Phytophthora infestans: AN EPIDEMIOLOGICAL RETROSPECTIVE FROM VANDERPLANK TO THE PRESENT

William E. Fry
Section of Plant Pathology and Plant-Microbe Biology
School of Integrative Plant Sciences

Cornell University
Ithaca NY 14853 USA

Phytophthora infestans (cause of late blight of potato and tomato) is one of the best known of all plant pathogens. A search on Google Scholar reveals that *P. infestans* is the subject of several thousand articles each year. Many of those articles deal with its epidemiology. Obviously, therefore, any review or analysis cannot be comprehensive. This pathogen stimulates so much attention because it caused the Irish potato famine of the mid-19th century (Large 1940) and because it continues to be a pathogen capable of causing dramatically devastating epidemics (Faber 1994; Fry et al. 2015; Johnson et al. 1997; Moskin 2009). Early epidemiological studies concerned the response of the pathogen to diverse environmental variables (Melhus 1915a; Melhus 1915b; Crosier 1934). Subsequently, quantitative analyses of epidemics were conducted (Large 1952).

Because so much was known about the epidemiology of the potato/*P. infestans* pathosystem it was an excellent system by which van der Plank could illustrate the concepts identified in his first two books in the 1960s. The first (Van der Plank 1963) (1963) focused on pathogen population growth strategies, bringing attention to pathogens such as *P. infestans* that are polycyclic, and to pathogens such as vascular wilt fungi that are monocyclic. He explained very clearly the importance of pathogen population growth rate and pathogen population growth strategy (compound interest, and simple interest diseases) and the logistic and monomolecular models. These explanations stimulated much activity in mathematical epidemiology, including the construction of computer simulators of plant diseases. The second book (Van der Plank 1968) focused on the host pathogen interaction emphasizing Vertical resistance and Horizontal resistance in the host, and virulence and aggressiveness in the pathogen, again emphasizing examples from the potato/*P. infestans* pathosystem. His influence in coining these terms has been dominant. Van der Plank's thinking has stimulated much thought about "durable resistance", the knowledgeable use of R genes, pathogen diversity (particularly with regard to stabilizing selection), quantitative epidemiology and integrated management.

In this presentation I will illustrate how quantitative thinking stimulated by Van der Plank has led to new understanding of epidemics and

new approaches to management in the potato/*P. infestans* pathosystem. The topics will include: i) incorporating the most important factors into an effective integrated management system; ii) using mathematical models to inform disease management decisions in near-real time; and iii) using knowledge of pathogen population genetics to inform disease management – in terms of specific tactics and in terms of general strategy.

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