm in diameter), oval, brown lesions surrounded by a narrow, yellow-green halo develop. The lesions may merge and their centers fall out giving leaves a tattered appearance. When the bacterium becomes systemic, tan sunken lesions with a reddish brown margin form on the stems and petioles. Bacterial exudate (ooze) and water-soaking are rare prior to lesion development. Pods develop somewhat circular, dark green, water-soaked areas which gradually enlarge, suddenly become depressed and tan, then dark brown with a distinctive, reddish brown margin. Pods infected when young are bent at an acute angle or are twisted. Bacterial ooze is white to cream colored.



Figure 5. Bacterial brown spot on leaf, caused by *Pseudomonas syringae* pv. *syringae*. (Courtesy A.W. Saettler)



Figure 6. Bacterial brown spot on pods, caused by *Pseudomonas syringae* pv. *syringae*. (Courtesy H.F. Schwartz)

## Disease Cycles

The disease cycles of all three pathogens are very similar. The bacteria are all disseminated in infected seed and from plant to plant and field to field by wind-driven and splashing rains, sprinkler irrigation, surface-drainage water, insects, birds, large animals, humans, farm machinery, tools, and other agencies. The bacteria may survive for 6 to 18 months in plant refuse (on or above the soil surface and under dry conditions), in bean cull piles within or near fields, on volunteer plants from a previous crop, and even on the surface of weeds. Long-distance spread is generally by seed, but there is evidence that minute aerosol particles from rainsplash carrying the bacteria can float in the air for more than two hours. Windborne particles carrying bacteria could move many miles during rainstorms.

There are two types of field infection. **Primary infection** involves the invasion of bean seedlings as they emerge from the soil. This occurs when the seed is infected or when an emerging seedling comes into contact with infected plant material. **Secondary infection** is due to spread from a primary source to other growing plants; often involving only one or two isolated plants, or it can cover an entire field or area. In severely diseased fields nearly all infection is secondary.

Bacteria enter a plant through natural leaf openings (stomata and hydathodes), and through wounds created by hail, blowing soil particles, insects, or cultivator injury. The brown spot organism often infects the leaves through rust pustules; thus, rust and bacterial brown spot are often found together in the same lesion.

When an infected seed sprouts and the seedling emerges, bacteria ooze to the surface of the diseased cotyledons, are splashed to a neighboring plant, enter the stomata, and infect. Stomate or hydathode entry also occurs from bacteria that survive on surface debris and are rainsplashed to the leaves and stems. Symptoms appear two to five days after penetration for common, fuscous, and halo blights. Once inside the plant the bacteria may move systemically, by way of the vascular bundles, to the leaves, stems, pods, and into the seed. The bacteria are carried by rainsplash to neighboring leaves and pod surfaces. They invade growing pods largely along the suture, and enter the seed through the vascular tissue. The bacteria remain on or just below the surface of the seed. The bacterial pathogens have been recovered from 3- to 14-year-old seed. The halo blight organism was found to be viable after passing through sheep fed on diseased bean plants.

Usually only a few seeds in a seed lot serve as a source of primary inoculum. One infected seed in 16,000 is thought to be sufficient to supply inoculum for a severe outbreak of halo blight where essentially every plant in one or more fields becomes infected. Seed from clean fields can be surface contaminated by small dust particles which adhere to the surface of the seed during threshing and milling.

Common blight and bacterial brown spot are favored by cloudy damp weather and relatively high air temperatures (82° to 90°F or 28° to 32°C), while halo blight thrives under damp and cooler conditions (64° to 72°F or 18° to 22°C).

## Control

1. Plant only certified, pathogen-free seed grown in semiarid areas of Idaho and California. In these areas the humidity and rainfall is normally too low for the bacteria to infect plants. The use of

pathogen-free seed cannot be overemphasized. All seed stock of reputable companies is treated with streptomycin to reduce or eliminate surface contamination. The seed is also inspected by State Department of Agriculture officials. For information on seed treatment, read the University of Illinois Extension Service Circular 1328, Midwest Vegetable Production Guide (revised annually).

2. Do not enter fields or gardens and cultivate or handle plants wet with dew or rain. Use a suggested herbicide to keep fields and border areas weed-free.
3. Practice good sanitation. Whenever feasible, collect and burn (or cover completely by thorough disking followed by deep plowing) all infected plant debris as soon after harvest as possible. Fields subject to wind and water erosion should be planted to a nonsusceptible cover crop before winter. Planters, harvesters and other equipment should be sanitized by spraying with a disinfectant such as chlorine dioxide, sodium hypochlorite, or a quaternary ammonium compound before moving from an infected to a blight-free field. Storage areas should also be sanitized.
4. Grow beans in the same area or field only once in three years or longer. In the rotation exclude all beans, soybeans, and cowpeas, or other plants affected by one or more of these diseases.
5. Foliar sprays with a fixed copper compound, applied weekly starting four days after seedling emergence or at the first sign of disease have given fair to good control when continued to harvest. Thorough coverage of the plants is required. Properly applied aerial sprays are superior to applications by ground equipment. Sprays provide good control of bacterial brown spot and halo blight, but only moderate control of common blight.
6. Efforts to develop bean varieties resistant to bacterial blights with acceptable quality and other characteristics have not been very successful partly because of the appearance of new races of the organisms. Grow bean varieties recommended for your area that are somewhat resistant to all three bacterial diseases.