LATE BLIGHT OF POTATOES UNDER CENTER PIVOT IRRIGATION IN BENTON AND WALLA WALLA COUNTIES IN 1975 1/

by

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ABSTRACT

Late blight (Phytophthora infestans) was found on three farms totaling about 2000 acres of potatoes under center pivot sprinkler irrigation in 1975. August weather records for the past 20 years indicate late blight could have occurred in 1968 and possibly 1969, 1964, 1962, 1959 and 1957 if a large number of sprinkler irrigation systems and P. infestans inoculum had been present in those years. Traces of late blight are expected to occur in future years with weather similar to 1975.

Destroying potato dump piles, elimination of late blight infected potato seed, reducing excessive nitrification to eliminate heavy vine growth and establishment of a late blight forecasting system to regulate sprinkler irrigation are proposed as means of control.

There is no information that foliar fungicides applied by aircraft to potatoes under sprinkler irrigation would control P. infestans. This means of control seems doubtful, since it would be necessary to re-apply after every irrigation.

INTRODUCTION

There are no published reports of late blight (Phytophthora infestans) (Mont.) DeBy occurring in central Washington. Sprinkler irrigation (hand lines and wheel movement) of potatoes began in about 1952 and center pivot systems were installed about 1956 (personal communications, Mel Hagood, Extension Irrigation Water Use Specialist). Less than 10 center pivot systems were present in 1965 but this increased to 906 by August 4, 1974 (10). Sprinkler irrigation has been reported to increase late blight (23) and early blight (Alternaria solani) (Ell. and G. Martin) L. R. Jones and Grout (9).

Plant foliage with dark brown irregular lesions typical of late blight were collected from a center pivot irrigated field in Walla Walla County by Gus Hokanson, Franklin County Area Extension Agent, on August 3, 1975. Diseased plants were found at the first sprinkler head of the pivot where soil and foliage were continually wet. According to the grower, similar symptoms developed in 1974 and a light trace of blight progressed into the field even after he shut off the first sprinkler head. We observed and collected blighted potato foliage from numerous center pivot circles on August 27, 1975 along the Columbia River in Benton County. Plants were dead in a few circles and emitted a mildly pungent odor (25). We also observed the disease in several circles in Walla Walla County near the Touchet River. There were no reports or observations of the problem in any other county. It is estimated that late blight occurred in varying degree on about 2000 acres in central Washington in 1975. This paper discusses means of predicting future occurrence of late blight and possible methods of control.

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HISTORY OF EPIDEMIOLOGY AND CONTROL OF LATE BLIGHT

Dump piles infected with P. infestans are a greater primary source of inoculum than either planting infected potato seed or volunteer plants from infected overwintering tubers (1, 11). Less than 1% late blight infected seed tubers produced diseased shoots in the United Kingdom and Maine. Death of the late blight fungus within infected tubers may account for part of the reason P. infestans doesn't invade stems (11). The fungus is a poor competitor with other rotting organisms within seed tubers, therefore infected tubers rot in soil with little or no emergence. P infestans invades stems and sporulates from stem lesions above the soil in the few infected planted seed tubers that do germinate (11, 22). Evidence also suggests that field infections may originate from lesions of non-germinating tubers in the soil. The fungus can pass upward through the soil (in soil water) to infect leaves near the soil and start epidemics (11). One report from Holland suggests that the late blight fungus overwinters as a saprophyte in the soil (6). Volunteer plants from infected overwintering tubers in the field rarely initiated late blight in the United Kingdom (11).

During a 5-year study in Maine out of 417 dump piles inspected, 232 were infected with the late blight pathogen which spread by wind to 52 nearby fields (1). Dump piles are ideal reservoirs of P. infestans because large numbers of infected tubers are present. Furthermore, lack of soil cover over infected tubers favors emergence of shoots and their exposure to infection. P. infestans was shown to be disseminated over 400 ft from the dump piles (1).

Forecasting of late blight has been helpful in the control of late blight in areas of high natural rainfall (13, 14, 15, 16, 17). It has to be assumed that the fungus is introduced by infected seed potatoes or dump piles for forecasting to be successful (11, 12). Conditions were favorable for late blight when rainfall the previous 10 days totalled at least 1.2 inches and the previous 5-day mean temperature was less than 78 F (17). Minimum temperatures of 45 F or less are considered unfavorable for late blight (14). Late blight symptoms appear 1-2 weeks after late blight is forecast (15). Years with early and numerous frequent late blight forecast periods have the most severe epidemics. After late blight is established 10-day favorable periods are no longer required for its spread. Conditions considered favorable for late blight are relative humidities over 90% and temperatures of 45-53 F for 14 consecutive hours, 54-59 F for 12 hours or 60-77 F for 10 hours (5, 14).

Foliage fungicides applied by ground equipment at about 100 gal of fungicide solution per acre at 400 psi have been very successful in controlling late blight in areas of natural rainfall (4, 18, 19, 21). Limited experimental evidence from Maine suggests that only 3 to 5 gal of fungicide solutions per acre applied by aircraft may be effective (20). Fungicides are sprayed about once a week under normal weather conditions and every 4 to 5 days when weather is damp, misty or rainy and when nights are cool (24). There are no reports that fungicides will control late blight, under our conditions in Washington, where potatoes are sprinkler irrigated at 1-2 day intervals.

Yields are reduced by severe late blight but the greatest losses result from tubers rotting in storage even in years of light late blight infection (3, 19). Some tubers near the soil surface are infected by spores from foliage penetrating wet soils, but most infections occur at harvest and develop rot in storage (25). Immature, bruised tubers may become severely infected (2). Killing the vines with chemicals prevents most storage rot of mature tubers, since P. infestans is a parasite (24). Some foliar fungicides applied by ground equipment in areas of natural rainfall are reported to reduce late blight tuber rot in the field (3).

METHODS AND MATERIALS

Leaflets collected from fields suspected to be infected with P. infestans were incubated for 24 hrs at 69 F in a moist chamber. Fungal growth was removed from the leaflets by a finely drawn glass tubing and transferred to frozen lima beam media (8) with pimaricin, penicillin and polymixin added and incubated at 69 F for two to three weeks. Cultures were forwarded to West Virginia University for verification of race of P. infestans.

Temperature, precipitation and relative humidity data collected near Kennewick and Hanford, Washington by the U. S. Department of Commerce for Washington and Hanford Meteorology Station for the past 20 years were analyzed to determine if previous periods favorable for late blight have occurred.

RESULTS

Isolates from infected leaves were verified to be those of P. infestans, probably of race zero (personal correspondence, R. J. Young, West Virginia University).

Average temperature, total precipitation, and average relative humidity for August 1975 when late blight developed was 70.8 F, 1.06 inches and 41.7%, respectively (Fig. 1). August 1968 had similar weather conditions. Augusts of 1969, 1964, 1962, 1959 and 1957 were as cool as August 1975, but had much less precipitation.

PREDICTION OF LATE BLIGHT IN THE FUTURE AND ITS CONTROL

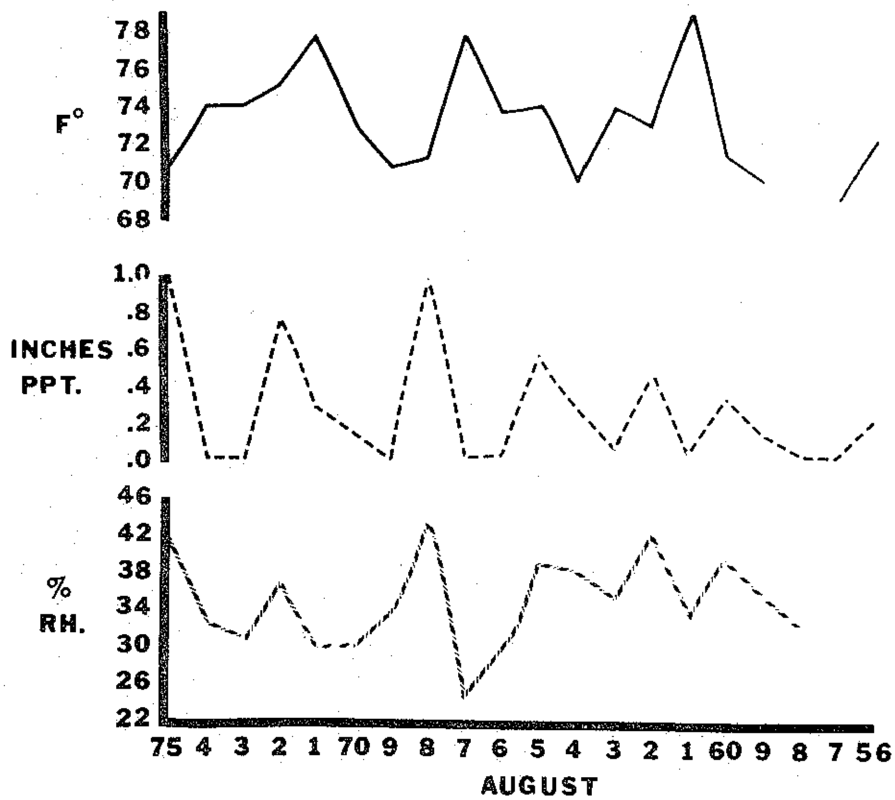
Until 1975 late blight had been controlled in Washington and other western arid potato growing areas by the natural low humidity environment. With the development of irrigation sprinkler systems, potato production became possible on coarse textured soils which required near daily irrigation because of their low water holding capacities. With these daily irrigations and the cool rainy periods which occurred in August 1975, there were long periods of 90 + relative humidity favorable for P. infestans sporulation (Fig. 1). It is probable that late blight would have occurred in 1968 if P. infestans inoculum had been present. Late blight might have occurred in 1969, 1964, 1962, 1959 and 1957 if the present number of center pivot systems had been present. Late blight will probably occur in the future, varying from a slight trace to serious losses, depending upon how we prepare to defend against it.

In 1975 P. infestans was probably introduced with infected seed from states where late blight occurs. Dump piles of rotted potato seed discarded at cutting may have also provided the primary source (1). Planting infected seed pieces and the occurrence of infected overwintering volunteer potatoes provides a low but constant source of this pathogen. Dump piles should be destroyed by chemical herbicides, burning or scattering and freezing (24). Any rotted seed should be inspected and destroyed if it contains late blight rot. Volunteer plants cannot be economically removed from fields, but chemically killing vines prior to harvest will keep late blight tuber infection at a minimum.

Forecasting could help in late blight control, assuming a source of P. infestans was present. Sprinkler irrigation supplies more than the critical 1.2 inches in 10 days (16), therefore, factors to consider would be temperatures lower than 78 F, overcast days, heavy potato foligae because of over-nitrification, and extended periods of 90 + relative humidity (15). Once late blight is forecast, increasing the dry periods between sprinkler irrigations or completely stopping irrigation should be attempted to stop sporulation and symptom expression.

Foliar fungicides may aid in the prevention of late blight, however, there are no published reports that aircraft application of fungicides will control late blight foliage symptoms or tuber rot of potatoes under sprinkler irrigation. On the contrary, because the early blight organisms was not controlled under these conditions in Washington (7) it is likely that aerial applications of fungicides will not control late blight unless applied after every irrigation. Fungicide applications after every irrigation wouldn't be economical unless irrigation was stopped for longer periods. It is not uncommon to apply fungicides 8 to 12 times per season for late blight control in Maine in a severe late blight epidemic (4, 18, 19, 21).

Figure 1: Average temperature (F) and total precipitation (PPT) from Kennewick Station and average percent relative humidity (RH) from Hanford Station for Augusts of 1956-75.



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