Late blight forecasting: Quantifying the risk from a known source

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Our long-term goal in this project is to predict the risk of late blight from a known remote source. To date we have determined survival of sporangia in relation to temperature, relative humidity (Minogue and Fry, 1981) and solar irradiance (Mizubuti, Aylor and Fry, 2000). Of these factors, solar irradiance appears to have the largest effect — whether sporangia are in the air or on leaf surfaces (Mayton and Andrade-Piedra, unpublished). Modeling efforts have been initiated (Aylor, Fry, Mayton, Andrade-Piedra, 2001). This paper deals with further efforts to quantify relationships between disease severity and aerial concentrations of sporangia as influenced by environment. Other components that are still under investigation are: a) models to describe long distance pathways of aerial transport and b) deposition.

We have measured disease severity, lesion area, total leaf area and sporangia on lesions during several days in each of several years. We have measured potentially important weather components during all of the sampling dates. Our goal is to develop a predictive model that will enable us to estimate the number of sporangia in a field of infected potatoes from knowledge of disease intensity, field size, host susceptibility, and important weather variables. Representatives of the types of data that we have collected are illustrated in Figures 1-3, corresponding to 9, 11 and 12 August 2000, 7, 9 and 10 days after inoculation (DAI) and disease intensities (D) of 6%, 20% and 32% infected foliage (estimated visually). The total number of sporangia on infected leaves (available sporangia) was estimated early in the morning before the plants had dried from overnight dew. Two spore traps were used, a Burkhard spore trap and a set of rotorod spore traps located at four different heights above the crop canopy. The Burkhard spore trap was operated continuously, whereas the rotorods were operated at four different two-hour intervals during the day.

As already known, changes in relative humidity are important to release of sporangia from sporangiophores, and the data in Figure 2 are from a day in which the relative humidity remained high all day, and although there was a large crop of sporangia, only a small proportion were released, and these were released rather later in the day than is the norm (e.g. as in Fig.1). This qualitative result was well known, but we will use these data quantitatively in a predictive system. Figure 3 provides data from a day that appeared to be optimal for sporangium production overnight and release of sporangia during the day.

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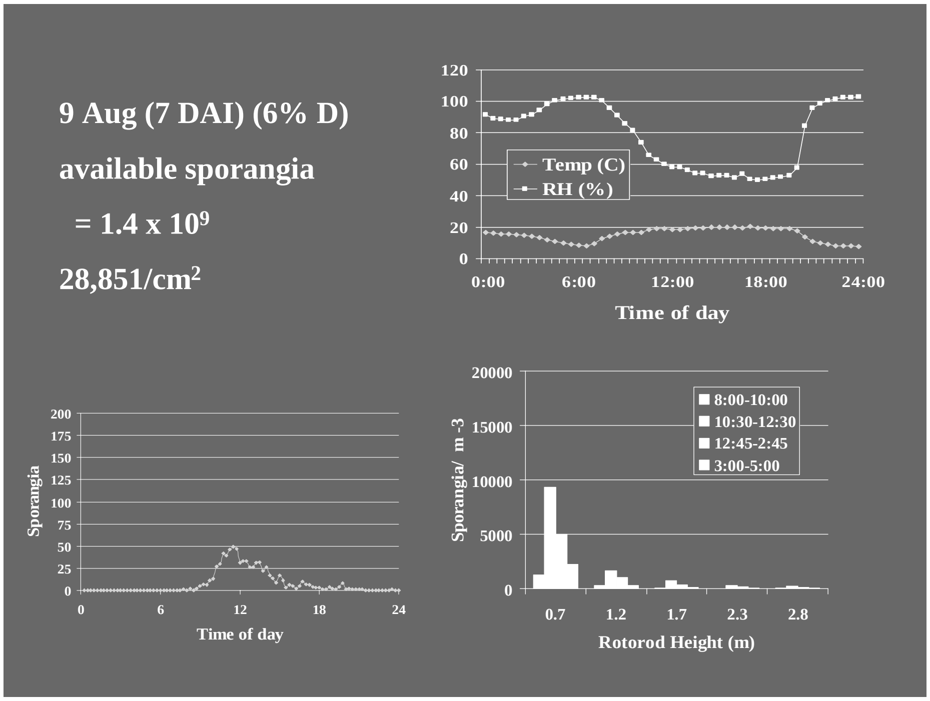

Figure 1. Sporulation on foliage and dynamics of release of sporangia from a small plot of infected potatoes at a disease intensity (D) of 6% infected foliage (estimated visually) with weather conditions that were favorable for sporulation and release. DAI = days after infection, RH = relative humidity

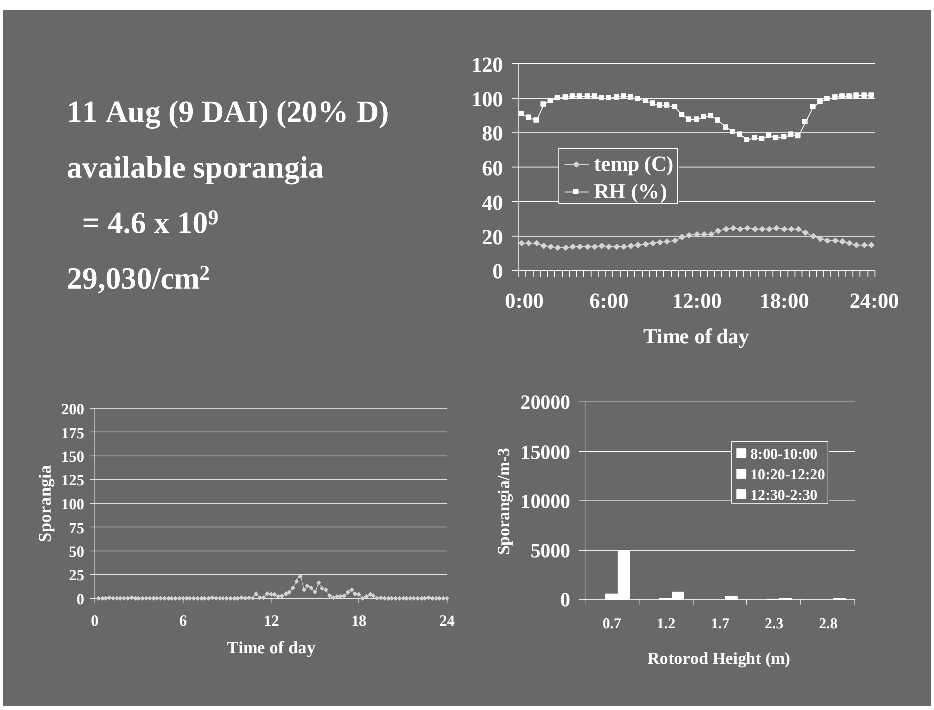

Figure 2. Sporulation on foliage and dynamics of release of sporangia from a small plot of infected potatoes at a disease intensity (D) of 20% infected foliage (estimated visually) with weather conditions that were unfavorable for sporulation and release. DAI = days after infection, RH = relative humidity.

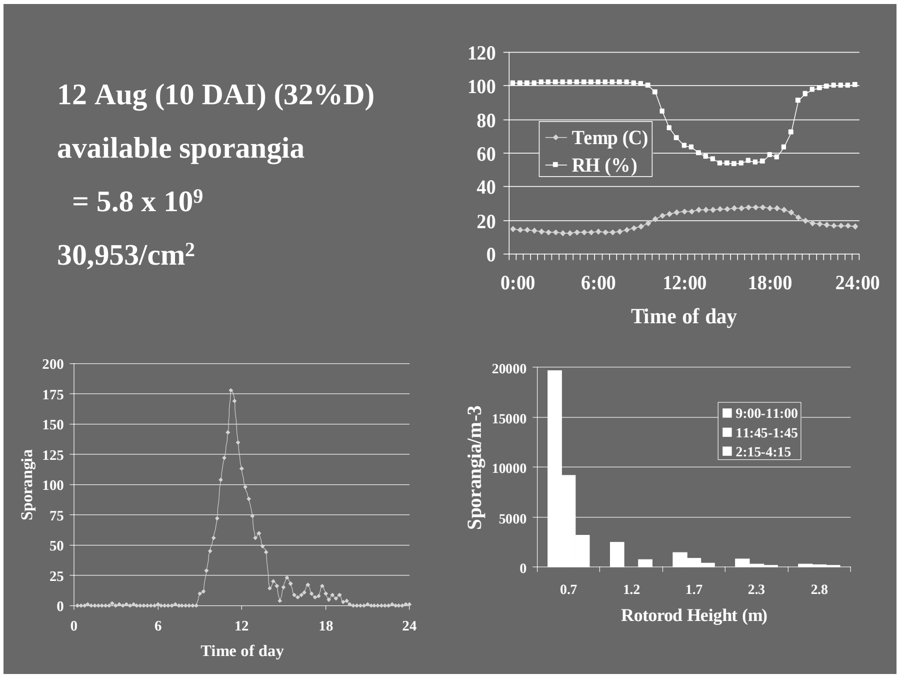

Figure 3. Sporulation on foliage and dynamics of release of sporangia from a small plot of infected potatoes at a disease intensity (D) of 32% infected foliage (estimated visually) with weather conditions that were apparently optimal for sporulation and release. DAI = days after infection, RH = relative humidity.

In some agro-ecosystems, late blight occurrence is a sporadic event and these isolated locations can be specific sources of late blight. It is under these conditions that our modeling approach can be useful. The major goal is to quantify the relative magnitude (with probability) of inoculum that can be liberated and transported viably to a known field of healthy plants. Such information will be a useful component in precision decision management. Field experiments and modeling activities are in process.

Literature cited

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