

## **Fun Facts - The top dry-bean producing States in 2006-08 were the following:**

- North Dakota--38 percent.
- Michigan--14 percent.
- Nebraska--11 percent.
- Minnesota--10 percent.
- Idaho--7 percent.
- California--4 percent.
- Washington--4 percent.
- Colorado--3 percent.

### **[USDA ERS - Dry Beans](https://www.ers.usda.gov/topics/crops/vegetables-pulses/dry-beans.aspx)**

<https://www.ers.usda.gov/topics/crops/vegetables-pulses/dry-beans.aspx>

## **Comprehensive Bean Production Handbooks**

University of California

<http://beans.ucanr.edu/files/80592.pdf>

North Dakota State University

<https://www.ag.ndsu.edu/publications/landing-pages/crops/dry-bean-production-guide-a-1133>

## **UNL Extension Publications (Shown on following pages)**

## Fertilizer Management for Dry Edible Beans

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Soil sampling and proper N fertilization of dry beans will help producers obtain consistent top yields.

Excellent yields of high quality dry beans can be obtained in western Nebraska. Traditional growing areas include the Panhandle and southwest Nebraska, western Wyoming, and eastern Colorado. High bean yields are produced on disseminate fertile soils. Dry beans respond to fertilizer if soil tests show nutrient levels in the low to medium-fertility range.

Soil samples representative of the field should be taken preplant from the 0-6" layer (usually 0-6") for pH, phosphorus, potassium, zinc, iron, and salinity and to a depth of 30 inches for nitrate-nitrogen. Information from these tests allows the producer to make informed decisions on fertilizer needs and to determine the potential for any soil pH or salinity problems.

### Nitrogen Recommendations

Dry beans are a member of the legume family and symbiotically fix nitrogen from the air. The nodules on the roots contain bacteria that fix nitrogen for plant use (*Figure 1*). Biofertilizer containing the Rhizobium bacteria can be purchased and applied with the seed or to the soil in the seed furrow.



Figure 1. Nodules on dry bean roots.

If there is no history of dry bean production on the field, inoculation of the beans at planting time is essential. If dry beans recently were grown on the land and the beans were well-maintained, inoculation is unnecessary.

Research in the Nebraska Panhandle has shown adding nitrogen fertilizer can increase seed yield if soil nitrate-N levels are low. Dry beans need 100 to 125 pounds of N per acre for top yields, in addition to N fixed by the plant. This additional N can be residual soil nitrogen, fertilizer nitrogen, nitrogen in irrigation water, nitrogen in manure, or a combination of these sources.

N rates based on residual nitrate-N are shown in Table 1.

Table 1. Nitrogen fertilizer suggestions for irrigated dry beans (2700-3000 lbs/ac) 2006.

LA N2, lb on 30 inches	ppm N2-N on 30 inches	Fertilizer N, lb/acre
0-20	0-2.2	100
21-40	2.3-4.6	80
41-60	4.7-6.9	60
61-80	7.0-9.3	40
81-100	9.4-11.7	20
>100	>11.7	0

Nitrogen rates can be reduced if the irrigation water has a high nitrate level. The pounds of nitrogen applied per acre foot of irrigation water is calculated by multiplying the parts per million nitrate-N in the irrigation water times the factor 2.72.

Surface irrigation water nitrate levels fluctuate over time but normally will be relatively low. During the irrigation season, nitrate levels in the North Platte River in western Nebraska range from 1.5 to 5.0 ppm nitrate-N. The median level was 3 ppm or 8 lb Nitrate foot. Well waters show considerable difference in nitrate-N, so well water testing is recommended.

The use of nitrogen fertilizer for dry beans does have some limitations. Excessive N rates can delay maturity. The same effect is seen when planting dry beans in a newly plowed alfalfa field. Planting dates and/or varieties should be adjusted

## Fertilizer Management for Dry Edible Beans

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EC509

## Direct Harvest of Dry Edible Beans

*A Nebraska Perspective*

John A. Thomas, Extension Educator, John A. Smith, Professor Emeritus, and Robert G. Wilson, Professor Emeritus  
 University of Nebraska Panhandle Research and Extension Center



# Direct Harvest of Dry Edible Beans: A Nebraska Perspective (EC309)

EC309



University of Nebraska—Lincoln Extension, Institute of Agriculture and Natural Resources  
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G2013

## Western Bean Cutworm in Corn and Dry Beans

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This NebGuide addresses the life cycle, scouting and treatment of the western bean cutworm in corn and dry beans.

Western bean cutworm (WBC) can be a serious pest in corn and dry beans. Larval feeding damages both crops through reduced yield and quality. In corn, direct feeding loss may be compounded by fungal infections associated with larval feeding and waste products. In dry beans, damaged or “worm-chewed” beans are a significant quality factor for both processed and bugged dry beans. Western bean cutworm infestations occur every year in western Nebraska and the surrounding region, but can be found in high numbers throughout the state. Traditionally, the western bean cutworm has largely been limited to areas in the western Great Plains, but in the last 10 years, western bean cutworm has steadily spread eastward through the Corn Belt to as far east as Pennsylvania.

**Life History**

Western bean cutworm has one generation per year with moth emergence usually beginning in early July. The emergence date can be predicted by calculating growing degree days. Starting heat unit accumulations on May 1, using a base air temperature of 50°F, growing degree days for 25 percent, 50 percent, and 75 percent moth emergence are 1,115, 1,421, and 1,536, respectively.

Populations vary from year to year, but there is a tendency for greater populations to occur every six to eight years. Throughout the western Great Plains region, western bean cutworm populations are greater in fields with sandy soils.

Western bean cutworm moths are about 1½ inch long with a wing span of about 1 1/2 inches (Figure 1). The body is light brown, and the wings are generally dark brown with a distinctive pattern. The front wings have a broad white or cream stripe that runs two-thirds of the length of the leading edge. Behind this stripe is a central white spot and, farther away from the body, a half-moon shaped spot. The hind wings are cream colored without markings. When at rest, the wings are swept back over the body. The moths are strong fliers and are known to travel several miles. Female moths emit a pheromone (scent) that attracts males for mating.



Figure 1. Adult western bean cutworm.



Figure 2. Newly laid western bean cutworm eggs.

After mating, eggs are usually laid on either field corn, popcorn, sweet corn, or dry beans. Tomatoes and fruits of nightshade and ground cherry are acceptable but non-preferred hosts. Eggs are laid in masses of 5 to 200 with an average of about 50 eggs per mass (Figure 2). The eggs are 0.85 millimeters in diameter, dome shaped with ridges and reticulations. When first laid, the eggs are pearly white, but within two days they turn tan. Egg development usually takes five to seven days and the eggs turn dark purple shortly (less than 24 hours) before hatching (Figure 3).

After egg hatch, the larvae remain clustered near the egg mass for several hours, feeding on the chorion (shell) of the eggs. The larvae then move to protected feeding sites, the location depending on the growth stage of the host. Larvae feed for about 31 days and develop through five stages (instars) on

## Western Bean Cutworm in Corn and Dry Beans

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G1562  
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## Bacterial Wilt of Dry Beans in Western Nebraska

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Bacterial wilt of dry beans has reappeared in Nebraska dry bean fields. This NebGuide addresses symptoms and identification, life cycle, and management of bacterial wilt in dry beans.

### Introduction

Bacterial wilt of dry beans, caused by *Curtobacterium flaccumfaciens* sp. *flaccumfaciens* (CF), has been a sporadic — but often serious — production problem in dry beans throughout the irrigated High Plains since first being reported in South Dakota in 1972. It was first observed in western Nebraska dry bean production fields in the early-mid 1990s, and continued to be an endemic, economically important problem throughout the 1990s and early 2010s. The disease then only periodically appeared in seed, but had little discernible effect on yields after the implementation of crop rotation and seed sanitation practices.

The pathogen was again identified in 2003 for the first time in this area in almost 25 years. Over the last seven to eight years, it has fully re-emerged in the Central High Plains (Nebraska, Colorado, and Wyoming) and has now been identified from more than 400 fields. Affected fields were planted with dry beans from multiple market classes and seed sources, including yellows, great northern, pinto, kidney, cranberry, black, navy, pinto, and small red. Disease incidence in these fields has varied from trace levels to >90 percent.

### Symptoms

Field symptoms consist of leaf wilting (Figure 1) during periods of warm, dry weather or periods of moisture stress. This occurs because of the pathogen's presence within the vascular system, which blocks normal water movement from roots into the foliage. Plants often recover during evening hours when temperatures are lower but wilt again during the heat of the day. Disease severity and plant mortality are often higher on young plants or those growing from infected seed. Seedlings are particularly susceptible, and if attacked when 2-3 inches tall, usually die (Figure 2). Symptoms on adult plants are less pronounced as the disease generally develops and progresses more slowly.

Infected plants in Nebraska have additionally exhibited symptoms consisting of necrotic lesions surrounded by bright yellow borders (Figure 3). These symptoms may be confused with those caused by common bacterial blight, *Leptotheca amaranthi* sp. *amaranthi*, (*Leptomyces* sp. *amaranthi*) (Figure 4), but bacterial wilt lesions




Figure 1. Leaf wilting symptoms on dry beans due to bacterial wilt.

Figure 2. Death of a dry bean seedling due to bacterial wilt.

## Bacterial Wilt of Dry Beans in Western Nebraska

G1562

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G1786  
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## White Mold of Dry Beans

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White mold symptoms, infection, and control in dry beans for western Nebraska and Colorado.

### Introduction

One of the most important diseases affecting dry beans in western Nebraska and Colorado is white mold caused by *Sclerotinia sclerotiorum*. White mold incidence and severity can be sporadic from year to year, but in recent years average losses of 20 percent have been documented, with losses in a few fields exceeding 60 percent.

### Signs and Symptoms

White mold is initially observed in fields after flowering with wilting in plant canopy (Figure 1). As the disease progresses, water-soaked spots or lesions form on individual leaves, stems, branches, and pods. These ultimately collapse into a watery rotten mass of tissue that becomes covered by a white fungal growth (Figure 2). Infection of stems and branches causes affected plant parts to die, taking on a dried bleached appearance (Figure 3). This bleaching symptom is characteristic of stem and girdler wilts types infected with white mold and differs from the normal tan color resulting from senescence or other diseases. Black and irregularly shaped sclerotia (resting structures of the fungus) form on and within infected plant parts, which also tend to become shriveled.

### Factors Favoring Disease

Development and spread of white mold is greatly influenced by prevailing environmental conditions and certain agronomic practices. The disease tends to be concentrated in localized areas of the field and only rarely affects an entire field. The disease may still occur substantial yield losses during wet, cool weather near the end of the growing season. High humidity, and wet plant canopy and soil surfaces are necessary for the fungus to spread. Thus, favorable conditions for disease development often occur at the end of the season when temperatures are cooler and foliar growth is dense. Yield loss occurs from rotted pods and reduced seed size on plants with girdled stems and branches (Figure 4). Agronomic practices such as irrigation management, plant





Figure 1. Stalk fiber wilting symptoms from white mold infection.

Figure 2. White mold growth on stem and stem, characteristic of advanced white mold infection.

Figure 3. White mold infected plant exhibiting bleached stem and branches.

# White Mold of Dry Beans

G1786

EC1866

## Abiotic Diseases of Dry Beans

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The environment plays a major role in the process of infection and disease development in plants by providing the conditions necessary for pathogens to cause disease. However, adverse environmental conditions or genetic abnormalities also may be responsible for plant damage. This type of damage often is referred to as abiotic disease or stress. Many of the symptoms of these "diseases" may be confused with true dry bean diseases, thus this publication is designed to educate those working with dry bean on how to recognize abiotic problems and avoid unnecessary disease treatments.

### Genetic Disorders

The genetic abnormalities leading to changes in color in dry beans include chimeras, leaf spotting, yellowing, or production of albino plants or seedlings. Chimeras are among the most common genetic disorders. These aberrations, which may be inherited, result from a single site (point) cell mutation or from

Figure 1. Genetic chimerism symptoms in dry bean

Figure 2. Genetic yellowing symptoms in dry bean

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# Abiotic Diseases of Dry Beans

EC1866

## Common Bacterial Blight of Dry Beans in Nebraska

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This NebGuide covers common bacterial blight of dry beans and its management.

### Introduction

Common bacterial blight of dry beans has been seen in Nebraska since the crop was first introduced in the 1920s. As the name implies, it's considered to be a major problem wherever beans are grown, and is the most commonly observed bacterial disease in the Central High Plains. It can be highly destructive during long periods of warm, humid weather, causing reductions in both yield and seed quality.

The last 30 years have seen reduced losses, due to many of today's cultivars having some resistance to the pathogen. This is due to the work of Coyne and Schuster in Nebraska beginning in the 1960s. Further improvements for managing this problem were realized when seed began to be produced in arid areas of the western United States, instead of being locally produced near commercial production fields in western Nebraska.

### Symptoms and Signs

Symptoms begin with small water-soaked spots on the bottom of leaves (Figure 1). The spots enlarge and coalesce



Figure 1. Early symptoms of common blight showing small water-soaked lesions on the underside of leaves.

### History

Common blight is caused by *Xanthomonas axonopodae* pv. *phaseoli* (G. S. Gentry). The disease was recognized for the first time in the U.S. in 1952 and was shown to be damaging to beans from both New Jersey and New York. Curiously, the pathogen was demonstrated to be internally seedborne at this time before it was actually identified as *Bacillus phaseoli* in 1957. Based upon later knowledge and systems of classification, the pathogen has undergone several name changes including *Bacterium phaseoli*, *Phytomonas phaseoli*, *Xanthomonas phaseoli*, and *Xanthomonas campestris* pv. *phaseoli* prior to its current name.

becoming brown, dry, and brittle. A narrow, bright lemon-yellow border of tissue often develops around dried, necrotic lesions (Figure 2), which may be found in both interveinal areas and along leaf margins (Figure 3).

Severe infections result in leaves remaining attached to plants, giving a burned appearance to foliage (Figure 4). Affected pods develop circular, water-soaked areas that may also have yellow masses of bacteria observed on lesions. Later, spots on pods become reddish-brown and mark



Figure 2. Necrotic lesions with narrow yellow border, characteristic of common blight.

## Common Bacterial Blight of Dry Beans in Nebraska

G1956

Extension Circular

# Soilborne Root and Stem Diseases of Dry Beans in Nebraska

EC1869

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G1958

## Halo Blight of Dry Beans in Nebraska

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Halo blight and its management are covered in this NebGuide.

### Introduction

Halo blight, like common bacterial blight, has been found in Nebraska for more than 70 years. It's considered a major problem anywhere moderate temperatures occur during bean production. Great High Plains losses have been reduced by planting cultivars with genetic resistance to the pathogen. While several popular cultivars have good levels of resistance to common and halo blights, they are more prone to infection by root or white mold.

### Symptoms and Signs

The first symptoms of infection are small water-soaked spots on leaflets. Under arid conditions, the infected lower leaf develops around necrotic spots (Figure 1), contrasted with the narrow, bright yellow border around lesions characteristic with common blight (Figure 2). The necrotic spots additionally remain very small (Figure 3), unlike that of common blight (Figure 4).

Infected mature upper leaflet number 11 (collected extensionally, young leaflets become curled and chlorotic and don't show necrotic spots or broad yellow halos. Yellow-green chlorosis becomes more pronounced at temperatures of 68°F

### History

Halo blight is a bacterial disease caused by *Parasponaria syriacus* sp. *phenacolicola* (Fay). This disease first appeared in the state of New York in the early 1920s, and very rapidly became a serious problem. The transmission of the pathogen through seed can partially explain its wide and rapid distribution. Pathogenicity (ability of the organism to cause disease) was proven and determined to be distinct from a different blight pathogen described by Walter Burkholder (bacterial brown spot). The bacterium was initially named *Phytomonas mealyensis* var. *phenacolicola*.

In 1927, the same time that halo blight was identified in the U. S., Florence Hodges was studying a disease of beans. She described and named the pathogen *Bacterium praeurtica*, and determined that the leaflet disease was caused by the same pathogen that caused halo blight.

Because Burkholder's description was published first, *B. praeurtica* became a synonym, and the pathogen was later transferred to the genus *Parasponaria*, where it resides today. Therefore, it has been presumed that the bacterium was imported on the leaflet vine (thought to have been introduced in 1876 at the Philadelphia Centennial Exposition from Japan), where it later became an important pathogen of beans.

Figure 1. Halo blight lesions from indeterminate dry beans consisting of a broad yellow-green halo surrounding necrotic centers.

Figure 2. Common blight lesion in comparison consisting of a narrow brown-yellow halo surrounding necrotic centers.

## Halo Blight of Dry Beans in Nebraska

G1958

## Bacterial Brown Spot of Dry Beans in Nebraska

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Bacterial brown spot and its management are covered in this NebGuide.

### Introduction

Bacterial brown spot is a more recently discovered disease of dry beans in Nebraska than either halo blight or common bacterial blight. It was first seen in western Nebraska dry bean fields on a limited basis throughout the late 1960s. Epidemics still occur sporadically, but the pathogen's presence has increased in incidence and damage along with halo blight during the past 20 years in the Central High Plains.

Brown spot/blast bean cultivars were first identified and reported by Schuster and Coyne in 1969 from field and greenhouse tests in Nebraska using the dry bean lines US 1141 and CN Nebraska #1 selection 27, and the snap bean cultivar Tempo. When the disease occurs today, however, it can be very damaging due to the lack of resistance in modern commercial cultivars.

### Symptoms and Signs

Lesion size can vary, but generally lesions are small, circular, and brown (Figure 1), often surrounded by a yellow zone (Figure 2). As the disease progresses, lesions begin coalescing to form linear, necrotic streaks bound by leaf



Figure 1. Small, brown, necrotic lesions characteristic of early bacterial brown spot infection.

### History

Bacterial brown spot, caused by *Parasolenomon strigosa* sp. nov., was first described by Walter Burkholder in 1935. It was determined to be a new disease of beans based on his laboratory investigations of diseased specimens from New Jersey. He named the pathogen *Phytomonas vignae* var. *Agrostophila*, but it was later recognized to be a synonym of *Parasolenomon strigosa*. Originally it was considered to be rare in the U.S., but in the mid-1960s, severe outbreaks occurred in Wisconsin snap and lima bean fields.

veins (Figure 3). If water soaking occurs, it appears as small circular spots on the underside of leaves (Figure 4). CBD lesions centers fall out, leaving lathery strips or "shot holes" on affected leaves (Figure 5) and evidence of water soaking may be visible at the edge of tissue next to the shot holes. Stem and petiole lesions are occasionally found when the pathogen becomes systemic.

Petal lesions are circular and water-soaked initially, but later turn brown and become necrotic (Figure 6). If young pods or these in the flat stage become infected, they may be bent or twisted with ring-spots or water-soaked brown lesions.

Like the halo blight pathogen, a crown to soil-borne bacterial ooze may emerge from stems, pods or leaves after



Figure 2. Bacterial brown spot lesions surrounded by yellow zones.

## Bacterial Brown Spot of Dry Beans in Nebraska