



BACTERIAL FOLIAGE DISEASES OF SOYBEANS

Three bacterial diseases—blight, pustule, and wild-fire—attack soybeans wherever they are grown, provided that the weather conditions are favorable for their development. Severe infection by any one of the diseases may cause premature defoliation. In most years in Illinois, bacterial blight and pustule can be found in 40 to 90 percent of the soybean fields in the state. The wildfire disease is more serious in the southern United States. The prevalence and the severity of these diseases fluctuate from year to year, depending on weather conditions. Yield losses range from zero to 15 percent with one to two percent common. Like many other diseases of soybeans, bacterial diseases are more severe in wet years than in dry ones.



Figure 1. Bacterial blight. Young distorted leaves showing yellow to light brown spots, typical of blight.

BACTERIAL BLIGHT

Bacterial blight is the most common bacterial disease of soybeans in Illinois. Cool, rainy weather in June and July favors the development of bacterial blight. It ceases to develop during hot, dry weather.

Symptoms

Bacterial blight appears on soybean leaves in June or early July as small, angular, yellow to light brown spots (lesions) with water-soaked centers. As the tissues die, the centers of the lesions soon turn dark reddish brown to black and usually are surrounded by a water-soaked margin bordered by a yellowish green halo. Infected young leaves frequently are distorted, stunted, and yellowish (chlorotic).

Angular lesions enlarge in cool, rainy weather and may merge to produce large, irregular dead areas. Diseased tissue in older lesions may tear and drop out, giving infected leaves a ragged appearance. Frequently, the leaves are badly shredded after strong winds and hard rains (Figure 1). Early defoliation of lower leaves may occur.

Lesions first appear on the cotyledons, usually at the margins. These lesions enlarge and turn dark brown as the tissue collapses. Young seedlings grown from infected seed commonly are stunted and blighted and usually die (Figure 2).

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The pods, petioles, and stems are also susceptible. Initially, lesions on the pods are small and water-soaked. Later, after enlarging, they merge to involve much of the pod. Lesions eventually turn dark brown to black. Seeds within affected pods may become infected and be eventually covered with a slimy bacterial growth. Stored seeds may appear healthy or may develop a variety of symptoms, including shriveling, sunken or raised lesions, or become slightly discolored. Infected seeds lack vigor and germinate poorly. Large, black lesions may develop on the stems and petioles.



Figure 2. Seedling blight resulting from a seed-borne infection by the bacterial blight organism.

Disease Cycle

The bacterial blight organism, *Pseudomonas syringae* subsp. *glycinea* (synonym: *P. glycinea*), overwinters in seeds, and in Illinois, in infected surface crop residue. Seeds become infected through the pods during the growing season, during harvesting, and during cleaning. Early infections of cotyledons may be a major source of inoculum that produces secondary lesions on seedlings. The bacterium spreads in the field during windy rainstorms and during cultivation while the foliage is wet. The bacteria survive as “residents” or epiphytes on leaf surfaces, buds, and stems, needing only the proper temperature and windblown rain to enter the soybean tissue. Invasion can occur either through the stomates on the underleaf surface or through wounds created by wind and wind-driven rain. After penetration the bacteria multiply between the cells in the leaf mesophyll where a toxin is produced that inhibits the synthesis of chlorophyll. Typical water-soaked lesions can be seen 5 to 7 days after infection.

Outbreaks of bacterial blight usually follow cool, rainy weather that is accompanied by strong winds. Optimum growth of the blight organism takes place when temperatures are 75° to 79°F (24° to 26°C). No growth occurs above 95° F (35°C) or below 39°F (4°C). At least nine races of the causal bacterium have been identified using differential soybean cultivars. Strains of the bacterium infect bean (*Phaseolus vulgaris*), lima bean (*P. lunatus*), tepary bean (*P. acutifolia*), and cowpea (*Vigna unguiculata*).

BACTERIAL PUSTULE

Bacterial pustule is more common in the southern half of Illinois when frequent showers occur during July and August. This disease also shows up occasionally in the northern third of the state. Premature leaf drop caused by this disease results in a slight loss of yield. Seed size is smaller and there are fewer seeds than on a healthy plant.

Symptoms

The symptoms of the pustule disease are somewhat similar to those of bacterial blight. Pustule however, is a warm, moist-weather disease that usually appears during the first two weeks in July. It usually persists through mid-August or later, and generally attains maximum infection toward the end of July. The small, pale, yellowish green spots (lesions) with dark reddish brown centers are most conspicuous on the upper leaf surfaces (Figure 3, left). The central part of each lesion develops into a minute, raised, light-colored pustule—usually on the lower leaf surface (Figure 3, right). Leaf spots sometimes form

without developing pustules. Bacterial pustule is distinguished from blight by the presence of the pustule and the absence of water-soaked areas in the early stages of development. In later stages, the pustules rupture and dry, making the two diseases difficult to tell apart late in the season.

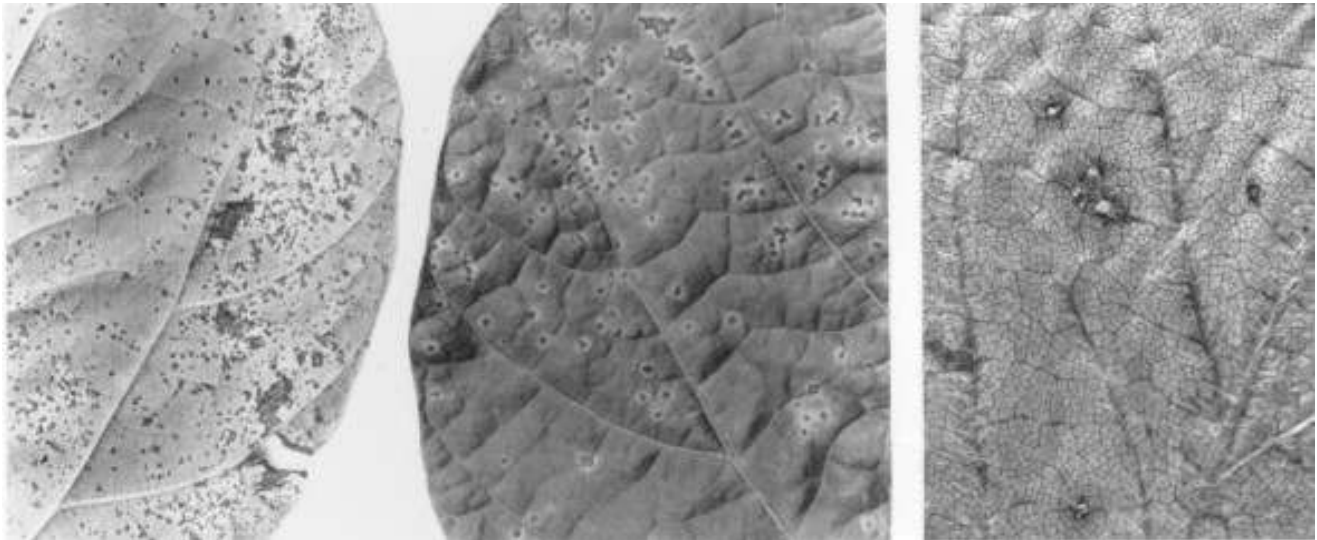


Figure 3. Bacterial pustule. Left, underleaf surface; center, upperleaf surface; right, close-up of the raised pustules in the center of lesions.

In bacterial pustule, many small lesions may merge—producing large, irregular, mottled brown, dead areas with yellowish margins. The leaves become ragged when parts of the brown, dead areas tear away during windy, rainy weather. Severe infection often causes some defoliation. Small, reddish brown, slightly raised spots may develop on the pods of susceptible soybean cultivars.

Disease Cycle

The pustule bacterium, *Xanthomonas campestris* subsp. *glycines* (Synonyms: *Xanthomonas glycines* and *X. phaseoli* var. *sojensis*), overseasons in crop residue on the soil surface, on seeds, in the rhizosphere of wheat roots and other crops. Additional host plants include garden beans (*Phaseolus vulgaris*) cowpea (*Vigna*), redvine, buckwheat-vine or ladies-eardrops (*Brunnichia cirrhosa*) and in India, twinflower Dolichos (*Dolichos biflorus*), and hyacinth-bean (*D. lablab*).

The pustule bacterium is spread in the field by splashing water, windblown rain, and cultivation when the foliage is wet. Bacteria enter the soybean plant through natural openings (stomata) and wounds. The bacteria multiply between the cells in invaded soybean tissue. New infections may occur throughout the growing season whenever warm-to-hot and wet or rainy conditions prevail. Bacterial pustule, unlike bacterial blight, is not checked by high temperatures. The optimum growth of the organism occurs at temperatures of 86° to 98°F (30° to 33°C). The maximum at which growth takes place is 100°F (38°C); the minimum, 50°F (10°C).

WILDFIRE

Wildfire disease rarely occurs in Illinois and is almost always associated with bacterial pustule. Its present significance is minor. Rarely, when the disease is severe, almost complete defoliation may occur.

Symptoms

Light brown to black, dead spots that are 1/8 to 1/2 inch (2 to 15 millimeters) or more in diameter and of variable shape develop on the leaves. These lesions are nearly always surrounded by a broad conspicuous yellow halo (Figure 4). Restricted spots may occur without the sharply delineated yellow halo; these lesions are dark brown to black, in contrast to the usual light brown, more expansive type of lesion. The halo distinguishes wildfire from other bacterial diseases of soybean. In damp weather, the lesions enlarge and merge forming large, dead areas in the leaf that become dry, tear away, and produce tattered leaves.



Figure 4. Wildfire. Note the wide halos around the dark lesions.

A bacterial pustule is almost invariably present in the center of a wildfire lesion. Evidence exists that the presence of bacterial pustule is required for wildfire infection. Bacterial blight lesions also may serve in the same way.

Disease Cycle

The wildfire bacterium, *Pseudomonas syringae* subsp. *tabaci* (synonym: *P. tabaci*), overwinters in infected crop residue and seeds. The bacterium multiplies on the root surfaces of many crop and weed plants and is spread by splashing water and windblown rain. Water congestion of soybean leaves caused by wind driven rains is often required for invasion and infection. The optimum growth of the bacterium occurs at temperatures of 75° to 82°F (24° to 28°C) The maximum temperature permitting growth is 100°F (38°C); the maximum, about 39°F (4°C).

Alternating freezing and thawing kills the bacterium and influences its geographical distribution. Isolates of the bacterium from soybean are similar to those from tobacco where the bacterium causes a common and serious disease. Tobacco isolates, however, generally are more pathogenic on tobacco than on soybeans. Soybean isolates are equally pathogenic on soybeans and tobacco.

Control

1. Plant only high-quality, pathogen-free seeds from a reputable dealer.
2. Rotate soybeans for one year or more with corn, sorghum, alfalfa, clovers, or cereals.
3. Completely cover the stubble and other plant residue by clean plowing after harvest. This practice may not be feasible where wind or water erosion are problems.
4. Do not cultivate fields when the foliage is wet.
5. Grow well-adapted soybean cultivars recommended for the area, other factors being equal. Pustule-resistant cultivars suggested for use are given in Illinois Agricultural Pest Management Handbook. This circular is revised annually and should be available at your nearest Extension office.