EARLY BLIGHT INFECTION OF POTATO TUBERS

by
Monty D. Harrison
Professor, Colorado State University

Early Blight has been recognized as a common foliage disease of potatoes for many years but the infection of the tubers by the fungus has been recognized as a problem only in recent years. During the past several years however, reports of heavy tuber infection have come from many areas in the United States, especially from the western part of the country. The increased problem appears to be associated with increasing sprinkler irrigation, mechanical harvesters and some of the newer varieties of potatoes although the older varieties are not immune from infection. The higher storage temperatures required for processing potatoes may also have contributed to the increased Early Blight problem.

Tuber infection caused by the Early Blight fungus appears as slightly sunken irregularly shaped spots on the surface of the tuber. The spots usually appear slate gray in color but may vary from almost black to slightly purplish in color. The decayed tissue beneath the spot is often quite shallow, sometimes only a few mm in depth, but in some varieties the decay may penetrate much deeper especially if infected tubers are stored at high temperatures. The decayed tissue is solid, dry and usually dark brown in color. The tuber lesions will vary in size from less than a centimeter in diameter to several centimeters depending upon the variety, the environmental conditions and the length of time since infection occurred.

Studies have been made at Colorado State University since 1967 to determine how and when tuber infection occurs, some factors affecting the severity of infection and possible methods of control.

Infection time

Concern by growers about the possibility that spores of the Early Blight fungus were washed into the soil by water from overhead sprinklers where they infected the tubers before harvest as the Late Blight fungus sometimes does, led to a study to determine when tuber infection actually occurs.

Tubers (variety Kennebec) were harvested (hand dug) from commercial fields at regular intervals from the time they were very small until the field was harvested in the fall. At each harvest date some tubers were surface sterilized with clorox to remove spores which may have contaminated the tubers at harvest and others were bagged without treatment. The tubers were stored for a time, then examined for infection. The results shown in Figure 1 show that clorox sterilization (T-3) almost completely eliminated infection. Nonsterilized tubers were infected at every date of harvest except the earliest date (July 11). The amount of infection increased until August 13, then declined.

It was concluded from the data that tubers are not infected while still in the soil but are attacked by the fungus when harvested and exposed to spores lying on the soil surface or present on infected foliage or stems.

The numbers of spores on the soil surface (Figure 2) increased in proportion to the amount of infection found on the tubers harvested at the different dates (Figure 1) up to August 13. Then the amount of infection decreased but the number of spores continued to increase.

Figure 1. The amount of early blight infection on surface sterilized and nonsurface sterilized Kennebec potatoes harvested at different dates. T-1 tubers lifted and bagged immediately, T-2 tubers lifted, laid on the soil surface, then bagged; T-3 tubers lifted, surface sterilized, then bagged.

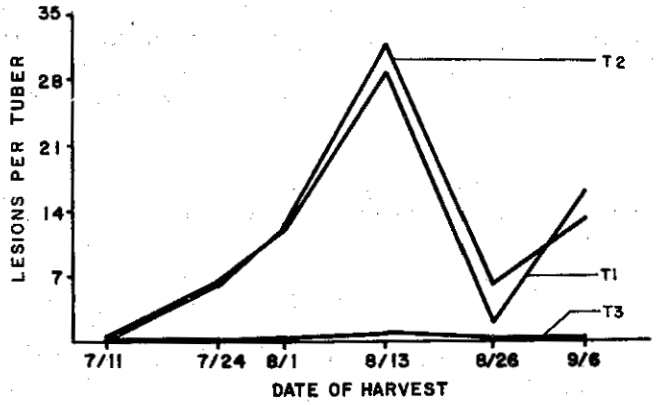
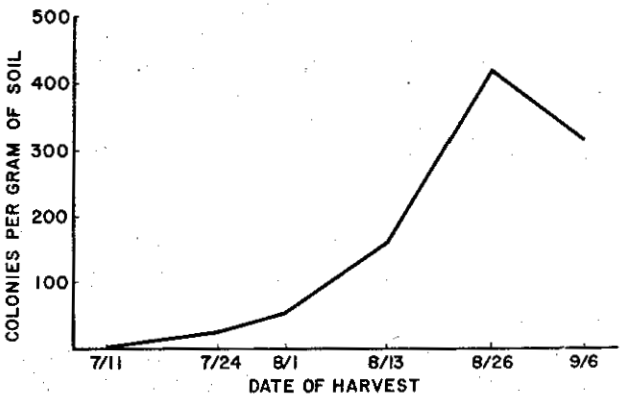


Figure 2. Number of spores of the Early Blight fungus on the soil in Colorado at different times of the season.



Factors affecting the amounts and severity of Early Blight infection on Potato Tubers

Since it was established that infection occurred at harvest time, several studies were made to determine the effects of several factors on that tuber infection.

Importance of Wounds

The importance of wounding was investigated by growing tubers in peat moss to eliminate accidental injuries, then wounding them in various ways and inoculating them with spores or mycelium of the fungus. Table 1 shows that unwounded tubers were almost never infected with Early Blight but that large amounts of infection occurred when tubers were injured by abrasion or by puncturing. Shallow abrasions were less effective than deeper puncture wounds as avenues for invasion by the fungus.

Table 1. Importance of wounds in the infection of potato tubers with Early Blight

Number of tubers	Kind of inoculum	Type of wound	% infection
	Test No. 1		
18	spores	None	0.0
		abrasion	33.3
		puncture	100.0
23	Mycelium	None	4.3
		abrasion	100.0
		puncture	100.0
	Test No. 2		
176	Mycelium	None	0.0
		abrasion	70.4
		puncture	81.3

Tuber maturity

Since wounds were so important as means of invasion, a study was made to determine if mature tubers which are generally more resistant to injury have less infection.

Katahdin tubers were harvested from field plots at various dates which represented very early to very late harvest times as compared with normal harvest. Tubers harvested at the very early date were very immature and were easily injured and those at the very late date had well set skins and were not easily damaged. The number of spores of the Early Blight fungus on the soil surface was measured to be sure that differences found in the amount of infection were not due merely to the presence of different amounts of inoculum.

The results (Table 2) showed that there was a reduction in the amount of infection (both numbers of infections per tuber and percent of tubers infected) as the harvest date became later even though the amount of inoculum present increased, indicating that tuber maturity was important in reducing Early Blight infection.

Table 2. Infection of Katahdin potato tubers harvested at different stages of maturity

Date of harvest	Lesions/tuber No.	Tubers infected %	A. solani spores per gram of soil
Very early (8/15)	29.5	92.7	280
Early (9/1)	14.2	89.6	564
Standard (9/17)[1]	2.3	63.8	888
Late (10/1)	3.5	71.5	884
Very late (10/15)	2.4	60.2	1068

[1] Vines destroyed by beating on 9/14.

Table 3. The effect of pre-harvest and post-harvest treatments on early blight infection of Norchip potato tubers

Treatment	Number of Early Blight Lesions per tuber	
	1971	1972
Pre-harvest		
Control	21.1	18.9
Du Ter	14.7	----
Du Ter & DMSO	11.4	----
Manzate D	13.3	----
Manzate D + DMSO	7.8	----
Burned 3 MPH	----	11.0
Burned 4 MPH	----	7.6
Burned 5 MPH	6.2	11.5
Post-harvest		
Washed 1/	4.2	10.9
Washed + Captan	4.9	8.2

1/ Excessive soft rot late in the storage period.

Storage temperature

Early Blight infection has appeared to be more severe in warm storages. Tubers taken from 50-55°F storages have often shown severe infection and deep penetration into the tuber. To determine the effect of temperature on blight development tubers were inoculated and stored under a range of temperatures from 39.2°F to 95°F. Lesions were small and very shallow at 39.2°F, but much larger and deeper at 59°F. At higher temperatures, lesions were even larger and penetrated deeper into the tubers.

Control of tuber infection by pre-harvest or post-harvest treatments

Since inoculum the soil surface or vines was shown to be the cause of infection, several pre-harvest treatments were applied to the soil surface in an attempt to reduce the number of spores and thus the amount of tuber infections. Post-harvest treatments were also applied to the tubers immediately after harvest.

Fungicides were applied to the soil surface with and without DMSO and the vines and soil surface were burned with a propane burner prior to tuber harvest. Post-harvest treatments consisted of washing tubers and the application of fungicides following washing.

The results of tests made in 1971 and 1972 are shown in Table 3. Fungicides applied to the soil surface reduced infection only slightly. The addition of DMSO increased the effectiveness of the chemical treatments. Burning was the most effective pre-harvest treatment tested. Washing tubers effectively reduced infection but resulted in considerable soft rot infection. The application of Captan to washed tubers decreased infection only little more than washing alone.

Discussion

Tuber infection caused by the Early Blight fungus infects tubers at harvest time through wounds. Practices which reduce injury such as allowing tubers to mature adequately before harvest, reducing bruising associated with mechanical harvesting, etc., will help to reduce losses. Of the methods tested for reducing inoculum in the field, none appear to be highly effective except possibly burning, which may be of some practical value in control. Excellent control of foliar infection may help reduce the amount of tuber infection but other methods will probably be necessary to achieve adequate control. Post-harvest washing apparently rinses inoculum off the tuber surface. This approach to control may be practical if means can be developed to reduce the potential losses from soft rot following this practice.

Early Blight infection develops slowly in storage at low temperatures, thus heavily infected tubers may be salvaged by maintaining temperatures of around 38°F to 40°F. Higher temperatures appear to favor rapid development of infection and excessive losses.

Overall, assuring tuber maturity, reducing mechanical damage, controlling foliage infection and possibly pre-harvest vine burning appear to be the most likely approaches to control at the present time.

References

1. Gratz, L. O. and R. Bonde. 1925. Alternaria solani as a cause of tuber rot in potatoes. Phytopathology 14:282-286.

2. Venette, J. R. and M. D. Harrison. 1973. Factors affecting infection of potato tubers by Alternaria solani in Colorado. American Potato J. 50:283-292.