CENTRAL WASHINGTON LATE BLIGHT EPIDEMIC OF 1982 --- Why It Occurred and Predictions of Future Epidemics [1]

by
G. D. Easton and M. E. Nagle [2]

SUMMARY

In 1982, a late blight epidemic occurred in central Washington over an estimated 35,000 acres of sprinkler irrigated potatoes. Primary inoculum was apparently introduced into the area on infected seed potatoes before 1982. It is assumed that a trace of blight probably also existed on some Washington farms in 1981 resulting in infected tubers in storages and dumps from transloading yards. These infected tubers survived the mild 1981-82 winter temperatures to provide secondary inoculum. Favorable growing conditions in 1982 delayed early dying from Verticillium wilt and extended conditions favorable for late blight.

Epidemics can be expected in central Washington after mild winters. Cold winters will destroy most infected tubers pushed aside at harvest but probably not infected tubers in deep piles from transloading yards. Sanitation practices in the fall will be wasted if infected tubers from the previous year's harvest in storage or infected seed potatoes are dumped near potato fields.

The only satisfactory method of destroying infected potatoes is by burying them in a landfill before the potato plants emerge in the spring.

INTRODUCTION

Late blight caused by Phytophtora infestan (Mont.) de Bary was first identified in central Washington in 1947 by J. D. Menzies (1). This disease occurred on about 2,000 acres in south central Washington in 1975 (4) and again in 1982 on about 35,000 acres. A Crisis Exemption, Section 18 of Amended FIFRA, was obtained on August 20, 1982 for use of metalaxyl (Ridomil ^{R}), class acylalanine, N-(2,6 dimethylphenyl) -N-(methoxyacetyl)- alanine methyl ester, (5, Appendix). Combinations of Ridomil were recommended with either chlorothalonil, (Bravo^{R}) tetrachloro-isophthalonitril; captifol, (Difolatan^{R}), cis-N-(1,1,2,2 tetrachloro-ethyl) thio)-4-cyclohexene-1,2 dicarboximide; or mancozeb, (Dithane M-45^{R}), zinc ion and manganese ethylenebisdithiocarbamate. It has been estimated that these combination applications cost about $25 per acre, or a total cost of $625,000 on the 25,000 acres treated, but saved the industry over $12.5 million by preventing reductions in yield and reducing storage rot losses.

Infected seed used to plant the 1973 and 1974 crops apparently provided the primary inoculum for the late blight epidemic of 1975 (5, 12). Some tubers apparently had been infected and survived the mild winter of 1974-75, thus providing secondary inoculum for the epidemic. In the spring of 1975, many volunteer plants emerged from overwintering tubers that had been pushed aside during harvest the previous fall. Rain in August, heavy irrigation, and dense foliage on potatoes relatively free of Verticillium wilt, created an ecoclimate favorable for blight in 1975.

1/ Mention of a product used in these studies does not constitute a recommendation by Washington State University over other products.

2/ Plant Pathologist and Agricultural Research Technologist III, Department of Plant Pathology, Irrigated Agriculture Research and Extension Center, Prosser, Washington 99350.

This Presentation is part of the Proceedings of the 1983 Potato Conference & Trade Fair.

Sprinkler irrigation has been shown to increase late blight (10, 11). Periods are conducive to late blight when there is 90% or more relative humidity and temperatures between 45-78°F for 10 or more consecutive hours per day (3, 7, 8, 9). Such conditions occur often under potato plants in Washington (6). In 1976 and 1977 only traces of late blight recurred on about 200 acres and late blight disappeared after the severe winter of 1978-1979 but, reappeared as an epidemic in 1982. It has been predicted that "occasional depidemics can be expected after mild winters on the cultivar Russet Burbank, especially when planted on new soils free of Verticillium wilt" (6).

This paper discusses meteorological data collected before and after the 1975 epidemic and before the 1982 late blight epidemic. It shows possible reasons why the epidemic of 1982 occurred and describes conditions under which other epidemics might be expected.

MATERIALS AND METHODS

Data were obtained for the years 1971-1982 concerning average temperatures and total precipitation during June, July, and August, along with minimum temperatures and number of days at or below 32°F during December and January from records of the National Climatic Center, Asheville, N.C., (Climatological Data, Volumes 75-86). Records were taken from the Kennewick and Quincy meteorology stations to represent conditions in the southern and northern areas of central Washington's potato production area.

RESULTS

Average daily temperatures for June, July and August in the late blight years of 1975, 1976, 1977, and 1982 differed only slightly from temperatures in non-blight years (Table 1). However, there was considerably more natural precipitation in August of 1975, 1976, and 1977 at the Kennewick station than in most non-blight years.

Average minimum temperatures at Kennewick during the winters of 1971-72, 1972-73, 1973-74, and 1974-75 at Kennewick preceding the 1975 late blight epidemic were mild varying between 22.5-33.2°F for December and January (Table 2). The number of days at or below 32°F for these winters varied from 11-25 days. Temperatures during these same four winters at Quincy, where late blight did not occur in 1975, varied between 12.9-27°F and the number of days at or below 32°F varied between 21-31 days. The winters of 1975-76, 1976-77, and 1977-78 were relatively mild at both stations. January of 1978-79 was especially cold, with a minimum temperature of 10.5°F and 31 days at or below 32°F at Kennewick and 4.9°F and 31 days at or below 32°F at Quincy. The winter of 1979-80 was also cold at Quincy. The winter of 1980-81 was very mild at both stations and the winter of 1981-82 relatively mild.

DISCUSSION

Primary inoculum for initial infection is apparently introduced into central Washington on infected seed potatoes from midwestern states and northwestern Washington where late blight is a common occurrence (5, 12). The secondary inoculum for the late blight epidemic of 1975 was thought to be from the few infected, unharvested tubers that survived the mild winter of 1974-75 and not from dump piles (2, 6).

The epidemic of 1975 occurred primarily on three farms in Benton and Walla Walla counties. Two of these farms, which were widely separated, were planted from the same seed sources. A trace of late blight had occurred on the third farm previously in 1974.

The epidemic of 1982 was widespread and occurred on many farms in a 50 by 100 mile area in Adams, Benton, Franklin, Grant and Walla Walla counties. A trace of late blight apparently occurred in this area in 1981 to provide the amount of secondary inoculum needed for the 1982 epidemic. Infected, unharvested tubers in the fields or adjoining fields are assumed to have provided most of the inoculum for the 1982 epidemic. Infected tubers from storages and transloading yards that survived the mild winter temperatures probably also contributed

to the inoculum for the 1982 epidemic. A field which had severe blight by August 15, 1982 had a load of rotted tubers dumped next to it earlier in the spring.

Higher than usual precipitation in August may have intensified the epidemic of 1975, but not the epidemic of 1982 (Table 1). Environmental conditions favorable for blight must have existed under the plant canopy throughout the season of 1982 (6).

In 1982, especially favorable growing conditions delayed appearance of Verticillium wilt several weeks. Presence of a dense canopy in late fall provided ideal conditions for late blight (8, 11).

Epidemics of late blight can continue to be expected after mild winters. Cold winters are needed to destroy the infected tubers pushed aside in the fields at harvest, but even cold winters may not destroy infected tubers deep in piles at transloading yards. The best of sanitation practices will be wasted if infected tubers from storages or rotted tubers from infected seed potato lots are dumped near potato fields in the spring.

The only satisfactory method of destroying late blight infected potatoes is by burying them in a landfill. Chemical treatment, burning and other methods of destroying the blighted tubers are either of no value or too expensive. These infected tubers must be destroyed before potato plants emerge in the spring.

LITERATURE CITED

1. Anonymous. 1947. Discover blight menace to late potato crops. Prosser Record-Bulletin, Prosser, Wa. 25 September.
2. Bonde, R., and E. S. Schultz. 1943. Potato refuse piles as a factor in the dissemination of late blight. Maine Agric. Exp. Sta. Bull. 416, pp. 229-246.
3. Croxall, H. E. and L. P. Smith. 1976. The epidemiology of potato blight in the East Midlands 1923-74. Ann. Appl. Biol. 82:451-466.
4. Easton, G. D. 1976. Late blight of potatoes under center pivot irrigation in Benton and Walla Walla counties in 1975. 15th Annual Washington State Potato Conf. and Trade Fair, Washington State Potato Commission, 5-8.
5. Easton, G. D. and M. E. Nagle. 1980. Potato late blight control by the systemic fungicide Ridomil (Abstr.), Phytopathology 71:214.
6. Easton, G. D. 1982. Late blight of potatoes and predictions of epidemics in arid central Washington state. Plant Disease 66:452-455.
7. Hurst, J. M. and O. J. Steadman. 1956. The effect of height of observation in forecasting potato blight by Beaumont's method. Plant Pathol. 5:135-140.
8. Hurst, J. M. and O. J. Steadman. 1960. The epidemiology of Phytophtora infestans. II. The source of inoculum. Ann. App. Biol. 48:489-517.
9. Hyre, R. A. 1959. The relation of rainfall and temperature to late blight of potato at Burlington, Vermont. Plant Dis. Rep. 43:295-297.
10. Rotem, J., J. Palti, and E. Rawitz. 1962. Effect of irrigation method and frequency on development of Phytophtora infestans on potato under arid conditions. Plant Dis. Rep. 46:145-149. 11.
11. Rotem, J., J. Palti, and J. Lomas. 1970. Effects of sprinkler irrigation at various times of day on development of potato late blight. Phytopathology 60:839-843.
12. Wallin, J. R. and W. G. Hoyman. 1958. Influence of post-inoculation air temperature maxima on survival of Phytophtora infestans in potato leaves. Am. Potato J. 35:769-773.

Table 1. Average daily temperatures and precipitation for months of June, July, and August during 1972-1982 at Kennewick and Quincy Meteorology Stations

	Temperature (F)						Precipitation (inches)					
	Kennewick			Quincy			Kennewick			Quincy		
Year	June	July	August	June	July	August	June	July	August	June	July	August
1972	70.3	74.9	75.2	67.0	70.1	71.5	.62	.16	.77	.73	.13	.80
1973	69.5	76.3	73.0	65.1	72.9	70.2	.13	0	0	.06	.03	.02
1974	71.4	73.3	73.9	68.2	69.3	71.6	.15	.23	0	.20	.60	0
1975	66.5	77.9	70.8	64.2	75.2	67.5	.22	.33	1.06	.11	.14	1.26
1976	65.3	73.2	70.6	62.3	70.0	67.4	.06	.20	1.33	.29	.24	.79
1977	71.5	72.6	76.7	70.0	69.6	74.3	.29	.13	1.67	1.11	.05	.90
1978	69.1	73.8	68.3	67.6	71.7	69.1	.26	.49	.86	.25	.70	.63
1979	65.9	75.6	73.6	67.4	72.2	71.9	0	.10	1.26	.03	.11	.66
1980	65.4	75.5	71.2	62.2	71.0	67.3	.62	.52	.11	.42	.12	.07
1981	65.4	72.7	76.0	61.9	68.0	72.4	.23	0	.06	.77	.37	.07
1982	69.3	73.3	75.0	67.6	68.7	69.9	.75	.14	.07	.36	.16	.22

Table 2. Average minimum temperature and number of days at or below 32°F during December and January in Winters of 1972-82 at Kennewick and Quincy Meteorology Stations

	Minimum Temperatures (F)				Number of Days			
	Kennewick		Quincy		Kennewick		Quincy	
Winter	December	January	December	January	December	January	December	January
1971-72	27.8	27.3	12.9	16.0	21	18	31	28
1972-73	22.5	23.4	19.0	19.0	19	25	24	31
1973-74	33.2	24.4	27.9	17.2	11	15	21	25
1974-75	31.6	25.5	25.5	14.8	13	24	26	31
1975-76	29.2	30.0	23.3	20.5	23	23	29	31
1976-77	27.1	23.0	19.8	17.2	25	29	30	31
1977-78	31.2	27.5	24.4	24.7	20	17	28	25
1978-79	22.2	10.5	16.9	4.9	29	31	30	31
1979-80	32.2	19.3	27.7	9.5	17	29	27	31
1980-81	30.9	32.4	25.5	31.4	18	20	26	18
1981-82	26.5	22.0	19.6	--[a]	24	25	23	--[a]

[a] Data not collected at station.

APPENDIX

Washington State University
Department of Plant Pathology
Irrigated Agriculture Research and Extension Center
Prosser, Wa. 99350

August 23, 1982

CRISIS EXEMPTION - SECTION 18 of AMENDED FIFRA
as of 12:00 p.m. PST, 20 August 1982 through October 8, 1982

CONTROL OF PHYOPHTHORA INFESTANS
THE CAUSE OF LATE BLIGHT OF POTATO IN WASHINGTON

A. Chemicals, rates/acre, methods of application and other pertinent in information concerning control of late blight of potato.

1. Rate of Chemical Combinations per Acre 1 pint of formulation Ridomil^{R}, 2E EPA Reg. No. 100-607 per acre plus:

   (a) 1-1/2 pint of formulation per acre, Bravo 500^{R}, chlorothalonil, tetrachloroisophthalonitril, 40.4% active.

   or

   (b) 1-1/2 lb. ai per acre, Difolatan^{R}, captifol, cis-N-(1,1,2,2-tetrachloroethyl) thio) -4-cyclohexene-1,2 dicarboximide, 39% active,

   or

   (c) 1-1/2 lb ai per acre, mancozeb, zinc ion and manganese ethylenebisdithiocarbamate 80%, a coordination product of manganese 16%, zinc 2%, ethylenebisdithiocarbamate 62%.

2. Methods of Application Apply at first appearance of late blight lesions on foliage. DO NOT APPLY more than two applications. DO NOT APPLY within 7 days of harvest.

   a. Ground - Spray chemical combinations in 50 to 100 gallons of fungicide-water mixture per acre. Repeat spraying in 2 weeks if new lesions appear.

   b. Aircraft - Spray chemical combinations in 5 to 8 gallons per acre. Repeat spraying in 2 weeks if new lesions appear. If potatoes are grown under sprinkler irrigation or receive supplemental irrigation apply .2 to .3 inches water per acre to wash part of the Ridomil from leaves into soil to be absorbed by the root system. Continue to irrigate as required for growth of the crop. Irrigate during night if possible with as light a rate as possible to reduce the number of 10-hour periods of high humidity favorable for late blight development. Repeat spraying in 2 weeks if new lesions appear.

   c. Sprinkler Irrigation - Constantly agitate chemical combinations in batch tank and inject into main line of sprinkler irrigation systems, to apply not more than 3,000 to 6,000 gallons of fungicide-water mixture per acre. A center pivot system, completing one rotation in a 7- to 10-hour period should apply 3,000 to 5,000 gallons of mixture per acre. Applying chemical combinations at greater gallonage may reduce their effectiveness in controlling late blight. Chemical combinations should be applied by aircraft method if sprinkler systems are not designed to apply 3,000 to 5,000 gallons of mixture per acre during one period of irrigation. Repeat injection of chemical combination through sprinkler irrigation system in 2 weeks if new lesions appear.

3. Mixing Chemicals in Batch Tank and Compatibility of Fungicides with Insecticides. Ridomil, Bravo 500, mancozeb, or Difolatan should be compatible with most insecticides, especially emulsifiable formulations. The following mixing instructions of chemicals in batch tank should prevent most incompatibility problems.

   (a) Add wettable powder formulations first and agitate until thoroughly mixed.

   (b) Mix each emulsifiable formulation separately in tank of water and then add to bulk tank.

4. Late Blight Control on Row-Irrigated Potatoes in Central Washington. Ridomil would not be recommended by aircraft application on row-irrigated potatoes in central Washington. Under row irrigation Ridomil would not be washed from leaves to be absorbed by roots to give maximum uptake into the plant. Other labelled nonsystemic fungicides applied by aircraft at 5 to 8 gal fungicide-water mixture per acre would not provide adequate coverage of upper and lower leaf surface. Reducing or terminating irrigation would reduce the number of over 90% relative humidity 10-hour periods needed for infection of P. infestans.

5. Rotation Crops Following Ridomil Applications to Potatoes. Thus far only corn, tobacco and root crops may be planted the year following treatment. Ridomil is being applied under a Crisis Exemption in Washington and the Environmental Protection Agency has not cleared Ridomil in the USA on potato. However, personnel CIBA-Geigy Corporation report that residues in other crops following treatment of potato either are nonexistent or are very low. In Washington under the current Crisis Exemption following Ridomil treatment on potatoes, no crop except wheat can be replanted this fall.

6. Potatoes from Late Blight Fields Scheduled for Storage.

   (a) Irrigation should be stopped 10 to 14 days prior to storage in all fields with plants showing even a trace of late blight. Stopping irrigation will dry the soil surface and stop infection by conidia of P. infestans to shallow tubers.

   (b) Plants in late blight fields should be killed with chemical vine killers at their labelled rates and by labelled methods of application, to stop infection by conidia of P. infestans at harvest of tubers going into storage. This vine killing treatment will also control inoculum that will infect next year's potato crop in the form of infected tubers that are pushed aside at harvest and overwinter in the field.