Definition of thresholds for soil moisture to assess zoospore infections by *Phytophthora infestans*

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Introduction

The prediction model SIMBLIGHT1 calculates the first appearance of *Phytophthora infestans* in potatoes in fields. These forecasts are based on meteorological data and crop characteristics (Figure 1). Studies done in the past have shown, that there must be a correlation between high soil moisture after planting and early occurrence of *P. infestans*. The aim of this current study is to specify the relation between soil characteristics and first appearance of *P. infestans.*

In addition the possibilities of soil water content simulation were tested. Therefore a bucket model was verified with the data collected in this study. Both, the relation between soil characteristics and appearance of *P. infestans* as well as the possibility of simulating the soil water content, should lead to an integration of a soil-module in SIMBLIGHT1.

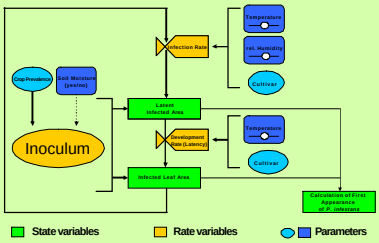

Figure 1: Structure diagram of SIMBLIGHT1

Hypothesis

Potato tubers, which are infected with *P. infestans*, are able to release sporangia and zoospores in the ambient soil, when temperature and soil moisture are optimal for the fungus.

With a diameter from up to 36 µm sporangia of *P. infestans* are hardly able to pass through soil pores. Zoospores of *P. infestans* instead have only a diameter of 10 µm (PORTER 2005). They have the possibility to move through water-filled pores within the soil. In this way zoospores are able to infect healthy potato sprouts from neighbor tubers (Figure 2).

Spore movement through soil depends on pore size distribution and size of water-filled pores. Saturation of soil starts within small pore sizes, which have a high water potential. For movement of zoospores all pore sizes smaller than 10 µm have to be filled completely with water.

In years, which offer high soil moisture over a period of at least 4 days the possibility for movements of zoospores exists over a long time. This process increases the risk of an early appearance of *P. infestans* in field. The effect of soil moisture on potato tuber infection due to *P. infestans* was assessed in a field-experiment.

Materials and Methods

Inoculated potato tubers were buried next to healthy tubers in the field. Afterwards the field was divided into four plots. Each plot was treated with a different number of irrigation-days (8, 4, 2 days of irrigation and one plot with no irrigation – Figure 2). In this way the possibility for movements of zoospores should be analysed.

VP_0	VP_2	VP_4	VP_8
no irrigation	2 days of irrigation (100 mm/m² within 2 days)	4 days of irrigation (200 mm/m² within 4 days)	8 days of irrigation (400 mm/m² within 8 days)

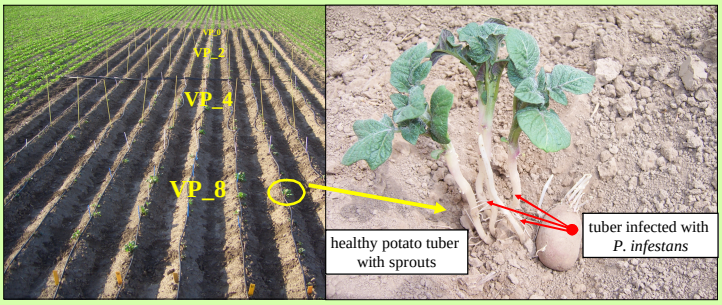

Figure 2: Arrangement of field-experiment and concept of buried transfer of zoospores from infected potato tubers

Results: Field experiment

The hypotheses for movements of zoospores lead to the generation of a „limiting infection value“ in relation to pore size distribution (Figure 3). For possible movements of zoospores the soil moisture has to be above this boarder.

In the field-experiment it could be seen, that the localisation of the limiting infection value depends on the amount of irrigation. As irrigation leads to consolidation, there must be a dislocation of the limiting infection value. Figure 4 shows the different limiting infection values of each plot.

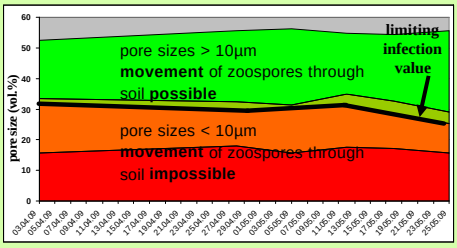

Figure 3: Generating of the limiting infection value on movement of zoospores form *P. infestans* through soil

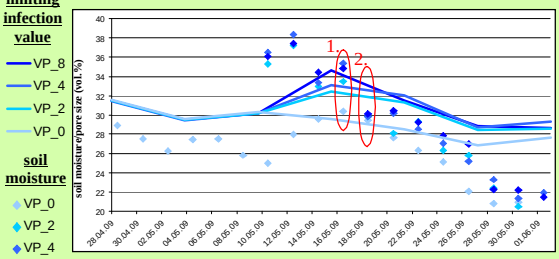

Figure 4: Comparison of the development of the limiting infection value in relation to soil moisture

These facts lead to some different effects (Figure 4):

1.) The mean soil moisture in the plots differs about 5 % by vol., but in all cases the limiting infection value for the related plot is reached.

2.) The mean soil moisture in each plot is nearly identical, but the limiting infection value is only reached in one plot.

Results: Simulation of Soil Moisture

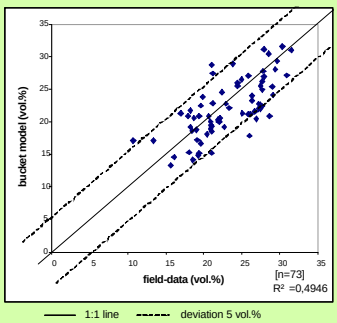

Figure 5: Correlation of the results of the bucket model with field-data

Soil moisture was measured directly every two days in a very time-intensive procedure within the field-experiment. A practical solution could be using so called bucket models. They simulate the soil water content with simple and generally available data from weather stations.

A first correlation between field-data and simulation shows good results. Most of the deviations lie in a range of 5 % by vol. This is identical with the variability of field-data within a plot.

Perspectives

The influence of soil moisture on the limiting infection value could be shown in this field-experiment. Further studies are required to specify the influence of soil type and maybe other so far unknown factors on the localisation of the limiting infection value. The verification of the bucket model for the simulation of soil water content showed promising results (deviations were within the range of variations in field). These results build a good fundament for the integration of soil parameters in a soil-module in SIMBLIGHT1.