An Integrated Program for Managing Potato Late Blight

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Potatoes are the most important vegetable crop in Wisconsin, with approximately 64,500 acres (26,103 ha) harvested in 1982. Production is principally in a northern area near Antigo in Langlade County and in the multicounty Central Sands area near Stevens Point. Weather is somewhat cooler and wetter in the northern area, but optimal conditions for disease development are common in both areas.

One of the greatest threats to potato production Wisconsin growers face is late blight caused by *Phytophthora infestans* (Mont.) de Bary. When foliage infection combines with tuber infection and decay, losses can be significant. Even though the disease is not epidemic every year, growers must consider the risk of late blight when they plan their pest control strategies. Traditional control methods include destroying cull piles and volunteer plants from overwintered tubers, rotation, planting certified seed, and spraying foliage with protectant fungicides, beginning when vines are 8–10 in. tall and continuing at 5- to 10-day intervals until vine kill (1,3).

During 1978–1980, numerous Wisconsin growers reported unusual difficulty in controlling late blight, and monetary losses were high because of reduced yield and storage decay. Late blight was particularly widespread and devastating in 1980, when weather conditions from late July through September favored disease spread. Cull piles from 1980-1981 storage losses were present in most potato-producing counties, and the probability of another late blight epidemic during the 1981 growing season was high. Consultation among growers, agribusiness representatives, and Cooperative Extension personnel provided the basis for a multifaceted program that incorporated field scouting, weather monitoring, computer analysis and communication, and registration of a highly effective systemic fungicide into the traditional control system.

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The plan of action

Educational meetings during the winter of 1980–1981 reviewed aspects of late blight development and conventional control strategies. An integrated pest management (IPM) program for potato pests tested in 1979 on limited acreage was used on a broader scale in 1980. Weekly field scouting, identification of pests (insects, diseases, weeds), and prompt implementation of control measures by the grower were emphasized. In 1980 the program helped detect late blight early and identify the fields where control was inadequate. Grower interest in improved late blight control stimulated program expansion—from 3,300 acres (1,336 ha) in 1980, to 5,300 acres (2,145 ha) in 1981, to 8,100 acres (3,278 ha) in 1982.

Before each growing season started, IPM scouts were trained in control strategies, epidemiological factors, detecting locations most favorable for late blight development, sampling individual fields, handling plants with suspicious symptoms, and identifying late blight and other major pests. Speed of identification was critical to implementing control measures, so microscopes and photomicrographs of the sporulating late blight fungus for use by trained personnel were located at key sites in the potato production areas. Procedures for submitting samples to the University of Wisconsin-Madison Plant Disease Diagnostic Laboratory for confirmation were outlined.

BLITECAST, the late blight forecasting program developed at Pennsylvania State University under the direction of R. A. Krause (6,7), was modified for use in Wisconsin. BLITECAST uses severity values to denote the effect of extended periods of high relative humidity and the temperatures during those periods on the development of late blight epidemics. The provision canceling severity values when temperatures the next day are 30 C or above (5) was removed. Also, to increase the margin of safety in controlling early blight (*Alternaria solani* (Ell. & G. Martin) Sor.), a 10-day spray schedule with a protectant fungicide was substituted for the "no spray is needed" recommendation. Spray recommendations for treatment with protectant fungicides were initiated when data entry began and did not wait for the accumulation of 18 severity values. The modified program was used on a trial basis in 1980 and was ready for use in the IPM program before the 1981 growing season started. Daily temperature, relative humidity, and rainfall data were collected from plant emergence to vine kill in potato fields near areas where late blight had been observed in previous years.

A network of 15 weather stations equipped with either recording hygrothermographs or CR-21 microloggers (Campbell Scientific Inc., P.O. Box 551, Logan, UT 84321) was established in fields in central and northern Wisconsin representing late blight "risks." Data collected at least once a week, depending on plant growth stage, presence of late blight, and environmental conditions, were entered by IPM personnel via remote terminals into files maintained on a PDP-11/70 computer (Digital, 444 Whitney St., Northboro, MA 01532) on the University of Wisconsin-Madison campus. The BLITECAST program then calculated the potential for late blight and the frequency of protectant fungicide applications needed for control.

The fungicide metalaxyl had been evaluated in Wisconsin and several other states before 1981 and had shown superior efficacy against the late blight pathogen. In addition to eradicant and protectant activity (4), metalaxyl was effective at low rates and was compatible with other commonly used pesticides. Proposals for the emergency labeling of Ridomil 2E (metalaxyl) in Wisconsin during the 1981 and 1982 growing seasons were sent to the Environmental Protection Agency (EPA) in advance of the anticipated need. Because resistant *P. infestans* strains developed rapidly after the exclusive use of metalaxyl for late blight control in Europe (2), Wisconsin recommendations specified combining metalaxyl with a protectant broad-spectrum fungicide, such as mancozeb. Isolates of *P. infestans* collected during 1981 and 1982 were evaluated for resistance to Ridomil 2E, using laboratory procedures described by Davidse et al (2).

The plan in action

Cool, damp weather with frequent rainfall marked the early part of the 1981 growing season. BLITECAST warned on June 22 that late blight was likely in northern Wisconsin within 7 to 14 days. The first sample of an active late blight infection was detected by an IPM scout on June 30, and within 48 hours, infected

Table 1. Accumulation of BLITECAST severity values for 1980–1982 and first appearances of late blight in northern Wisconsin

Dates	Severity values		
	1980	1981	1982
June 5–10	10	0	2
11–20	6	9	4
21–30	9	10	2
Total	25	19	8
July 1–10	2	8	9
11–20	13	28	11
21–31	10	12	14
Total	25	48	34
August 1–10	14	23	13
11–20	20	11	5
21–31	21	28	18
Total	55	62	36
Season total	105	129	78
Severity values totaled 18	June 23	June 24	July 11
Late blight identified	July 28	June 30	August 4

plants were identified in five fields. Two potato cull piles—one with active late blight lesions—were located and destroyed. This was the earliest recorded appearance of late blight in Wisconsin and signaled the critical nature of the problem. Within a week, BLITECAST warned that late blight was likely in the Central Sands area, and within another 2 weeks, the disease was found in two fields there. Weather tended to favor late blight development through July, especially in northern Wisconsin, then less so during August and September.

On July 2, 1981, the EPA granted approval for emergency labeling of metalaxyl for late blight control in Wisconsin. The same day, applications of Ridomil 2E (1 pt/A; 1.2 L/ha) combined with mancozeb (1.2–1.6 lb a.i./A; 1.3–1.8 kg a.i./ha) were started. Field monitoring through the rest of the growing season helped identify the problem fields and verify the effectiveness of the fungicide applications.

Metalaxyl was used in four counties to treat 30 fields totaling 1,634 acres (661 ha), about 3% of the potato acreage. Timing of applications varied among counties, reflecting differences in weather. Most growers found that one metalaxyl application—after late blight was observed and supplemental to a protectant fungicide program—arrested disease spread within 5 days. Nine fields were sprayed again, 14 days after the first application, to ensure control. Protectant fungicides were then used at 5- to 10-day intervals until vine kill. By the end of the growing season, the observed incidence of late blight was at a 4-year low. Only two growers reported late blight in storage—and neither had used metalaxyl or the IPM program.

The early part of the 1982 growing season was marked by infrequent rainfall and low relative humidity, and BLITECAST did not signal the potential for a late blight outbreak until after July 11. Not until August 4 was late blight confirmed in two fields in northern Wisconsin, and then weather did not favor spread of the disease, so metalaxyl was not used to supplement protectant sprays. No other late blight was observed in northern Wisconsin during 1982. In the Central Sands area, however, rainfall during late July and August favored disease development, and by early September, three fields with infected plants were found. Two were scheduled for vine killing within 5 days and were not treated with metalaxyl, but sections of the third (about 50 acres, or 20.2 ha) were sprayed with metalaxyl tank-mixed with mancozeb, and no additional late blight was observed during the growing season or storage.

Five isolates of *P. infestans* collected during the 1981 and 1982 growing seasons were evaluated for resistance to metalaxyl. All were susceptible to concentrations equal to or greater than 0.1 μg/ml a.i. of the fungicide. No evidence of metalaxyl resistance was observed after two seasons of use in Wisconsin.

How the plan worked

The statewide computer network rapidly disseminated timely information. Every week during the growing season, Cooperative Extension agents received electronic newsletters and thus were alerted to the first identification of late blight, the progress of disease spread, the approval of the metalaxyl label, and the control strategies. Agents in turn dispersed this information throughout their counties via grower newsletters and news releases.

During the 3 years, late blight was not observed until 18 BLITECAST severity values had accumulated, and warnings at this point alerted IPM personnel and growers to the likelihood of disease development. In northern Wisconsin, the first isolated plants with late blight were found 35 days after accumulation of 18 severity values in 1980, 6 days after in 1981, and 24 days after in 1982 (Table 1). The pattern was similar in the Central Sands area.

Overall use of protectant sprays increased slightly through participation in the IPM program. However, combining metalaxyl with a protectant fungicide to treat individual fields and prevent disease spread to adjoining areas apparently curtailed the need for more intensive spraying of widespread potato acreages. Future use of metalaxyl will be limited to problem fields during periods favorable to disease spread.

Integrating education, prediction, surveillance, monitoring, and fungicide control has successfully reduced the threat of potato late blight in Wisconsin. Placing a monetary value on this integrated program is difficult, but the negligible losses attributed to late blight in 1981 and 1982 contrast sharply with the more than $1.3 million loss reported in 1980. The IPM program has made a significant impact on potato production in Wisconsin.

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