

## The economic impact of potato late blight on US growers

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### Summary

Potato growers have been able to control the fungus, *Phytophthora infestans*, that causes late blight with fungicides, but at an increasingly higher cost. A Delphi survey was conducted with thirteen experts to estimate the impact of late blight on potato yields, storage losses and fungicide use. It was estimated late-blight fungicides cost \$77.1 million and lost revenue for US growers was an additional \$210.7 million. These total costs, which average \$507 per hectare, do not include non-fungicide control practices.

### Introduction

Late blight has devastated potato production for the last century and a half. Niederhauser (1993) claims it is the most important potato disease in the world. Because of the variability and virulence of the fungus (*Phytophthora infestans*) that causes late blight, durable resistance to the disease is difficult to incorporate into commercial potato cultivars. In recent years, growers have effectively controlled late blight with fungicides, but at a high cost. Blight control costs in some US areas exceed 10 percent of total production costs (Stevenson, 1993).

Limited research has been conducted on the economic impact of potato late blight. Knutson et al. (1993) concluded that Maine potato yields would decline 25 percent if fungicide applications were cut in half and that late blight would wipe out the entire Maine potato industry if fungicides were unavailable. More recently, Guenthner et al. (1999) found that late blight was the most serious disease problem in the US potato industry and that the loss of chlorothalonil, a late blight treatment, would cost the industry \$80 million.

The objective of this study was to estimate the economic loss to potato growers caused by late blight. Two categories of loss were investigated: (1) fungicide costs (materials and application) and (2) revenue reduction due to yield, storage loss and quality impacts. Although the impacts of late blight go beyond the farm, we did not estimate losses to other enterprises or consumers.

### Methods

A Delphi survey (Linstone & Turoff, 1975) was used to obtain expert opinion from thirteen University scientists who were knowledgeable about potato late blight.

Delphi surveys consist of two or more rounds. Researchers provide participants with group averages and their own answers to previous-round questions. With this new information they ask respondents to again answer the questions, leading to a group consensus. Rasp (1973) found that anonymous responses were more likely to be objective. By not being in the same room, participants are more confident in contributing their opinion and do not feel pressured by a dominant group leader.

Respondents were chosen on their knowledge of potato late blight, the fungicides used to control it and their willingness to participate. Electronic mail was selected as the method of questionnaire distribution for the participants' and facilitators' convenience. The questionnaire asked participants to estimate changes in yield, storage loss and fungicide use if late blight did not exist. The experts were asked to answer the questions from the perspective of the impact on the entire potato industry rather than the geographical area in which they work.

Average responses for second-round responses were quite close to first round responses. For yield loss and metiram use the average responses were identical. The range of answers narrowed for all questions between the two rounds. Relatively wider ranges persisted for some fungicides, suggesting differences in local conditions. Although respondents were asked to consider the entire US potato industry, some indicated that their answers were influenced by local conditions. Since the average answers remained stable, the survey was concluded after two rounds.

## **Results**

Results of the expert opinion survey are summarized in Table 1. Respondents estimated that under a no-late-blight scenario yields would increase 5% and storage loss would decrease 17%. Fungicide use was estimated to decrease by as much as 98% for cymoxanil, dimethomorph and propamocarb but as little as 3% for metalaxyl.

The impact of late blight on potato grower revenue is \$210.7 million (Table 2). The Delphi survey results were applied to yield and storage loss impacts to USDA potato crop values for the 1995–98 period. Quality impact (rejections and price discounts) was calculated at 64% of the yield impact, which Wiese et al. (1998) estimated as the average for the three potato fungicides in that study. Under a no-late-blight scenario, an increased potato supply would push down prices. We used a long-run price elasticity of 1.2 from Guenther (1987) to calculate a price adjustment of \$46.3 million.

Estimated fungicide costs of \$77.1 million (Table 2) are based on survey results and USDA data. For the first eight fungicides in Table 1, USDA chemical use surveys (1990–98) and USDA annual price summaries (1990–98) were used to calculate baseline values. Since the last three fungicides were not included in the USDA sources, use data came from the Delphi survey and price data from the University of Idaho (Patterson, 1998). USDA chemical use surveys after 1998 were deemed too limited in scope regarding potatoes to provide updated data for this study.

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Table 1. Summary of late blight expert opinion.

Category	Change
Potato yields	5%
Storage loss	-17%
Fungicide use:	
Chlorothalonil	-33%
Copper ammonium	-54%
Copper hydroxide	-51%
Mancozeb	-26%
Maneb	-26%
Metalaxyl	-3%
Metiram	-32%
Triphenyltin hydroxide	-44%
Cymoxanil	-98%
Dimethomorph	-98%
Propamocarb	-98%

Table 2. Estimated grower costs of late blight.

Category	Value	Totals
Revenue loss:		
Yield decrease (\$ million)	\$136.1	
Storage loss increase (\$ million)	\$33.8	
Quality decrease (\$ million)	\$87.1	
Price adjustment (\$ million) *	-\$46.3	
Total revenue loss (\$ million)		\$210.7
Fungicide costs (\$ million)		\$77.1
Total US grower costs (\$ million)		\$287.8
Costs per hectare (\$/h)		\$507

\* Assumes long-run price flexibility of 1.2 (Guenthner, 1987)

## Discussion

Annual late blight costs to US growers are an estimated \$287.8 million, or \$507 per hectare. The lost-revenue estimate of \$210.7 million is much higher than the fungicide-cost estimate of \$77.1 million. Chemical costs of late blight control represent only about one-quarter the total estimated cost of this disease to the grower. In spite of the availability of effective fungicides, late blight still causes serious losses in production, storage and quality.

Yield revenue loss (\$136.1 million) and storage revenue loss (\$33.8 million) are partially offset by a price adjustment of \$46.3 million. The adjustment accounts for the negative price impact of a larger potato supply in a no-late-blight scenario. Growers respond to lower prices by reducing plantings, which increases prices for the next crop, leading to another change in plantings. The elasticity number used in this study is for

the net price impact after a five-year adjustment period (Guenthner, 1987).

The absence of late blight would reduce, but not eliminate, fungicide use in potato production. Metalaxyl use would decrease by only 3% because growers apply it to control pink rot (*Phytophthora erythroseptica*) and pythium leak (*Pythium* spp.). Growers would also continue to use other fungicides, such as metiram, triphenyltin hydroxide, cholorthalonil and copper hydroxide to control early blight (*Alternaria solani*).

Costs of non-fungicide control practices were not analyzed. Experts recommend that growers plant certified seed, destroy potato dumps, reduce volunteer potato populations, and maintain plant health to help control late blight. The costs of these practices were not estimated because even if late blight did not exist, the same measures would be recommended to control other diseases.

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