# Analysis of correlation between soil moisture and late blight occurrence

EuroBlight Workshop

St. Petersburg, 09.-12.10.2011

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# Structure

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    - 2010
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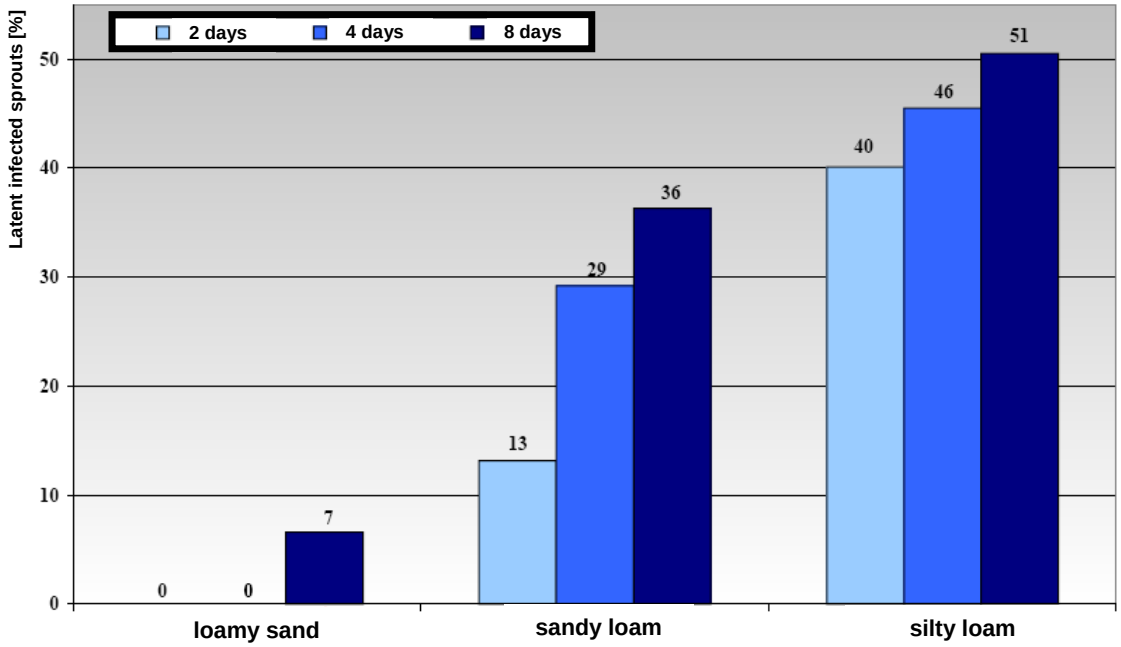
# Introduction

- ADLER (2000):
  - latent infected potato tubers became more important on primary infections in years with wet springs
  - research has to focus on soil borne infections between planting and emergence
- BÄßLER (2005):
  - influence of soil type and soil moisture on primary infections
  - he recommended a soil module for prediction models



# Introduction

- The correlation between infected tubers and infected sprouts on the surface is controversially discussed in literature:
  - MELHUS (1915), MURPHY and McKAY (1927): **correlation between the volume of covered soil and infected sprouts on surface**
  - HÄNNI (1949): **infected sprouts cannot reach the surface**
  - BOYD (1980): **primary infections are not caused from soil borne infected sprouts but spores are directly splashed from contaminated soil to leaves**

The ZEPP prediction model SIMBLIGHT1 calculates the first occurrence of late blight

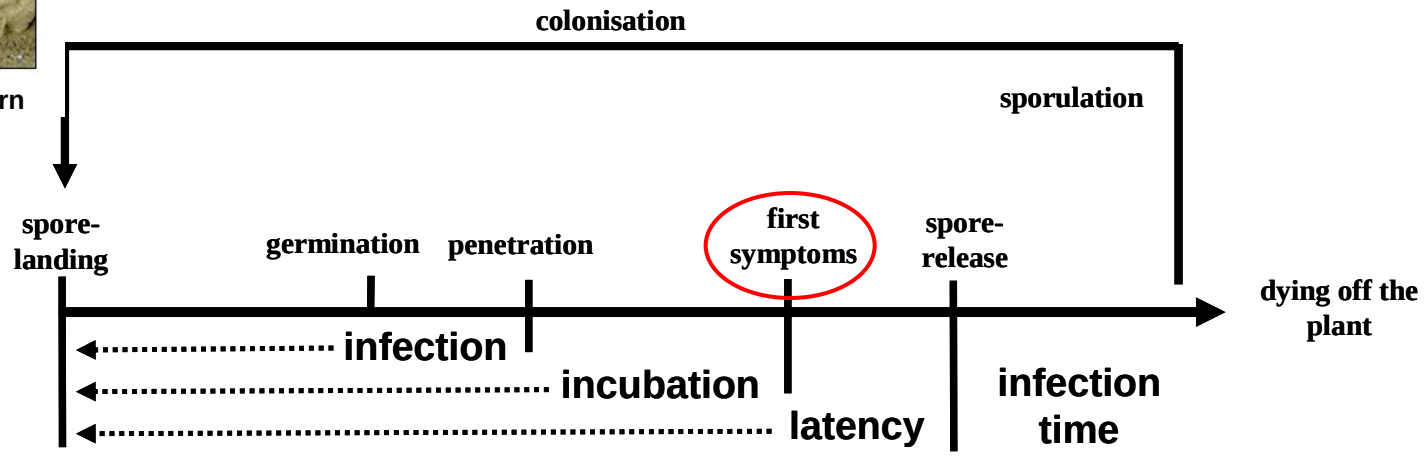
It predicts an earlier outbreak, if there has been a four day period of totally saturated soil between planting and 7 days after emergence

# Hypotheses

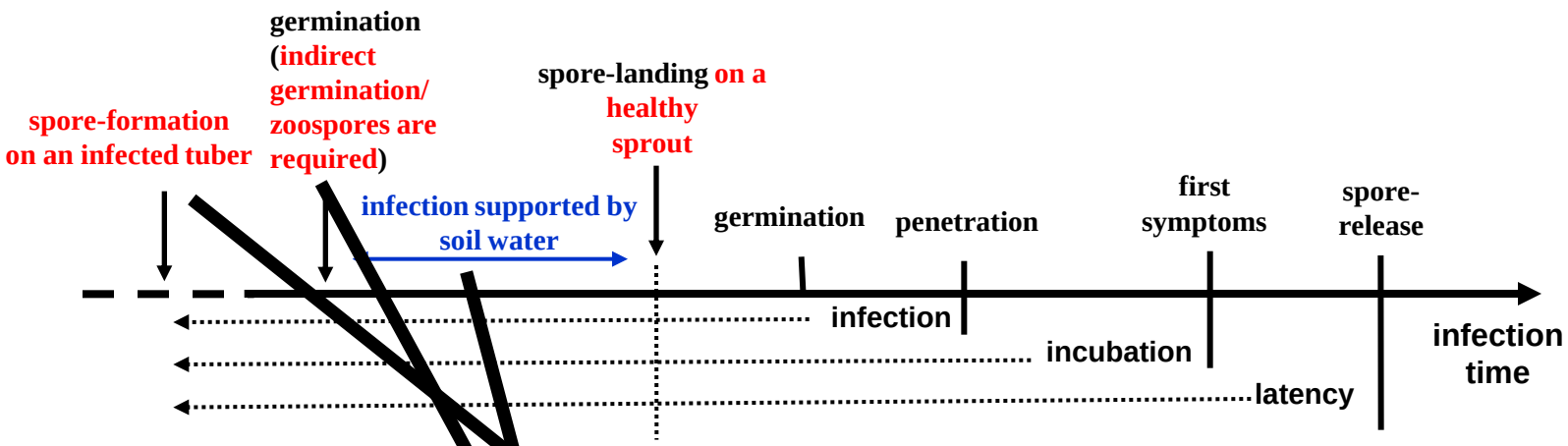
- The influence of soil moisture on the first occurrence of late blight was analysed
- The analyses were focused on the incubation period of *Phytophthora infestans*

- Soil borne infections from infected tubers to healthy sprouts should now be taken into account

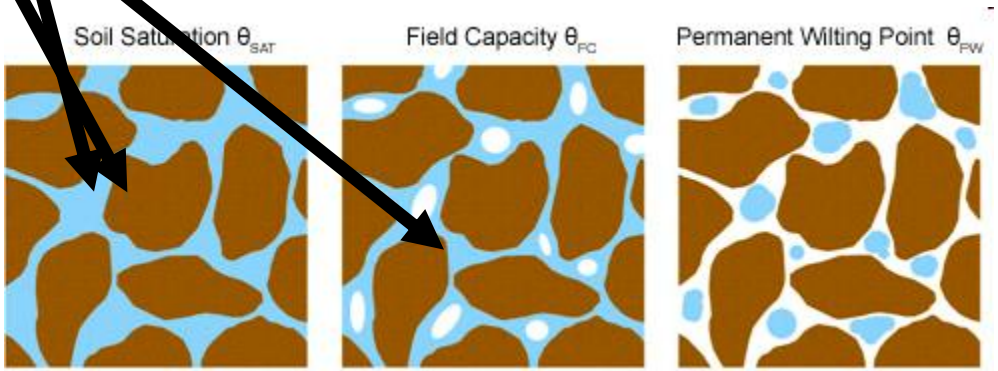
source: LfL Bayern



# Hypotheses




Water potential: 0-60 hPa 60-300 hPa 15000hPa




(Bellingham 2009)

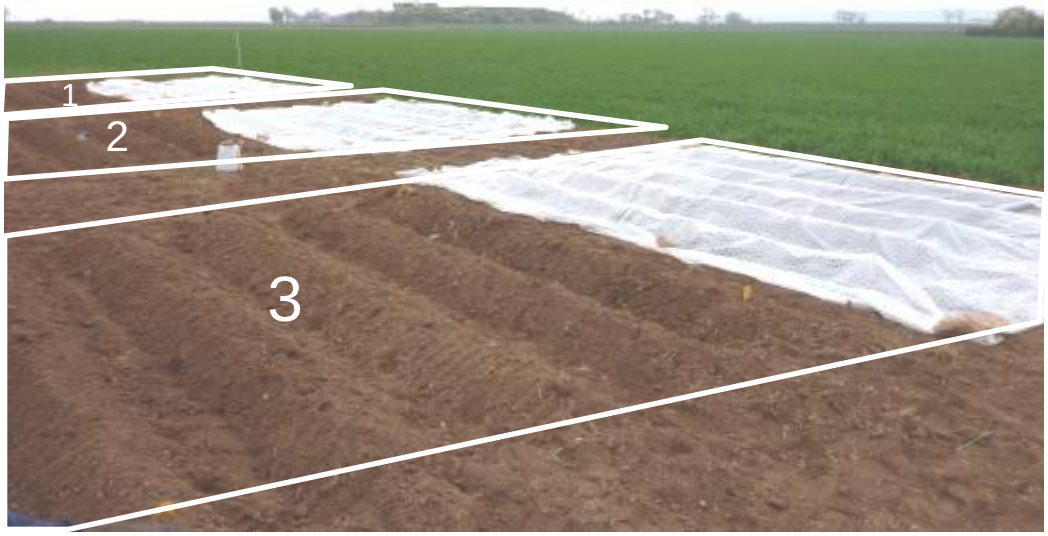
Processes:

**indirect germination** (MACDONALD and DUNIWAY (1978))

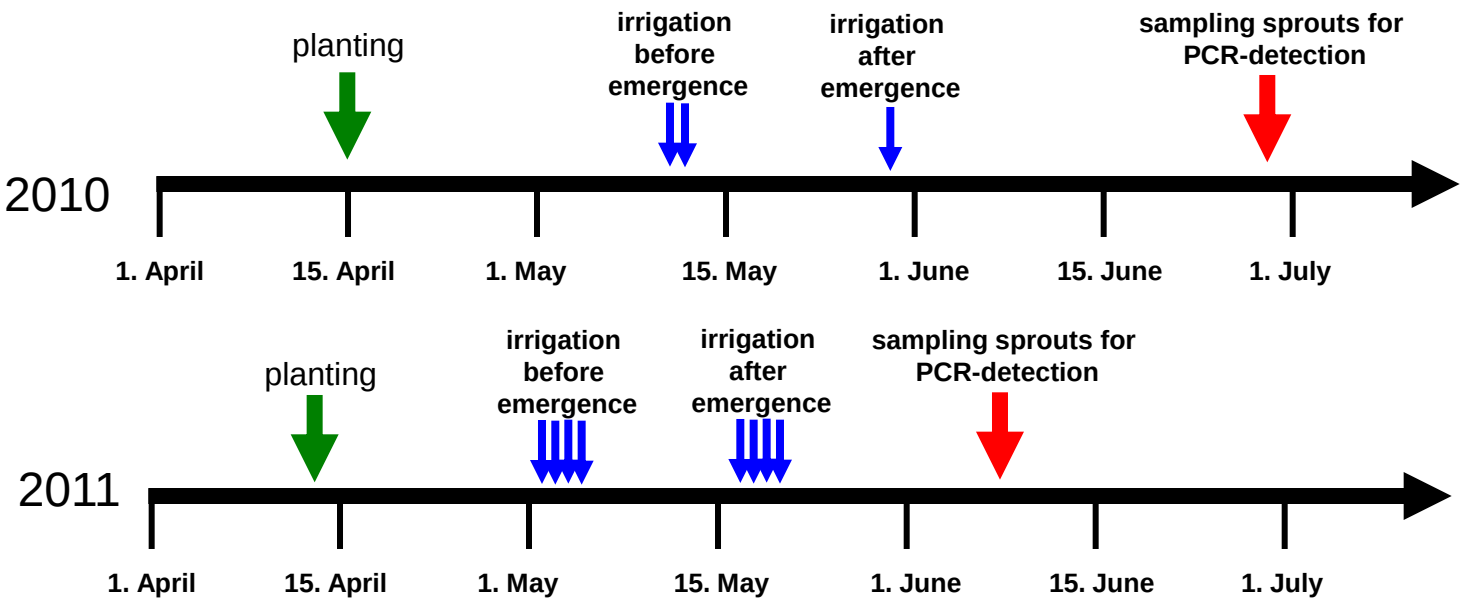
**Sporangia formation** (MACDONALD and DUNIWAY (1978))

**zoospore transport** (STOLZY et. al (1965) and PORTER (2005))

# Field Experiment– planting

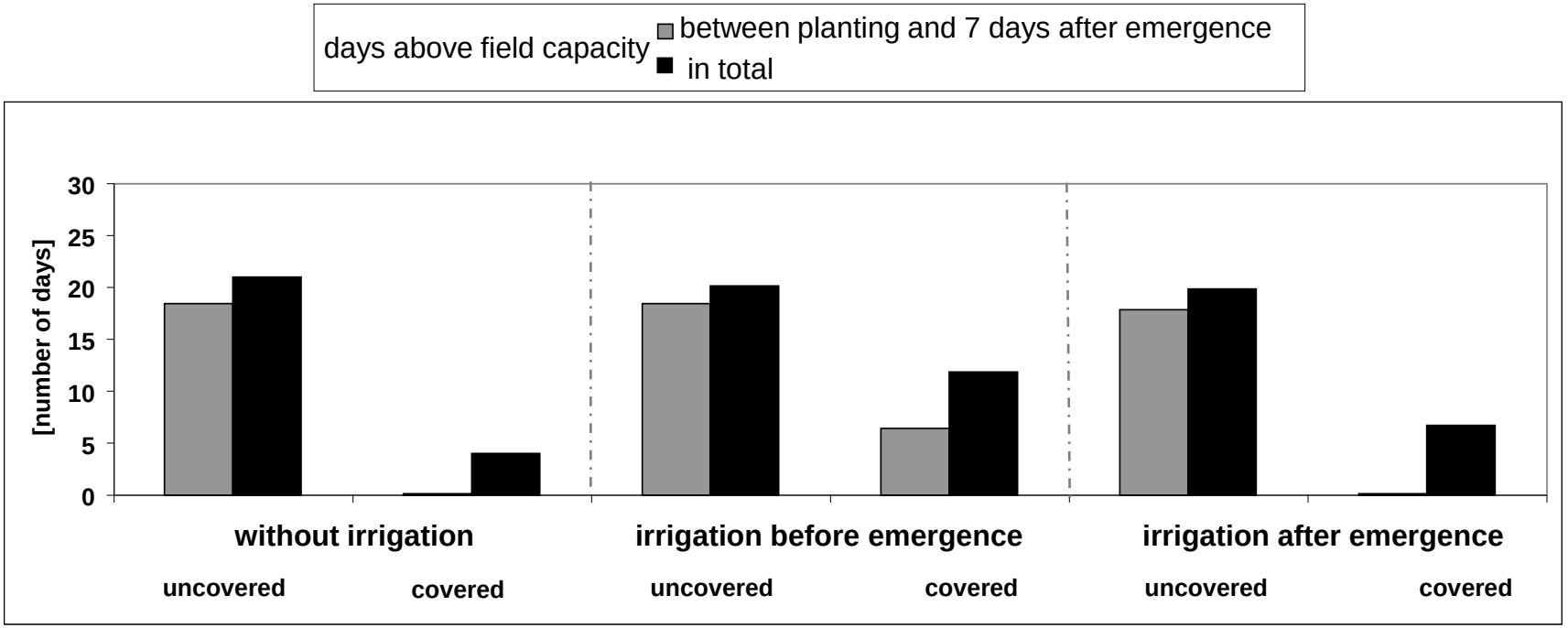


# Field Experiment 2010/2011



# Field Experiment 2010 – Irrigation


# Field Experiment 2010 – Results

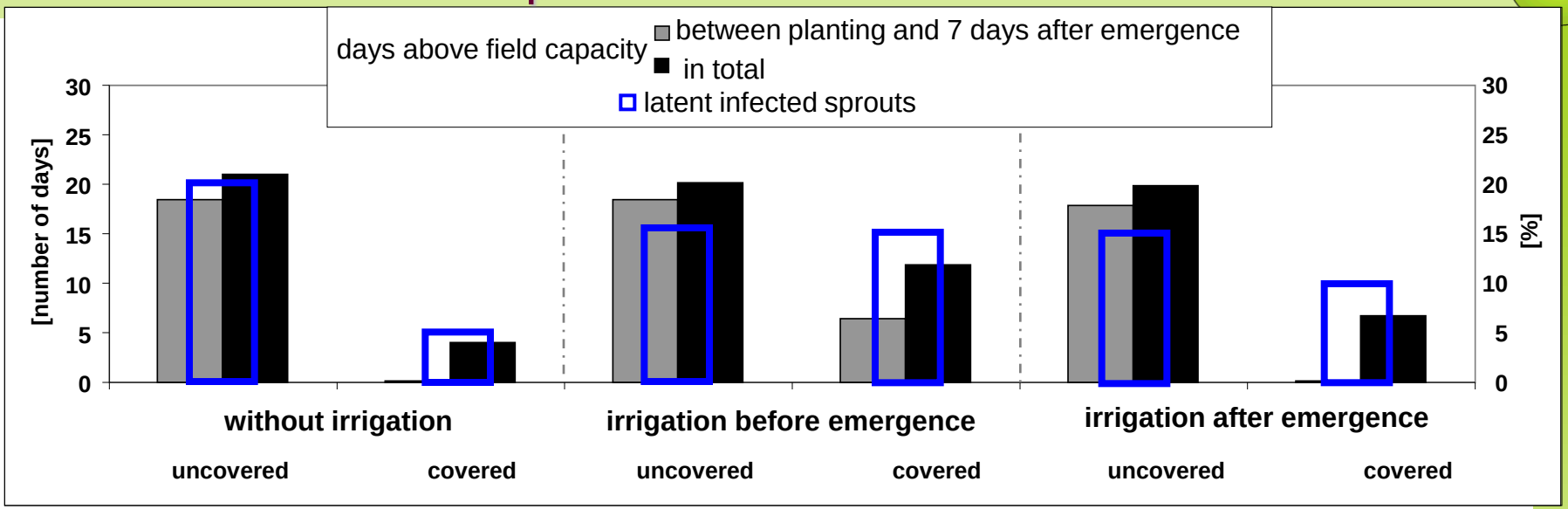


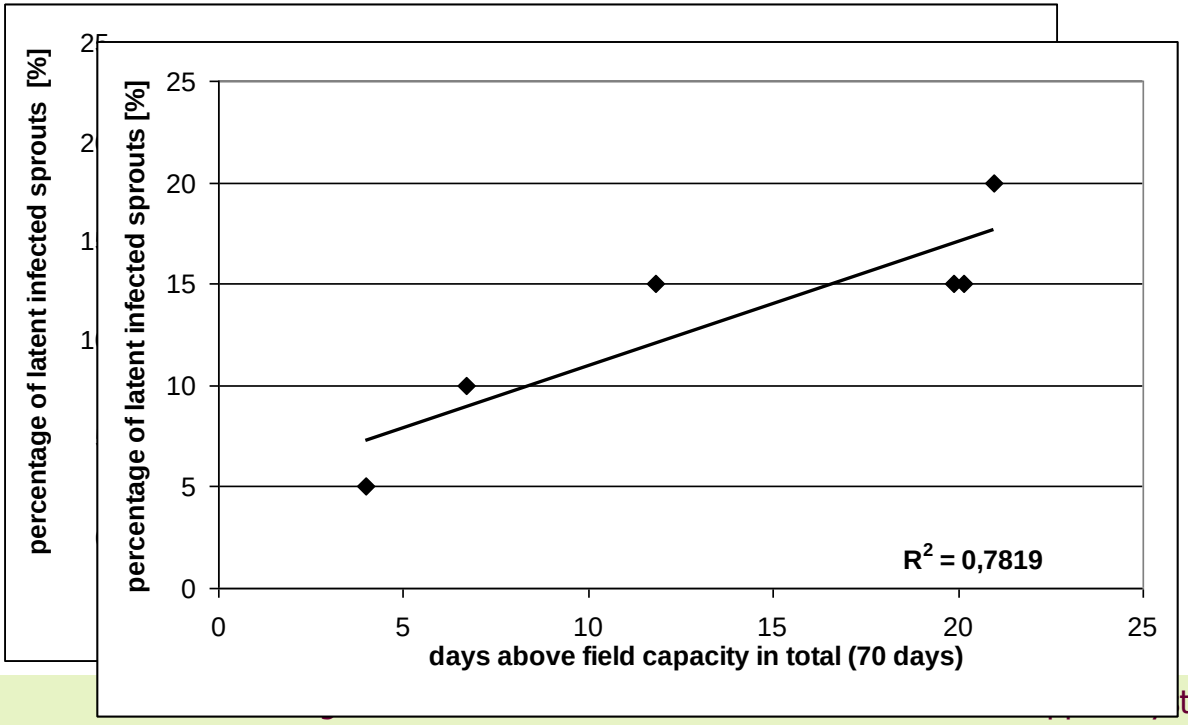
# Field Experiment 2010 – Situation 21.06.

No late blight symptoms until harvesting

Sampling of 20 Agria sprouts per plot on 28. June for PCR-detection of latent infected sprouts

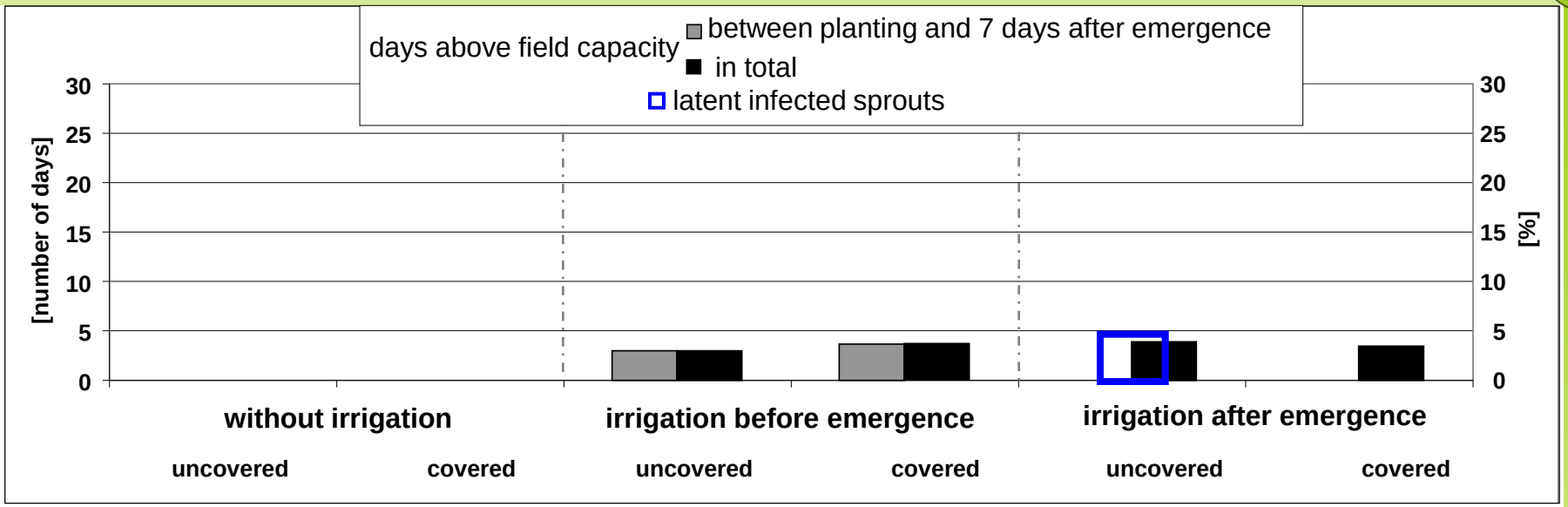
# Field Experiment 2010 – Results




- Percentage of latent infected sprouts is positively correlated with days above field capacity
- No visual late blight symptoms in field

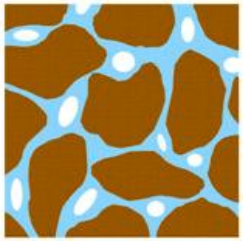
# Field Experiment 2011 – Results




- Very dry weather conditions throughout April until June – field capacity only due to irrigation
- No statistical analysis because of only one latent infected sprout
- No visual late blight symptoms

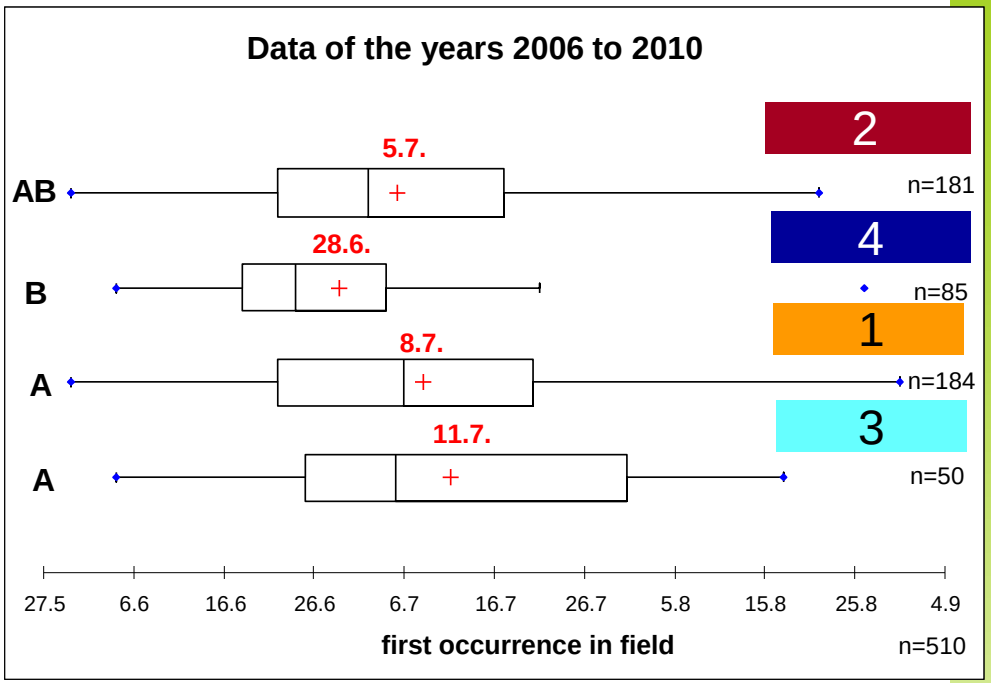
- Conditions seemed not to be suitable for sporangia formation on the surface of the infected tubers
- Complex correlation between the processes for soil borne infections

# Field Experiment 2010 and 2011 – Results

| processes | conditions | 2010 | 2011 |
|---|---|---|---|
| sporangia formation an the tubers surface | Field Capacity $\theta_{FC}$  | ✓ | ✗ |
| indirect germination (zoospore release) | Soil Saturation $\theta_{SAT}$  | ✓ | ✓ |
| zoospore transport through soil water | Soil Saturation $\theta_{SAT}$  | ✓ | ✓ |

# Analysis of monitoring data

- In the *Phytophthora* monitoring in Germany the parameters crop prevalence (high/low) and soil moisture (high/low) were assessed
- Analysis concerning the variability of first occurrence according to the four groups:




| | | soil moisture | |
|---|---|---|---|
| | | low | high |
| crop prevalence | low | 1 | 3 |
| | high | 2 | 4 |

**Soil moisture has no significant influence on the date of the first occurrence of late blight**

**Significant influences are given by crop prevalence**

| Contrast | | | Significance |
|---|---|---|---|
| 1 | versus | 3 | no |
| 2 | versus | 4 | no |
| 3 | versus | 4 | yes |
| 3 | versus | 2 | no |
| 1 | versus | 4 | yes |
| 1 | versus | 2 | no |

Tukey-Test (confidence interval 95% )

# Discussion

| | monitoring data 2006 to 2010 | field experiment 2010 | field experiment 2011 |
|---|---|---|---|
| correlation between high soil moisture and latent infected sprouts | | ✓ | ✗ |
| correlation between high soil moisture and date of first late blight occurrence | ✗ | ✗ | ✗ |
| correlation between high crop prevalence and date of first late blight occurrence | ✓ | | |

- This leads to the question…

# Discussion

Is the effect of soil moisture on the date of first occurrence of late blight considerably overestimated?

- Also discussed in literature
- Analyses which lead to a high effect of soil moisture on first occurrence are often related to latent infections
- The correlation between soil moisture and latent infections could be proved in the field in 2010
- Latent infections are not correlated to an earlier outbreak of late blight
- It seems that the outbreak is related to other environmental conditions for the fungus

# Discussion

- High soil moisture could lead to an intense distribution of zoospores in soil resulting in a high percentage of latent infections
- High soil moisture has no influence on the date of first occurrence of late blight in the field
- **The integration of soil moisture in prediction models for the first occurrence of late blight has no practical use**

# Thanks for your attention!

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