Control of early blight disease of potato

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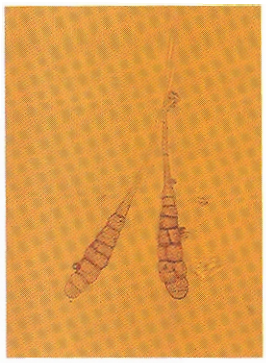

Fig. 1. Micrograph of *Alternaria solani* spores, the fungus causing early blight of potato.

Early blight, caused by the fungus *Alternaria solani*, is one of the most common foliar diseases affecting potatoes in Idaho (fig. 1). Early blight can cause significant U.S. No. 1 and total yield losses, particularly if disease development begins early in the season. Foliar damage occurring late in the season, 2 to 3 weeks before vine desiccation, does not greatly affect tuber yield. Under favorable conditions, early blight causes tuber infections that can result in quality losses during storage.

The disease is present in all major potato producing areas in Idaho and commonly occurs in potato crops under sprinkler irrigation. Sprinkler irrigation provides free moisture that may persist on potato foliage for several hours after irrigation. Such conditions are ideal for the development of early blight.

Fig. 2. Chlorosis (yellowing) of healthy tissue surrounds the lesions.

Fig. 3. Early blight lesions on potato foliage. Lesions are mostly circular and have raised, concentric rings like bull's-eye targets in the necrotic (dead) tissue.

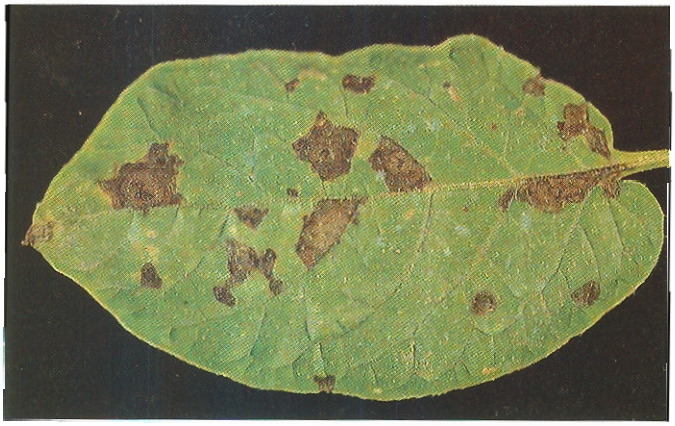

Fig. 4. Tubor lesions are typically oval, light to dark brown, and usually less than 1/8 inch deep.

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Symptoms

Early blight is characterized by dark brown to black lesions on leaves and stems. Lesions usually appear on the lower or oldest leaves first. Lesions tend to be circular although they may be angular when their development is stopped by a large leaf vein.

Typical early blight lesions contain a series of concentric rings that give them a target or bull's-eye appearance (fig. 3). These lesions are often bordered by a chlorotic (yellow) zone that fades into the normal green of the surrounding healthy tissue (fig. 2). Chlorosis is due to alternaric acid, a toxin produced by the fungus. As lesions expand in size, the entire leaf becomes yellow, dies, turns brown, and dries out, but the leaves usually remain attached.

The first lesions can appear in late June, even before row closure, but the disease does not generally begin to spread beyond the initial infections until early- to mid-July. Stem lesions may appear later in the growing season or may not occur at all unless the disease is particularly severe. The presence of stem lesions is an indication that early blight is building to high levels.

Tuber symptoms do not appear until potatoes have been stored for several months. Lesions on tubers are small, circular, dark brown to black, and usually superficial on most potato varieties (fig. 4). On Russet Burbank, the superficial lesions often are similar in color to the skin, but they may be slightly darker.

Where lesions penetrate into the tuber flesh, the flesh becomes brown, dry, and grainy. Lesions can continue to increase in size during storage, and tubers with advanced infections may become shriveled. Early blight lesions tend to be dry and, consequently, are not quite as prone to invasion by secondary organisms as lesions of other tuber rots. Lenticel infections also occur and often are accompanied by an arc or small crescent pattern. The tuber infection phase is a destructive form of the disease and can be a serious problem in white-skinned chippers and other susceptible varieties.

Disease cycle

The fungus *Alternaria solani* overwinters in the soil on potato vine debris. This fungus can survive on weed hosts related to potato, such as nightshade. Within the potato debris, the fungus produces numerous spores, providing the primary inoculum for the new season. Short rotations which build up the level of potato debris can increase the levels of overwintering inoculum.

The spores are carried by wind and are deposited on potato leaves, or leaves may become contaminated by rubbing on infested soil. The spores germinate on leaves when free moisture is present and initiate infection by direct penetration of the leaf surface. Leaf symptoms usually do not become visible until a week or so after flowering even though the initial infection occurred much earlier.

The foliar phase of early blight is always more severe on weakened plants. Plants that are aged, stressed, suffering from poor nutrition, or infected with other diseases, particularly Verticillium wilt, are more susceptible to early blight than healthy plants.

The pathogen produces spores (conidia) in mature lesions on the lower leaves of infected plants. Secondary spread of the disease begins when the spores are transported by wind to other leaves on the plant and other plants in the field.

This is the "critical period" when the disease has the potential to spread rapidly and build up to damaging levels in a potato field. In eastern Idaho, this critical period commonly occurs between July 20 and August 15, and fungicide sprays should be applied during this time for satisfactory control of the disease.

Sprinkler irrigation, with its alternating wet and dry periods, provides a particularly conducive environment for secondary spread. Wet conditions favor spore germination and infection, while dry conditions provide an excellent

Table 1. Early blight field trial in eastern Idaho. Properly timed foliar fungicide application (schedule 3) was as effective at reducing yield losses as application schedules that were begun too early (schedule 1) or continued through the entire growing season (schedule 4).

	Fungicide application schedules	Leaflets with symptoms[1] (%)	Tubers under 4 ounces (%)	Yield U.S. No. 1 (lb)	Yield Total (lb)
1	Two applications: June 29, July 11	65	23	268 a[2]	406 ab
2	Three applications: July 11 and 24, Aug. 4	31	19	295 ab	416 ab
3	Three applications: July 24, Aug. 4 and 16	47	17	318 b	429 b
4	Six applications: June 29, July 11 and 24; Aug 4, 16, and 28	24	15	294 ab	432 b
5	Control (no treatment)	90	22	270 a	386 a

Source: Douglas, D. R., and M. D. Groskopp. 1974. Control of early blight in eastern and southcentral Idaho. Am. Potato J. 51:361-368.

[1] Evaluations made on August 31.

[2] Means within the same column with the same letter are not significantly different from each other at the 5% probability level.

environment for wind dissemination of spores. Continuous repetition of this pattern can lead to rapid buildups and serious outbreaks of disease.

Tubers are not invaded as easily as leaves or stems, and a wound usually is required before infection can take place. Such wounds routinely are inflicted during harvesting and subsequent handling operations.

Soil and foliage in fields with heavy disease pressure contain high levels of early blight spores. These spores infect injured tubers as the tubers are mixed and agitated with infested soil and foliage during harvest. Tuber lesions are not visible at harvest but develop in storage over the course of several months. Vine debris left in the soil provides inoculum for the following year.

Control

In many cases, simply employing sound cultural practices that maintain potato plants in good health will keep early blight losses below economic levels. Proper fertilizer applications, proper irrigation scheduling, and management of other diseases such as Verticillium wilt reduce plant stress and early blight severity.

Tuber infections are more likely to occur in potatoes grown in coarse, sandy soils and harvested when wet. The abrasiveness of sand in coarse-textured soil creates microscopic wounds that allow fungal entry into the tuber. Wet conditions not only provide a favorable environment for spore germination, but the swollen lenticels on wet tubers are invaded easily.

Tuber blight phase — Optimal tuber maturity is the most important factor for control of the tuber blight phase. Tubers harvested before maturing are susceptible to wounding and subsequent early blight infection. Tubers should be allowed to heal completely (2-1/2 to 3 weeks) before lifting. Vine desiccation by flaming may help to remove in-field inoculum.

After harvest, tubers should be stored at 50° to 55°F, at high relative humidity, and with high volumes of air to promote wound healing. Proper healing will reduce the amount and severity of tuber infections that develop in storage. White-skinned, chipping varieties and both Hilite and Frontier are more susceptible to the tuber blight phase than Russet Burbank.

Fungicides — Application of fungicide for control of early blight can reduce yield loss significantly, but proper timing is important for maximum efficiency (Tables 1 and 2). Fungicide applications to the foliage probably will be necessary if early blight is killing the vines prematurely, if the production area has a history of severe early blight, or if the potato crop is produced under conditions that favor the tuber blight phase. Early maturing varieties are particularly susceptible to tuber blight. Fields with high levels of foliar blight contain high levels of inoculum that facilitate tuber infection. However, calendar fungicide applications to control early blight on potato foliage are less effective and more costly than fungicide applications timed to stages of disease and crop development.

Fungicide applications should begin when the first lesions appear on leaves in the upper two-thirds of the plant. In the 1974 *American Potato Journal* article "Control of Early Blight in Eastern and Southcentral Idaho," D. R. Douglas and M. D. Groskopp recommend applying fungicides in the perennial early blight areas of eastern and southcentral Idaho as follows:

	Eastern	Southcentral
First application	July 20 to 23	July 8 to 10
Second application	10-12 days later	10-12 days later
Third application	10-12 days later	10-12 days later
Fourth application	None	10-12 days later

Table 2. Early blight field trial in southcentral Idaho. Foliar fungicide applications timed too early (schedule 1) or continuous throughout the entire growing season (schedule 5) were no more effective in reducing yield losses as properly timed (schedule 2) fungicide application.

	Fungicide application schedules	Leaflets with symptoms[1] (%)	Tubers under 4 ounces (%)	Yield U.S. No. 1 (lb)	Yield Total (lb)
1	Three applications: June 28, July 10 and 23	55	25	199 a[2]	277 ab
2	Four applications: July 10 and 23, Aug. 3 and 16	33	17	258 b	322 c
3	Three applications: July 23, Aug. 3 and 16	48	19	242 b	306 bc
4	Three applications: July 10 and 23, Aug. 3	38	27	204 a	300 bc
5	Six applications: June 28, July 10 and 23, Aug. 3, 16, and 28	35	14	263 b	317 c
6	Control (no treatment)	70	22	197 a	263 a

Source: Douglas, D. R., and M. D. Groskopp. 1974. Control of early blight in eastern and southcentral Idaho. Am. Potato J. 51:361-368.

[1] Field evaluations made August 28.

[2] Means within the same column with the same letter are not significantly different from each other at the 5% probability level.

In nonperennial areas, Douglas and Groskopp recommend following these steps:

1. Do not spray until blight lesions appear on leaflets above the lower one-third of the plant.
2. If the first spray date is near that of a perennial area, then follow the perennial schedule.
3. If the first spray date is near August 1, follow with another application 10 to 12 days later.
4. If the first spray date is near August 10, check closely to determine if another application is necessary.
5. If buildup develops after August 15, do not spray in eastern Idaho. Depending on when harvest is to start, one spray might be applied in southcentral Idaho.

Fungicides currently cleared for use on early blight are all protectants and to be effective must be in place on the plant surface before plant infection occurs.

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Pesticides residues — These recommendations for use are based on currently available labels for each pesticide listed. If followed carefully, residues should not exceed established tolerances. To avoid excessive residues, follow label directions carefully with respect to rates, number of applications, and minimum interval between application and reentry or harvest.

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