

MICHIGAN Potato Diseases



Early Blight

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Early Blight

Alternaria solani (E. & M.) Jones and Grout
(Hyphomycetes, Hyphales)

Introduction

Early blight is a very common disease of potato that is found in most potato-growing areas. Although it occurs annually to some degree in most production areas, the timing of its appearance and the rate of disease progress help determine the impact on the potato crop. The disease occurs over a wide range of climatic conditions and depends in large part on the frequency of foliage wetting from rainfall, fog, dew or irrigation, on the nutritional status of foliage and on cultivar susceptibility. Though losses rarely exceed 20 percent, if left uncontrolled, the disease can be very destructive. In Michigan and other potato-growing areas, intensive fungicide treatment has restricted losses to less than 5 percent. In the eastern United States, foliar infection is the most critical phase of the disease; in the West, particularly the Rocky Mountain production areas, tuber infection can be more important than foliar infection. In contrast to its name, the disease rarely develops early, and it usually appears on mature foliage.



Figure 1. Early blight lesions first appear as small, irregular to circular dark brown spots on lower leaves. Spots range in size from a pinpoint to 1/8 inch.

Symptoms

Foliar symptoms of early blight first appear as small, irregular to circular dark brown spots on the lower (older) leaves. These spots may range in size from a pinpoint to 1/8 inch in diameter (Fig. 1). As the spots enlarge, they become restricted by leaf veins and take on an angular shape. Early in the growing season, lesions on young, fully expanded, succulent leaves may be larger – up to 1/2 inch in diameter – and may, because of their size, be confused with late blight lesions (Fig. 2). Leaf lesions are relatively easy to identify in the field because lesion development is characterized by a series of dark concentric rings alternating with bands of light tan tissue (Fig. 3). A narrow band of chlorotic tissue often surrounds each lesion, and extensive chlorosis of infected foliage develops over time. Elongated, superficial brown or black lesions may also form on stems and petioles. By the end of the growing season, the upper leaves of infected potato plants may be peppered with numerous small early blight lesions (Fig. 4), and subsequently, lesions may coalesce to cover a large



Figure 2. Early blight lesions on young leaves may be up to 1/2 inch in size. Unlike late blight lesions, they are angular and become restricted by leaf veins.



Figure 3. Early blight lesions are characterized by an alternating series of light tan and dark concentric rings surrounded by a narrow band of chlorotic tissue.

area of the leaf (Fig. 5a). Severely infected leaves eventually wither and die but usually remain attached to the plant (Fig. 5b). Severe infection of foliage by the early to midbulking period can result in smaller tubers, yield loss and lower tuber dry matter content.

Tuber symptoms of early blight include circular to irregular lesions that are slightly sunken and often surrounded by a raised purple to dark brown border. The underlying tissues are leathery to corky in texture, dry and usually dark brown (Fig. 6). These lesions reduce the quality and marketability of fresh market tubers. Tuber infection also presents a challenge to processors because tuber lesions often require additional peeling to remove the darkened lesions and underlying tissues.

Disease cycle

Early blight is caused by the fungus *Alternaria solani*. The dark-colored spores (Fig. 7) and mycelia of the pathogen survive between growing seasons in infested plant debris and soil, in infected potato tubers, and in overwintering debris of susceptible solanaceous crops and weeds, including hairy nightshade (*Solanum sarrachoides*). Overwintering spores and mycelia of *A. solani* are melanized (darkly pigmented) and can withstand a wide range of environmental conditions, including exposure to sunlight and repeated cycles of drying, freezing and thawing. In spring, spores (conidia) serve as primary inoculum to initiate disease (Fig. 8). Plants grown in fields or adjacent to fields where potatoes were infected with early blight during the previous season are most prone to infection because large quantities of overwintering inoculum are likely to be present



Figure 4. Late in the growing season, the upper leaves of infected potato plants may be peppered with small early blight lesions.

from the previous crop. Initial inoculum is readily moved within and between fields because the spores are easily carried by air currents, windblown soil particles, splashing rain and irrigation water.

Spores of *A. solani* (Fig. 7) are produced on potato plants and plant debris at temperatures between 41° and 86°F (the optimum is 68°F). Alternating wet and dry periods with temperatures in this range favor spore production. Few spores are produced on plant tissue that is continuously wet or dry. The dissemination of inoculum follows a diurnal pattern in which the number of airborne spores increases as leaves that are wet with dew or other sources of nighttime moisture dry off, relative humidity decreases and wind speeds increase. The number of airborne spores generally peaks in midmorning and declines in late afternoon and at night.

Spores landing on leaves of susceptible plants germinate and may penetrate tissues directly through the epidermis, through stomata, and/or through wounds such as those caused by sand abrasion, mechanical injury or insect feeding. Free moisture (from rain, irrigation, fog or dew) and favorable temperatures (68° to 86°F) are required for spore germination and infection of plant tissues. Lesions begin to form 2 to 3 days after initial infection.

Many cycles of early blight spore production and lesion formation occur within a single growing season once primary infections are initiated. Secondary spread of the pathogen begins when spores are produced on foliar lesions and carried to neighboring leaves and plants. Early blight is largely a disease of

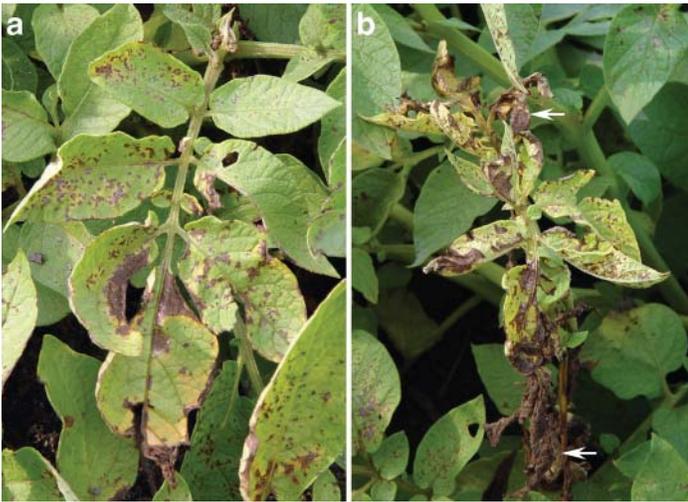


Figure 5. (a) On severely infected leaves, the small early blight lesions may coalesce to cover large areas of the leaf. **(b)** These leaves eventually wither and die but remain attached to the plant (arrows).

older plant tissues and is more prevalent on senescing tissues on plants that have been subjected to stresses induced by injury, poor nutrition, insect damage or other types of stress. Early in the growing season, the disease develops first on fully expanded leaves near the soil surface and progresses slowly on juvenile tissues near the growing point. The rate of disease spread increases after flowering and can be quite rapid later in the season during the bulking period and during periods of plant stress. Early blight lesions are often found on most leaves of unprotected plants late in the growing season.

In potato tubers, germinated spores penetrate the tuber epidermis through lenticels and mechanical injuries to the skin. Tubers often become contaminated with *A. solani* spores during harvest. These spores may have accumulated on the soil



Figure 6. (a) Early blight lesions on tubers are usually circular to irregular and slightly sunken, often surrounded by a raised purple to dark brown border. **(b)** Underlying tissues are leathery to corky in texture (arrows).

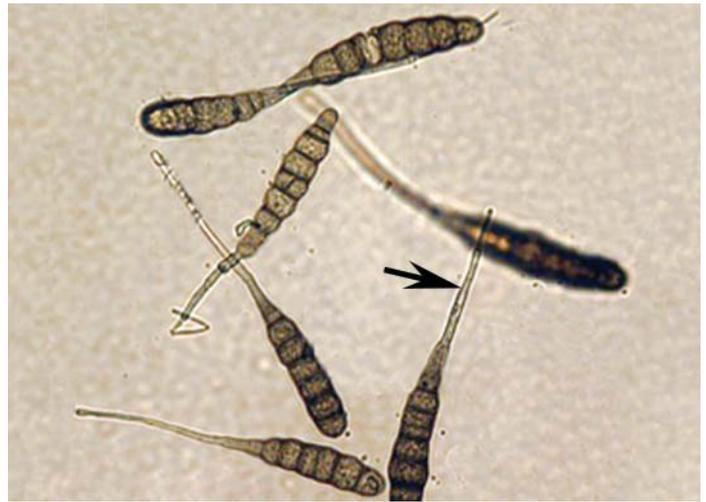


Figure 7. Spores of *Alternaria solani*, causal agent of early blight, are melanized and can withstand a wide range of environmental conditions. Note the transverse and vertical septa and the long “beak” (arrow).

surface or may have been dislodged from desiccated vines during harvest. Infection is most common on immature tubers and those of white- and red-skinned cultivars, since they are highly susceptible to abrasion and skinning during harvest. Coarse-textured soil and wet harvest conditions also favor infection. In storage, individual lesions may continue to develop, but secondary spread does not occur. Infected tubers may shrivel through excessive water loss, depending on storage conditions and disease severity. Early blight lesions on tubers, unlike late blight lesions, are usually not sites of secondary infection by other decay organisms.

Monitoring and control

Effective management of this disease requires implementation of an integrated disease management approach. The disease is controlled primarily through



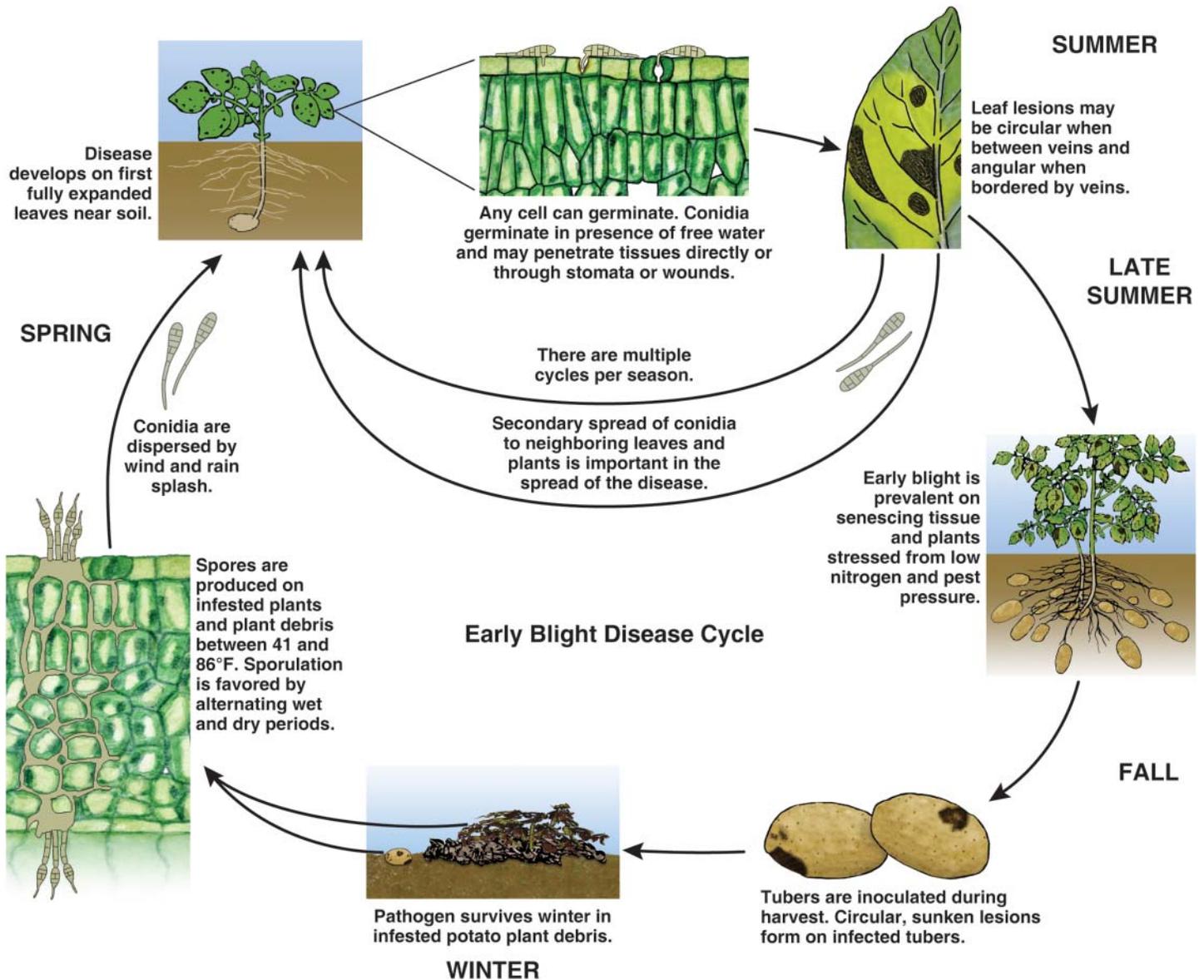


Figure 8. The disease cycle of the early blight pathogen, *Alternaria solani*.

the use of cultural practices, resistant cultivars and foliar fungicides.

Cultural control

Cultural practices such as crop rotation, removing and burning infected plant debris, and eradicating weed hosts help reduce the inoculum level for subsequent plantings. Because *A. solani* persists in plant debris in the field from one growing season to the next, rotation with non-host crops (e.g., small grains, corn or soybean) reduces the amount of initial inoculum available for disease initiation. Other cultural control measures include:

1. Avoid irrigation in cool, cloudy weather, and time irrigation to allow plants time to dry before night-fall.
2. Use certified disease-free seed.

3. Use tillage practices such as fall plowing that bury plant refuse.

To minimize tuber infection after harvest, tubers should be stored under conditions that promote rapid suberization because *A. solani* is unable to infect through intact periderm.

Resistant cultivars

Cultivars with good levels of field resistance are available, but no immunity to early blight has been found in commercial potato cultivars or in their wild parents. Highly susceptible cultivars such as Red Norland, Norchip and Superior should be avoided in locations where early blight is prevalent and disease pressure is high. Field resistance to foliage infection is associated with plant maturity.

Chemical control

The most common and effective control method for early blight is application of foliar fungicides (Table 1). Protectant fungicides recommended for late blight control (e.g., maneb, mancozeb, chlorothalonil and triphenyl tin hydroxide) are also effective against early blight when applied at approximately 7- to 10-day intervals. Resistance to the strobilurin group of fungicides (Group 11; Table 1) has been reported in Michigan. The geographical spread of this resistance is not known, but applications of strobilurins should be made in combination with tank mixtures of the fungicides listed above. Other fungicides that have shown efficacy against early blight contain azoxystrobin, trifloxystrobin, famoxodone, pyrethamil, fenamidone and boscalid.

The application of foliar fungicides is not necessary in plants at the vegetative stage, when they are relatively resistant. Accordingly, spraying should commence at the first sign of disease or immediately after bloom. The frequency of subsequent sprays

should be determined according to the genotype and age-related resistance of the cultivar. Protectant fungicides should be applied initially at relatively long intervals and subsequently at shorter intervals as the crop ages.

Early-season applications of fungicides before secondary inoculum is produced often have minimal or no effect on the spread of the disease. Early blight can be adequately controlled by relatively few fungicide applications if the initial application is properly timed. Predictive models to time the first application are commonly used. Models for Michigan can be found at the Website <http://www.potatodiseases.org>. The first application for early blight control should be timed at 200 P days after emergence. Regular inspection of fields after plants reach 12 inches in height is recommended to detect early infections.

Table 1. Product name, FRAC^a resistance management grouping, common name, rate of application and season limit of some currently registered products for control of early blight of potato in Michigan.

Product ^b	FRAC ^a group	Common name	Rate of application ^c	Season limit (lb or pt of product)
Quadris	11	azoxystrobin ^d	6.2 - 15.4 fl. oz/A	3.8 pt/A
Headline	11	pyraclostrobin ^d	6.0 - 9.0 fl. oz/A	4.5 pt/A
Gem	11	trifloxystrobin ^d	6.0 - 8.0 oz/A	3.0 lb/A
Tanos	11	famoxodone ^d	6.0 oz/A	3.3 lb/A
Scala	9	pyrethamil	7 fl. oz/A	2.2 pt/A
Reason	11	fenamidone ^d	5.5 - 8.2 fl. oz/A	1.5 pt/A
Endura	7	boscalid	2.5 - 4.5 oz/A	1.3 pt/A
Maneb	M3	maneb	1.5 - 2 lb/A	11.2 lb/A
Dithane, Manzate, Penncozeb	M3	mancozeb	0.5 - 2 lb/A	15.0 lb/A
SuperTin	30	triphenyl tin hydroxide	2.5 - 3.75 oz/A	11.25 oz/A
Bravo, Echo, Equus	M5	chlorothalonil	1.0 - 2.2 pt/A	15.0 - 22.5 pt/A, depending on product

^a Fungicide Resistance Action Committee. See (<http://www.frac.info>) for more information.

^b Product names are provided as a convenience only, and mention of them shall not be construed as an endorsement of the product, or sponsorship by or affiliation with the company manufacturing that product. Specific instructions are included on the labels of all of the products, and these must be adhered to.

^c Rates of application are provided as a guide only. Consult specific instructions included on the label for complete details.

^d Should always be used in combination with a protectant fungicide (i.e., maneb, mancozeb or chlorothalonil).

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For more information, please visit: <http://www.potatodiseases.org>.

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