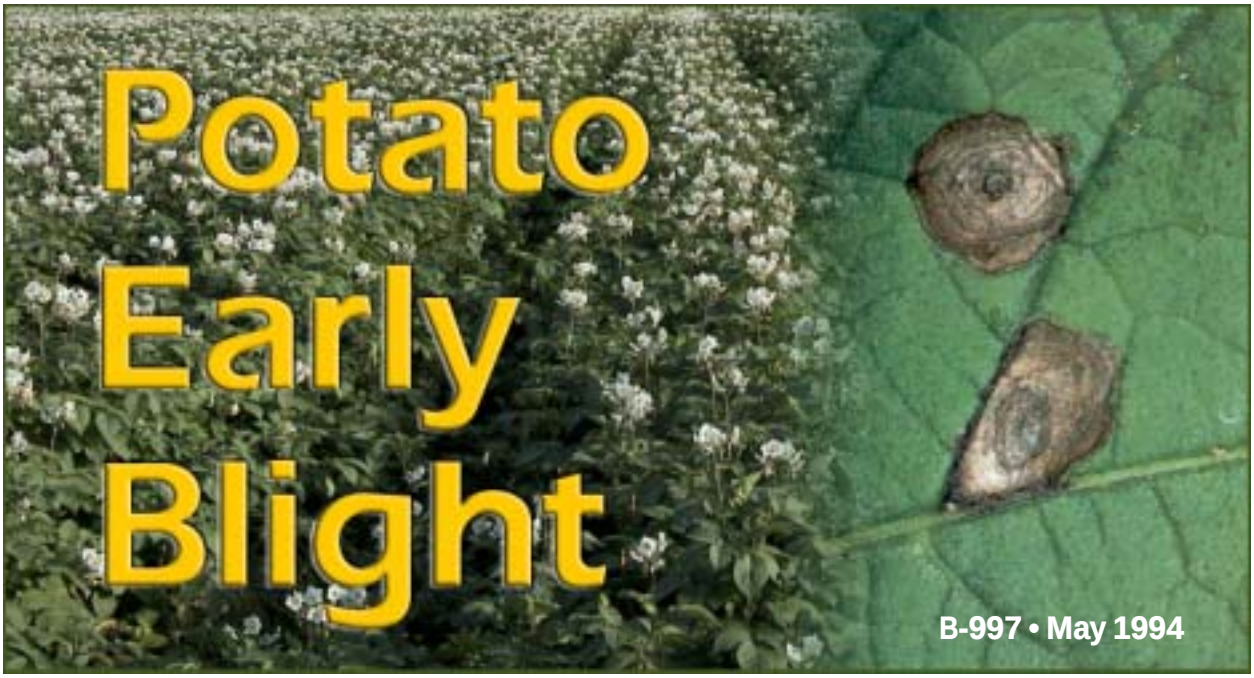

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Quick Facts

- Early blight is a common disease of potatoes caused by the fungus *Alternaria solani*. The fungus spreads by wind-blown spores.
- Foliar early blight lesions are commonly observed during the second half of the growing season, appearing first on lower leaves and then progressively spreading to younger foliage. Concentric ridges may give lesions a target-like appearance. Disease severity is greater when overhead irrigation is used.
- Planting late-maturing varieties using cultural practices that minimize plant stress and / or the timely application of protectant fungicides will reduce the impact of early blight.
- Tuber infection by *A. solani* spores occurs during and immediately after harvest. After infection, dry rot decay develops in storage.
- Cultural practices that promote tuber skin set and harvesting methods that minimize tuber skinning and bruising greatly reduce tuber infection.

Introduction

Early blight occurs worldwide and is prevalent wherever potatoes are grown. Although the foliar phase of early blight was first reported in 1893, the tuber decay phase was not recognized until 1925. Foliar early blight and tuber decay are common in Colorado, Wyoming, and western Nebraska.

Foliar early blight lesions decrease the leaf surface area, which reduces tuber yield potential. Although yield suppressions of 70 to 80 percent are reported, most losses rarely exceed 20 percent. Interaction of early blight with other diseases such as blackleg or Verticillium wilt can increase losses. Tuber infection and subsequent decay in storage can severely affect the quality of both fresh market and processing potatoes.

Symptoms

Foliar lesions are dark, may be surrounded by a yellow border, and may contain concentric ridges of alternately raised and depressed necrotic (dead) tissue that give lesions a target-like appearance (Figure 1). As circular lesions enlarge, they become angular because expansion is limited by leaf veins. Lesions usually appear first on the older, lower leaves followed by gradual upward progress within the canopy. In later stages of the disease, dark, oblong, fleck-like lesions can appear on stems and petioles. When disease-induced senescence of infected leaves

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Figure 1. Typical foliar early blight lesions are shown. Concentric ridges give lesions a target-like appearance.

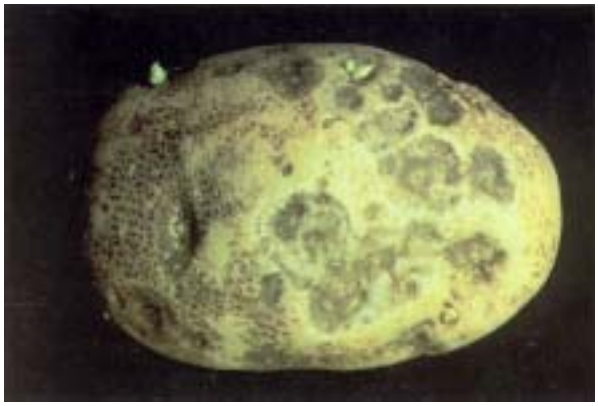

Figure 2. Tuber dry rot symptoms caused by infection with Alternaria solani are pictured. Lesions are typically shallow and dark in color, and affected tissue is leathery or corky in texture.

occurs, affected leaves die and remain attached to the plant. Advanced foliar symptoms can integrate with those of Verticillium wilt or other diseases, making diagnosis more difficult.

Tuber lesions are dark, frequently sunken, and circular to irregular in shape (Figure 2). Lesions often are surrounded by a raised margin. The decayed tissue is dark brown and appears leathery or corky. Margins of decayed areas can appear water-soaked and yellow to greenish yellow. Shallow lesions can often be easily removed or "scooped out" with the tip of a knife. Infected tubers become shriveled after prolonged storage, especially at higher temperatures. Moisture is lost from tubes in areas of early blight infection.

Disease Cycle

Potato early blight is caused by the fungus *Alternaria solani*. It is assumed that the disease starts when leaflets become infected by spores that survived over winter in association with soil or perhaps by airborne spores produced on plant debris or other hosts. Lesions first appear on older, lower leaves because they are more likely to be exposed to inoculum and because the aged, stressed foliage is more susceptible than younger, more vigorous leaves. Fields with no rotation or short rotation are at greatest risk of early season infection.

Secondary spread of the fungus and the associated rapid increase in early blight severity does not occur until spores are dispersed from foliar lesions (Figure 3). This corresponds to the optimum time for the first foliar fungicide application. Because spore formation is favored by alternating wet and dry conditions, disease pressure is greatest in fields where overhead irrigation is used or foliage is frequently wetted by dew, fog, or rain. Because spores can move long distances on air currents, all but the most isolated fields will be exposed to some degree.

Free water or high humidity is required for spore germination. Infection of leaf tissue is reduced when humidity drops below 90 percent. Spores deposited on leaf surfaces can remain viable for at least eight weeks and then infect leaves when conditions become favorable.

Spores produced on foliar lesions also contaminate soil and infect tubers through wounds made during harvest. Tuber infection does not occur before harvest because spores do not percolate into the soil and are unable to infect through the intact periderm. Instead, infection occurs when contaminated soil and / or infected foliage contacts wounds made during harvest. Tuber wounds provide an avenue for infection and may also furnish the moisture necessary for spore germination. Free water on tuber surfaces may favor infection.

Tuber lesions develop slowly and continue to expand in storage. The pathogen does not spread from tuber to tuber in storage but can appear to do so because lesions may take weeks or months to become visible.

The severity of foliar and tuber infection is often unrelated. Efforts to manage foliar early blight do not guarantee freedom from tuber decay. Factors such as field isolation, cultivar susceptibility, tuber maturity, tuber injury at harvest, and storage environment all interact to affect the availability of inoculum, tuber susceptibility, and the subsequent development of decay in storage. A diagram of the early blight disease cycle is shown in Figure 4.

Disease Management

Several cultural practices can significantly reduce the impact of foliar early blight and tuber decay.

Reducing plant stress can slow foliar disease development and reduce the need for chemical control. Proper fertility, especially nitrogen, is important for reducing the rate of disease development and reducing losses. However, too much nitrogen may delay tuber maturity and increase early blight decay in stored tubers. Plant stress can also be reduced by planting high-quality seed and by proper irrigation management, supplying only the amount of moisture required by the plant to replace water lost through transpiration and evaporation.

Foliar resistance to early blight has been identified and is closely related to plant maturity. In general, disease progresses more rapidly on earlier maturing varieties and more slowly on varieties that mature later. Within each maturity group, however, there are exceptions to this rule. There is renewed emphasis on early blight resistance in some breeding programs.

Foliar disease severity can be reduced but not eliminated by the application of labeled protectant fungicides. The optimum time for the first fungicide application is at the time of secondary spread when airborne spores first appear. Fungicide applied too soon is potentially wasted, while applications made too late fail to control initial infections. Research on disease development in several production areas has resulted in disease models that predict when spore production is likely, permitting growers to more accurately time fungicide applications. Spore traps can also be used to determine when spore dispersal occurs. In production areas where information on timing the first application is not available and where early blight is a chronic problem, general recommendations are to make the first application shortly before row closure.

The classes of fungicides commonly used are chlorothalonil, fixed copper, iprodione, mancozeb, and maneb. These fungicides generally provide adequate early blight control under most situations. However, because they are protectants and must coat leaf surfaces to be effective, uniform coverage with fungicide throughout the plant canopy is essential. For this reason the application of fungicide by ground rig or center pivot generally provide better control than application made by airplane. Higher rates of fungicide and shorter application intervals may be needed as the season progresses due to increased disease pressure and increasing plant susceptibility. All fungicides must be applied in accordance with the label directions.

Figure 3. These are spores of Alternaria solani. Spores are easily dislodged from foliar lesions and become airborne, causing progressive spread of early blight. Spores also contaminate soil and infect tubers through wounds made during harvest.

Mechanical vine removal or chemical vine desiccation coupled with delayed harvest to promote "skin set" and reduced skinning injury will effectively reduce tuber infection. Proper equipment adjustment and adoption of other methods to reduce tuber bruising and abrasion during harvest is also extremely important for reducing tuber infection and subsequent decay.

No fungicides are currently labeled for application to tubers to reduce tuber infections. Research is not being done to identify effective fungicides that may be labeled for post-harvest application to tubers. Thiabendazole is not effective for this purpose.

Establishing a storage environment that permits rapid suberization and wound healing immediately after harvest will reduce tuber infection. However, once infected, warm temperatures favor tuber decay while colder temperatures slow the rate of development.

Additional Information

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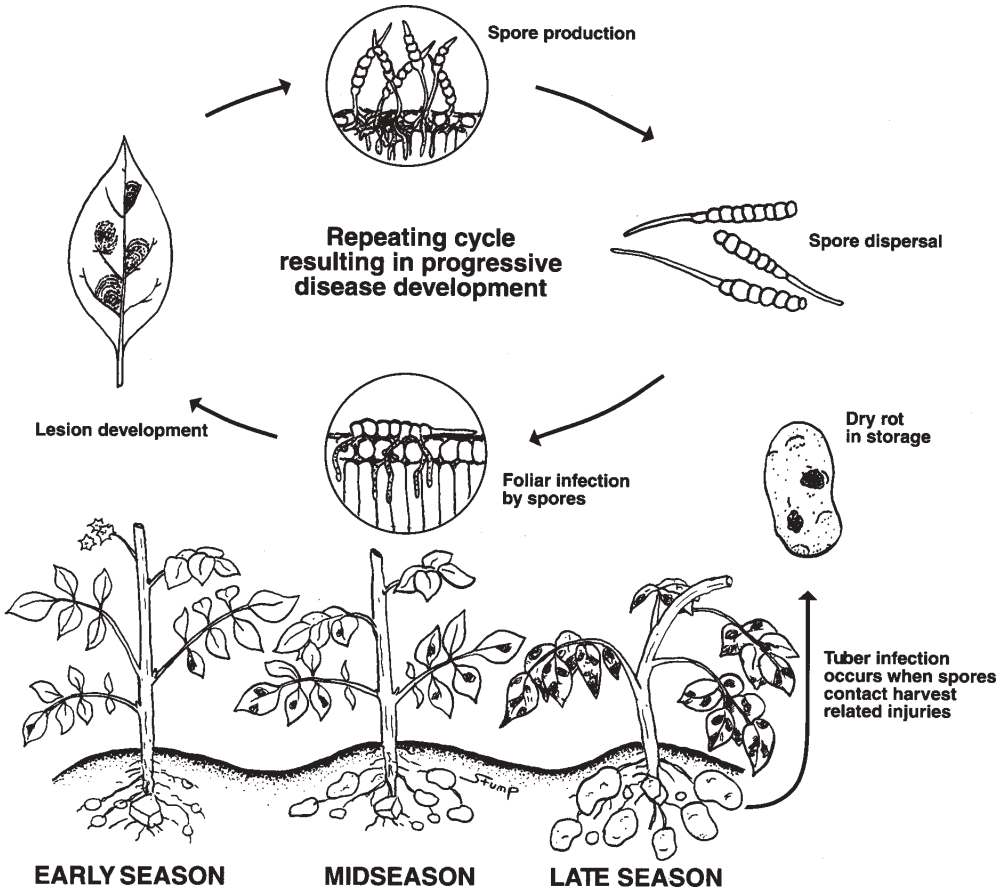

Figure 4. Early blight disease cycle is shown. Spore production and spore dispersal results in progressive foliar disease development. Spores dislodged from foliar lesions also contaminate the soil surface. Spores from contaminated soil and/or infected foliage infect tubers, and decay develops during storage (prepared by W. L. Stump and G. D. Franc).

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