FORECASTING LATE BLIGHT OUTBREAKS IN SOUTH CENTRAL WASHINGTON

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Severe outbreaks of late blight have recently occurred in 1990, 1991, 1992, 1993, and 1994 on potato in south central Washington. Late blight was first identified in this area during the growing season of 1947 when weather was unusually cool, cloudy and wet. It was next reported 27 years later in 1974 and was observed in fields seven of 16 years between 1974 and 1989.

Several factors may have contributed to the recent outbreaks of late blight in south central Washington. These include wetter than normal weather (6), an increased proportion of the *P. Infestans* population insensitive to metalaxyl (2), and increased production of cultivars extremely susceptible to *P. Infestans* (5).

Management of late blight has been augmented in several regions of North America and Europe by scheduling fungicide applications using prediction models (4,7); however, an adequate model has not been developed for the irrigated potato region in south central Washington (2). The purpose of this study was to investigate the role of weather on the development of late blight outbreaks and to develop a forecasting model for south central Washington.

Materials and Methods

The years from 1970 to 1993 were used to study the effects of weather on late blight development in south central Washington. Total rainfall, number of rainy days, number of consecutive days with rain, minimum temperature and maximum temperature from April to September of each year, and average temperature, mean minimum temperature, minimum temperature, number of days with temperatures below 0 F, and precipitation from November to February preceding each growing season were collected at the Irrigated Agricultural Research and Extension Station near Prosser, Wa.

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Results

Late blight was observed 11 of 24 years in commercial fields from 1970 through 1993. Years classified as having outbreaks were 1974, 1975, 1976, 1977, 1982, 1983, 1984, 1990, 1991, 1992, and 1993. Late blight was found in one field in 1974 and a few fields in 1976, 1977, and 1984. Estimated area affected was 2000 acres in 1975, 25,000 acres in 1982, 35,000 acres in 1983 and over 37,000 acres each in 1991, 1992, and 1993 (3). In 1990, late blight occurred on about 400 acres late in August in the southern and northeastern areas of the Columbia Basin of Wa.

A model with an indicator variable for the presence of an outbreak the preceding year (BLAG), number of days of rain in April and May (DAYR-AM), and number of days of rain in July and August correctly classified the disease status for 92% of the years. The percentage of years with outbreaks correctly classified (sensitivity) was 91% and years with no late blight correctly classified (specificity) was 92%. A second model using BLAG, DAYR-AM and total precipitation in May when daily minimum temperature was greater than or equal to 41 F (MPPT 5) correctly classified the epidemic status for 88% of the years. Sensitivity and specificity of this model were 91% and 85%, respectively.

The year 1994, not included in the data set for model development, was correctly classified as an outbreak year. Logistic regression, which requires fewer assumptions, had similar results to the discriminant analysis.

Discussion

The effect of weather on the development of late blight outbreaks has been known for many years (9). Potatoes are mostly grown under center pivot irrigation systems in the semiarid environment of south central Washington and before 1990 late blight was generally not considered to be a serious threat to potato production. Late blight has been important on potatoes grown under irrigation in the arid regions of Israel (8).

Weather factors in south central Washington had a major influence on late blight development. In this study, number of rainy days in April and May, number of rainy days in July and August, and total precipitation in May when the minimum temperature was greater than or equal to 41 F were good indicators of late blight outbreaks.

Mean monthly maximum temperatures did not appear to deter late blight development in south central Washington. Wallin reported that detached spores of the late blight fungus survived the afternoon and into the evening on potato leaves when afternoon temperatures were 81 to 88 F but not when temperature were above 90 F (9). In Israel, survivability of dispersed spores was reduced during days with high temperature and low humidity. However, under extremely unfavorable conditions of temperature and humidity that endure only temporarily, mycelium of the late blight fungus survived in leaf and stem tissue and was able to produce spores when conditions became favorable (8).

The importance of initial inoculum for the development of late blight outbreaks has long been recognized (7), and initial inoculum has been assumed to be constantly present in an area by most forecasting models (7). In this study, initial inoculum was demonstrated to be an important factor for the development of late blight outbreaks in south central Washington by the indicator variable for the presence of an outbreak the preceding year. If an outbreak occurred the preceding year, inoculum would be expected to survive the winter in infected tubers in fields, cull piles or storage. G.D. Easton thought that cold winters eliminated overwintering inoculum (2). However, we did not find an effect of low and extreme winter temperatures on late blight development. This may be due to infected tubers being buried below the frost line in fields and/or infected tubers being removed from storage and placed in cull piles in late winter.

Initial inoculum and early season moisture were important indicators of late blight outbreaks. This supports a hypothesis that favorable weather conditions are needed for inoculum to build up in fields containing volunteer potatoes and in cull piles and for dissemination of spores to commercial fields. Spores are sensitive to drying and are effectively disseminated from field to field mostly only during wet weather (8). Once potato plants in a commercial field of irrigated potatoes are infected, microenvironmental conditions are generally favorable for continued late blight development (2, 6).

Forecasts for the occurrence of late blight could be made each year on 1 June. The three variables, BLAG, DAYR-AM, and MPPT5, would be available at that time and discriminant or logistic functions could be solved using the second model. One of three variables of the first model, DAYR-JLA, is not available on 1 June, but the model could be indirectly useful in that the value of DAY-JLA needed for an outbreak to occur could be calculated and compared to the normal and expected occurrences of rainy days in July and August. The calculations could be repeatedly made and the forecast updated as weather and crop conditions change in July and August. These empirical forecasts would be general in nature, advising growers near the beginning of the growing season of the likelihood of an outbreak. Such an advanced warning is important in an area where a disease is sporadic in occurrence and when individual growers have large areas of potatoes that may need monitoring and fungicide applications.

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