Site – Specific Monitoring For Diseases Forecasting in Winter Wheat

M. El Jarroudi[1] , F. Giraud[2], P.Delfosse[3], M. Beyer[3], L. Hoffmann[3] , H.Maraite[4], and B.Tychon[1]

[1]University of Liège, Arlon, Belgium

[2]Staphyt/BIORIZON, Martillac, France

[3]CRP-Gabriel Lippmann, Department Environment and agro-biotechnologies (EVA), Belvaux, Luxembourg

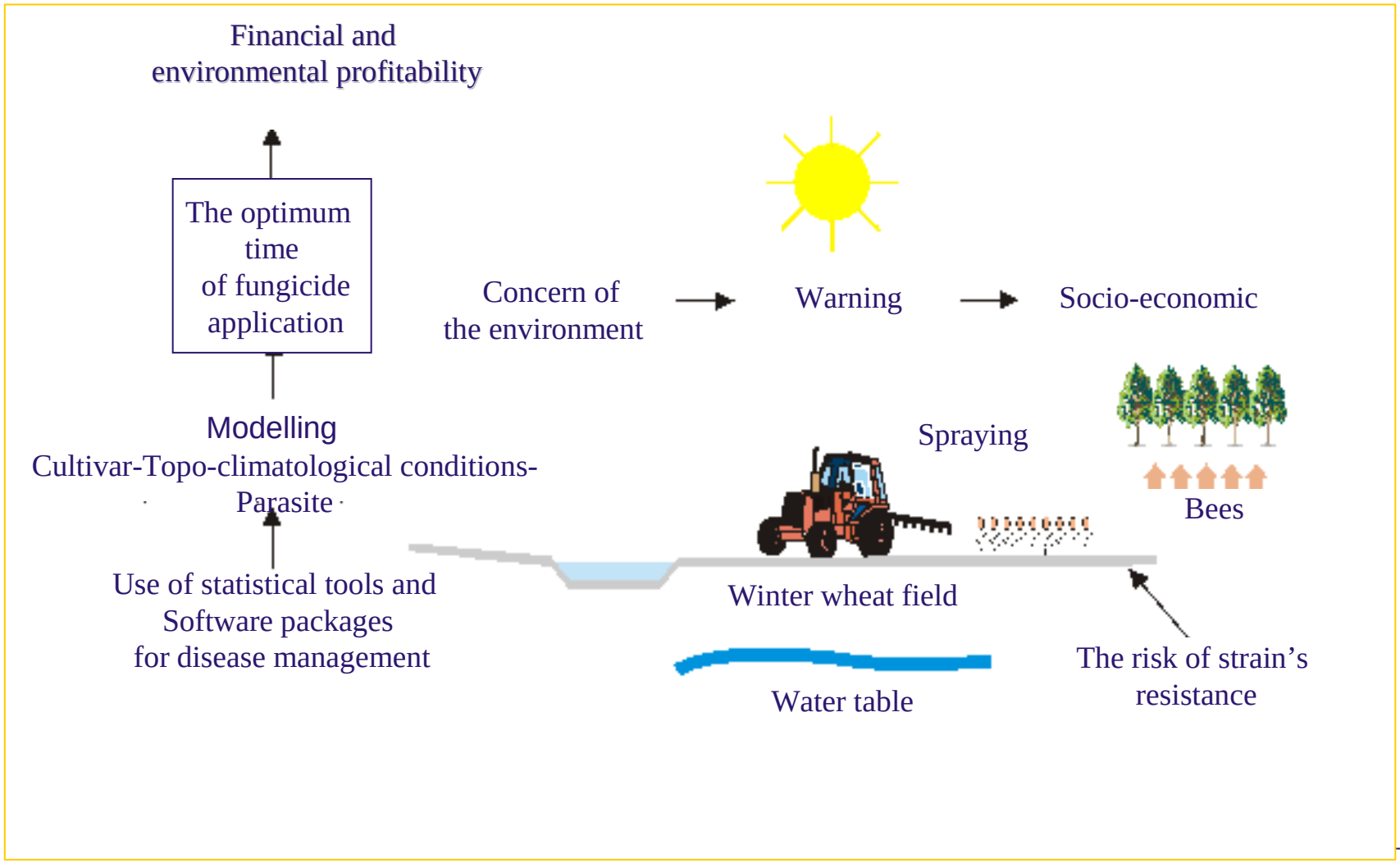
[4]Unité de Phytopathologie,UCL, Louvain-la-Neuve, Belgium

Conference on
"Impact of plant pathogens on food quality of agricultural crops and wine (Patholux)"
Remich, November 22 and 23, 2010

Contents

Introduction

Why to set up a decision support system for disease control in wheat?



Introduction

Powdery mildew

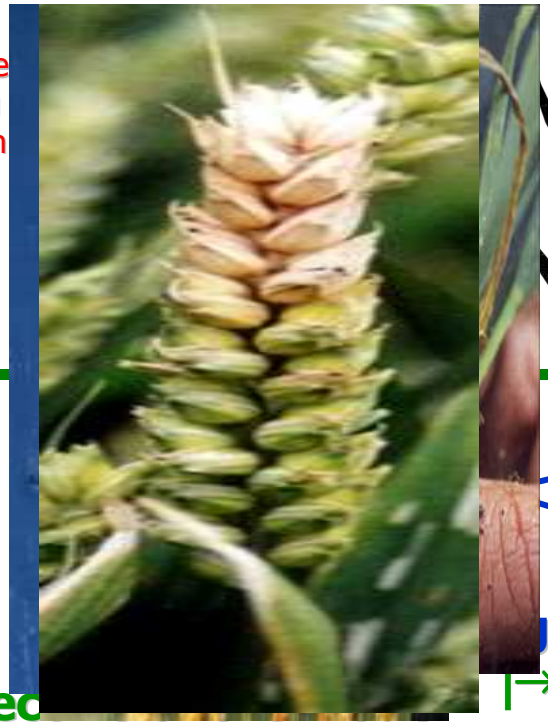
Septoria

Yellow rust

Leaf rust

Fusarium

The goal is therefore to provide
frame for site-specific spraying
setup for sites throughout Luxem



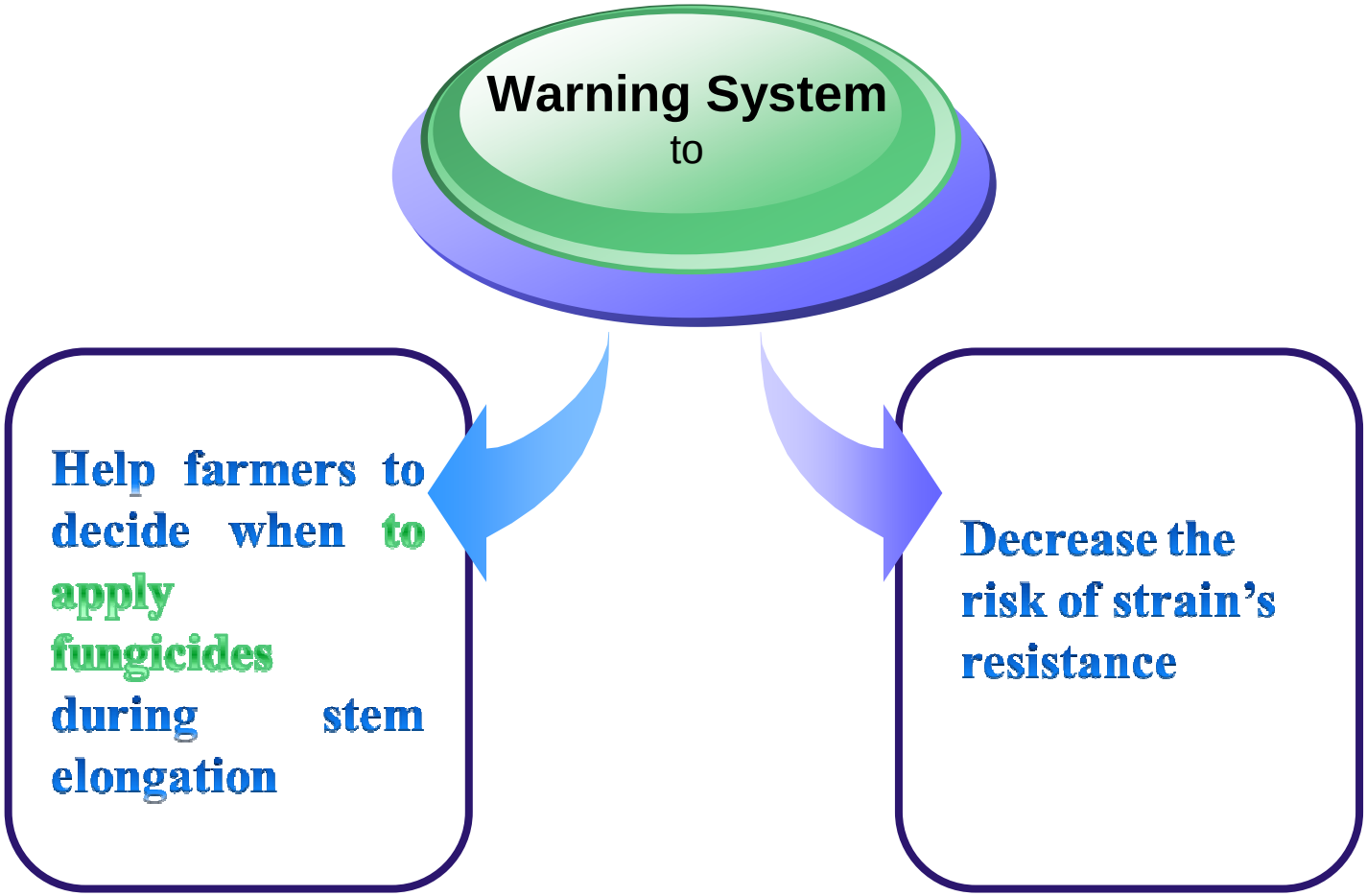
Objec

Average: 1,6

Generally ≤ 1

When ?

Objectives of the work



Methodology

CRP: Public Research Center Gabriel Lippmann, for its initials in French
ASTA: Administration of Agricultural Technical Services, for its initial in French.

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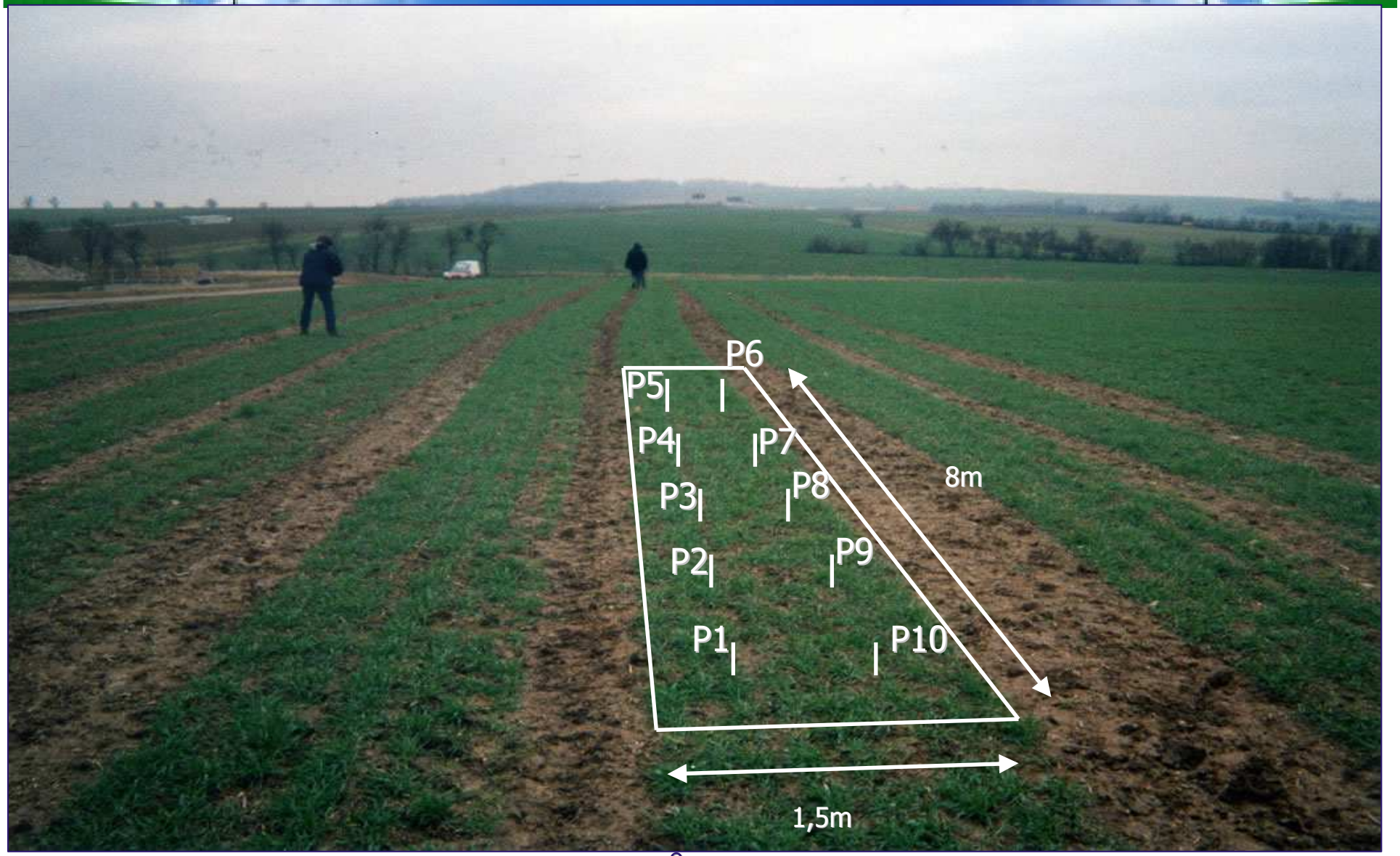
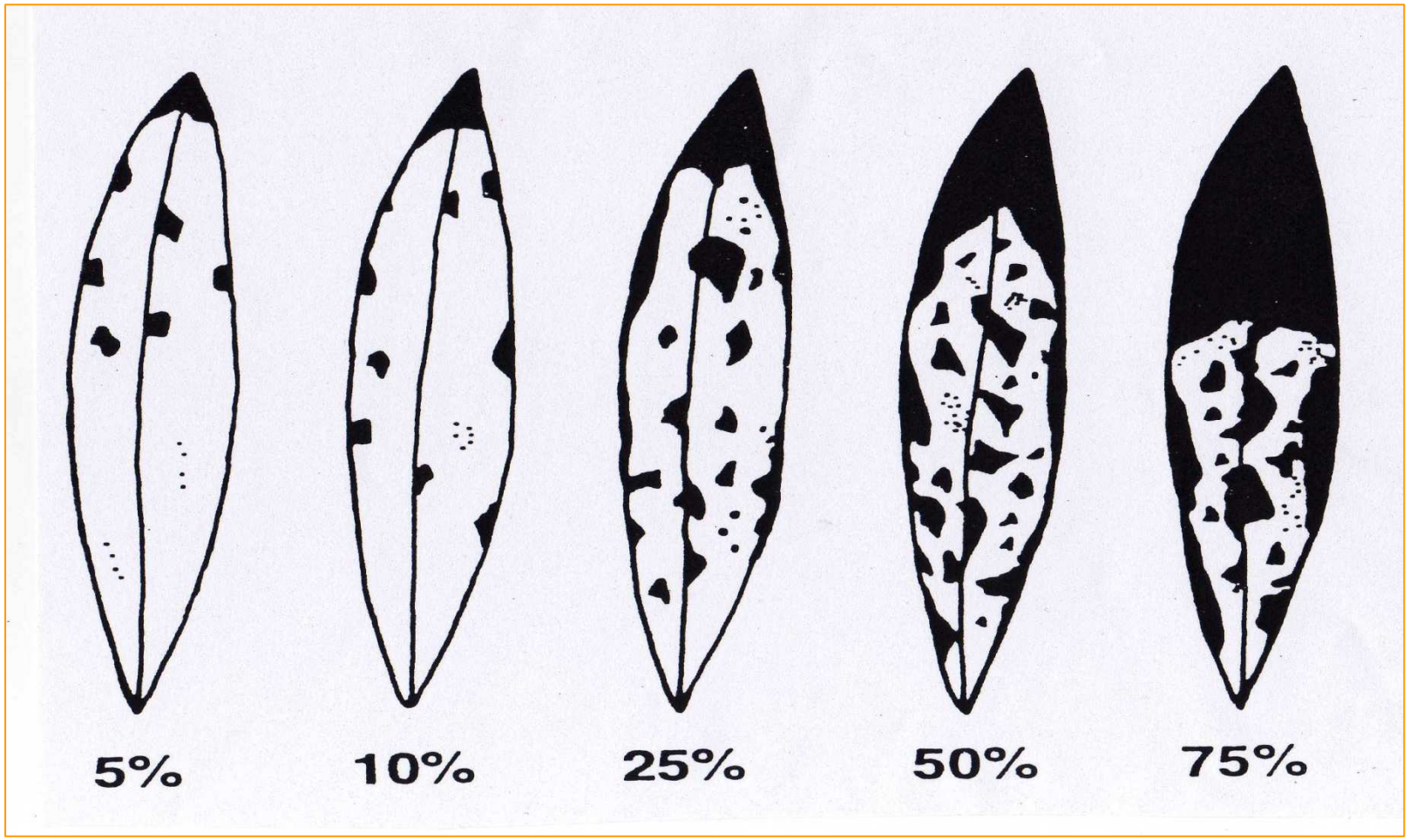
4 replicated field experiments on 2 cultivars (minimum) were established in the sites of Everlange, Burmerange, Christnach and Reuler G.D. of Luxembourg, for the growing seasons for 11 years.

Methodology



Methodology



Standard area diagrams of James (1976) and software programs DISTRAIN

Septoria Leaf Blotch 1/4

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Percentage of the leaf area covered by sporulating *S.tritici*
(Pink: Primary infection, red: secondary infection)

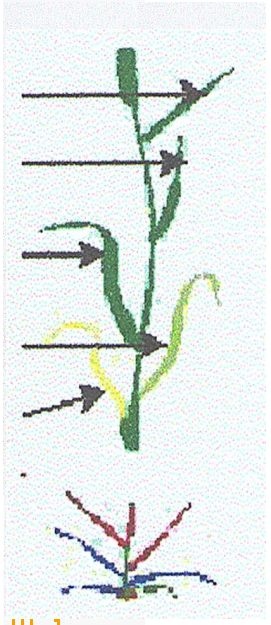
Forecast of the percentage of the area covered by sporulating *S. tritic*
(beige: Primary infection, brown: Secondary infection

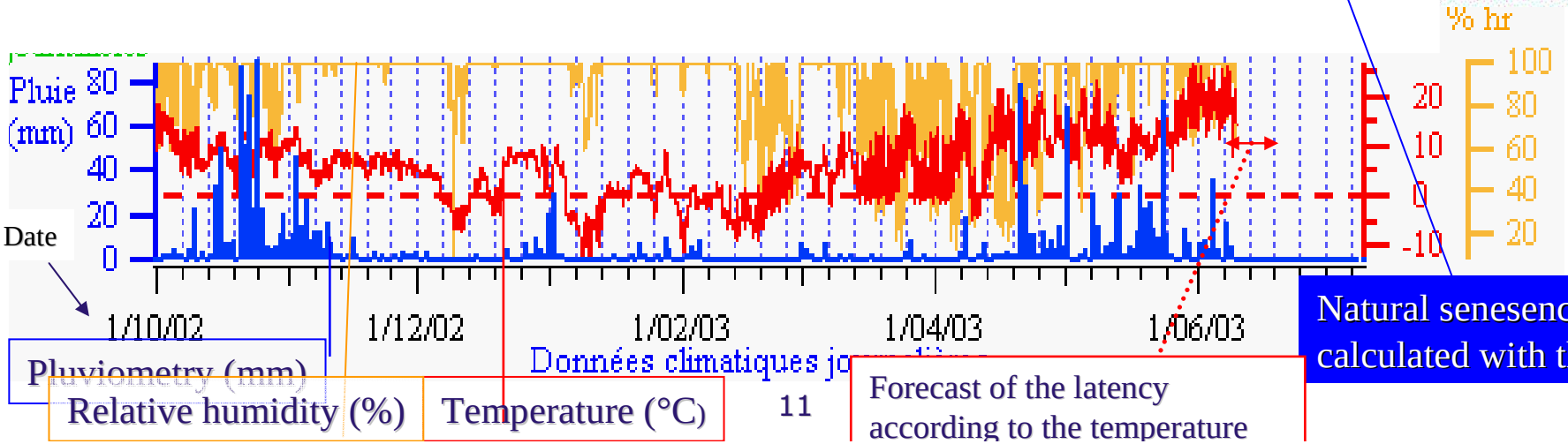
Logarithmic scale

Leaf area development

Example of latent period

Sowing date

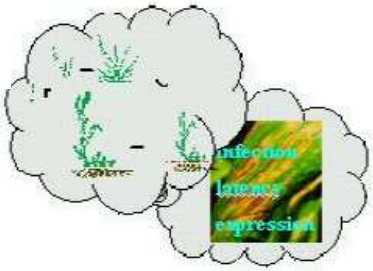




PROCULTURE Model 2/4

Time spray strategies for Septoria Leaf Blotch disease progress on winter wheat: the use of forecasting model

- ≥ 0.1 mm in 1st H
- ≥ 0.5 mm in the 2nd H
- RH > 60% for 16 H
- T >4°C for 24 H



Automatic weather stations

PROCULTURE model on web server

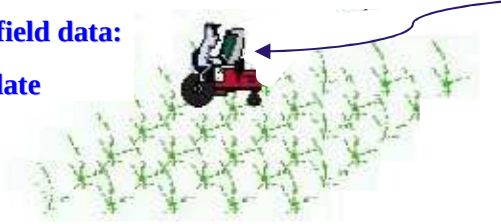
Web

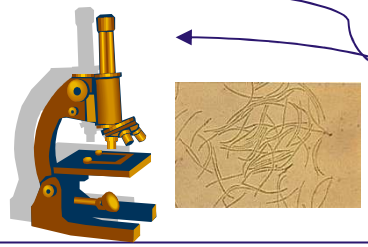
Web

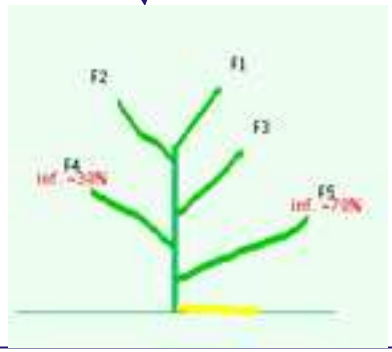
De Letzeburger Bauer and Chamber of Agriculture

Farmer's field data:

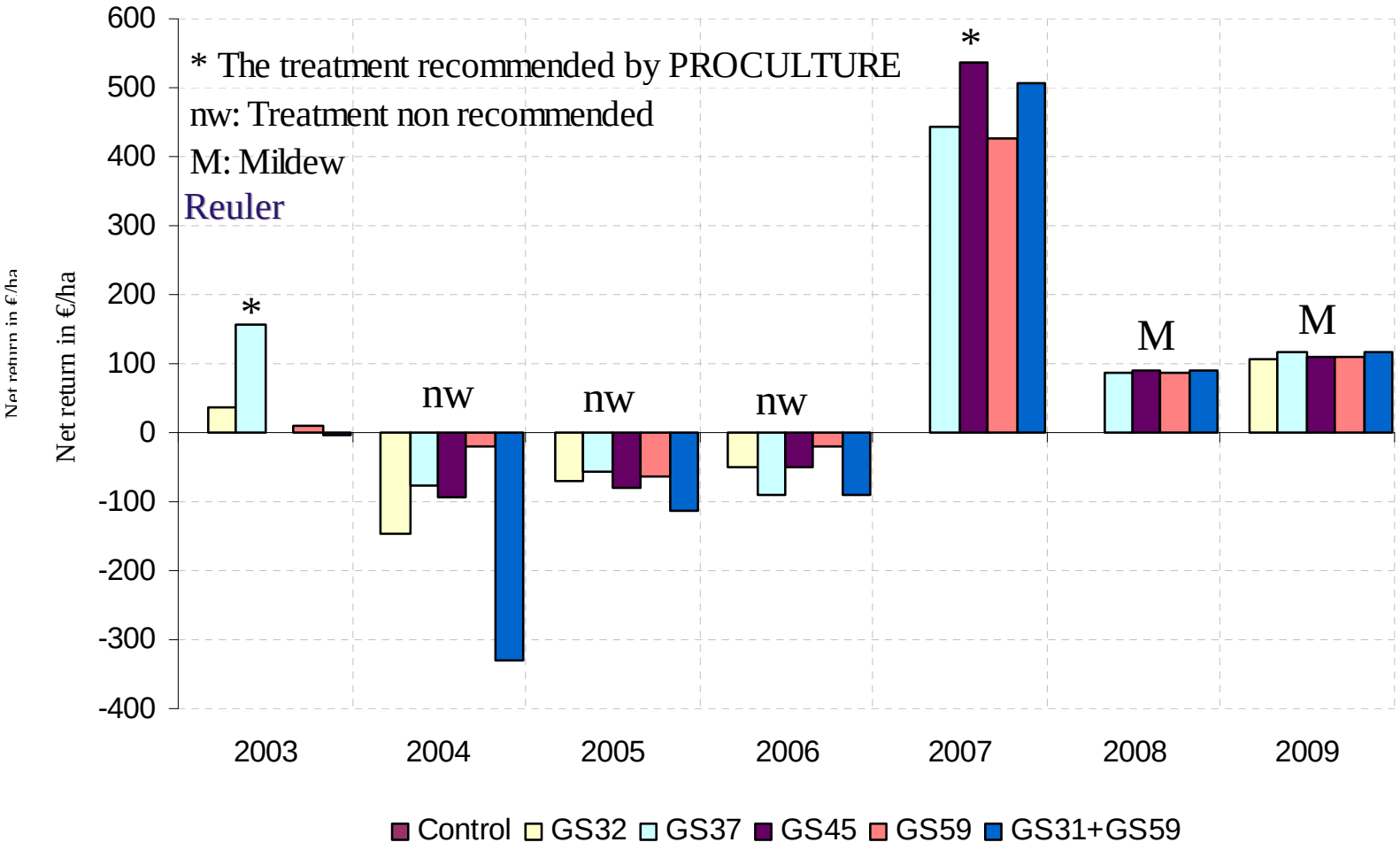
- **Sowing date**
- **GS and**
- **SLB**
- **Variety**





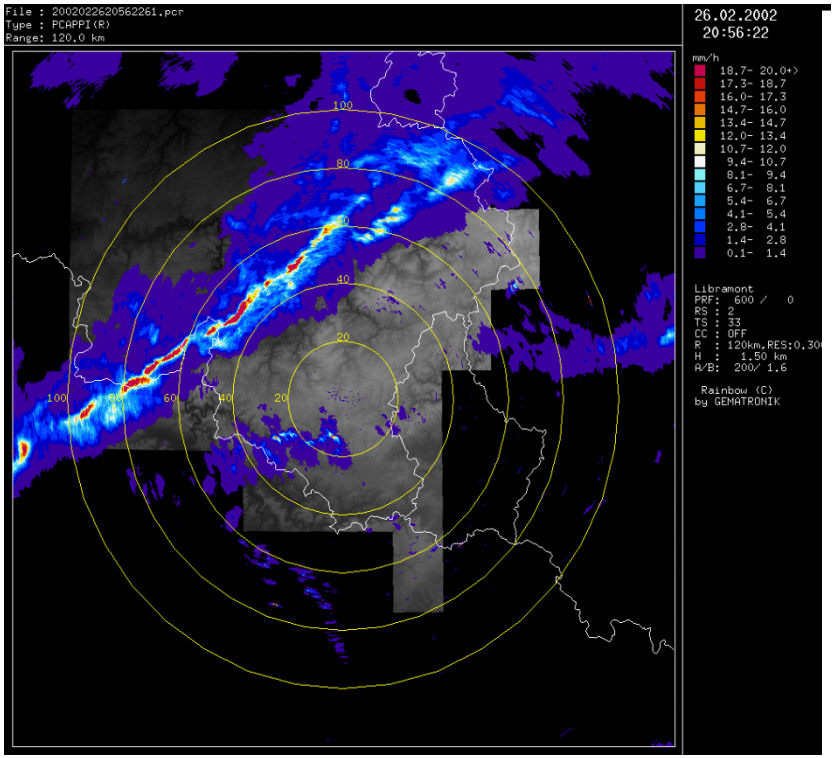


PROCULTURE Model 3/4

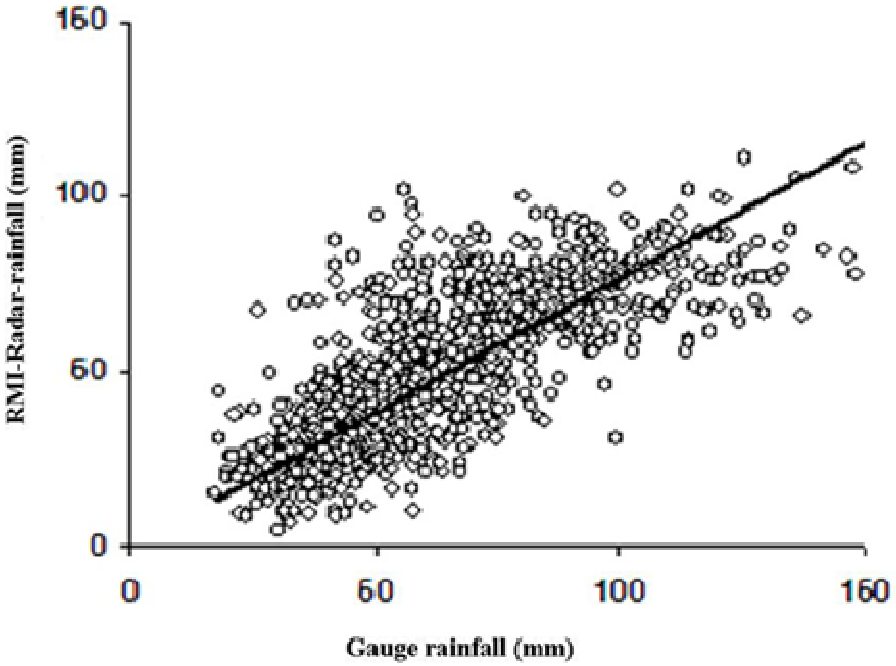


PROCULTURE Model 4/4

Spatial early-warning systems



($R^2 = 0.75$, $P < 0.001$)



The use of radar could be a promising alternative for site-specific SLB risk assessment.

Leaf rust 1/3

Infections occur preferentially at night (De vallavieille-Pope et al. 1995)

Most rapid spread occurs at

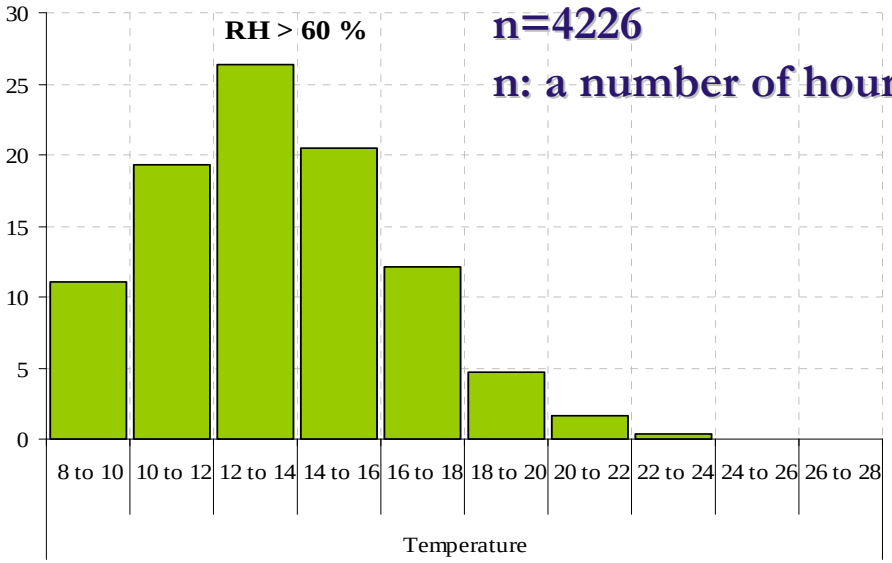
The originality of our work is the development of a predictive model based on the analysis of the night weather and leaf rust incidence.

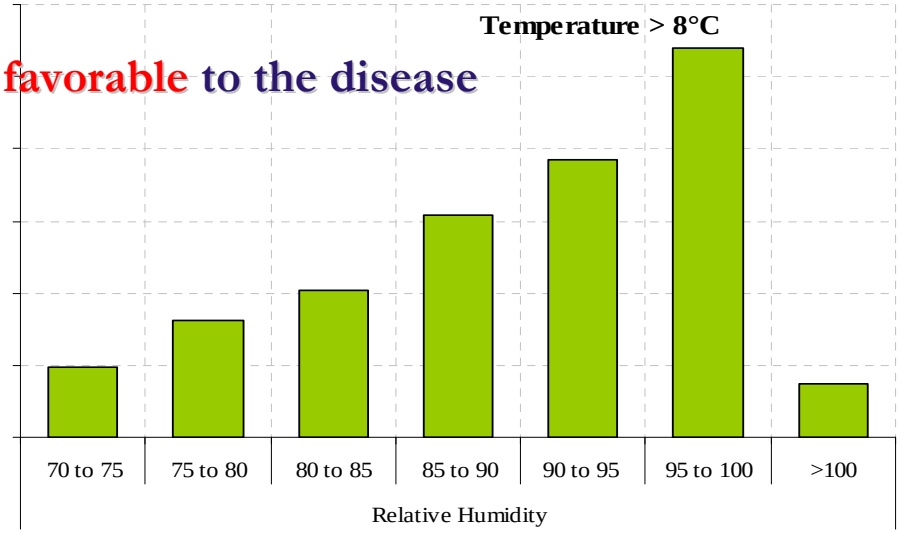
and basidiospores.
Aecidial stage found on alternate hosts.

Slow disease development in spring – infection by wind borne uredospores

Over-winters on volunteers

Leaf rust 2/3





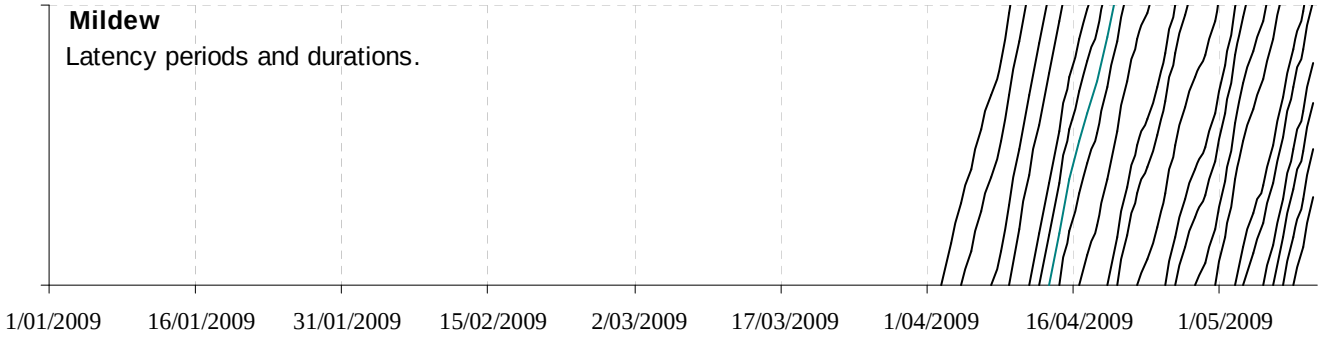
- The weather conditions which supported the germination of brown rust between 2000 and 2003 are especially the night temperature classes ranging between 10 and 18 °C with an optimum between 14 and 16°C associated with ambient relative humidity ranging between 60 and 100%.
- Night T°C ranging between 24 and 28°C never occurred during the 4 years of the study.
- The frequency of the night temperature classes ranging between 18 and 24 °C does not exceed 10%.

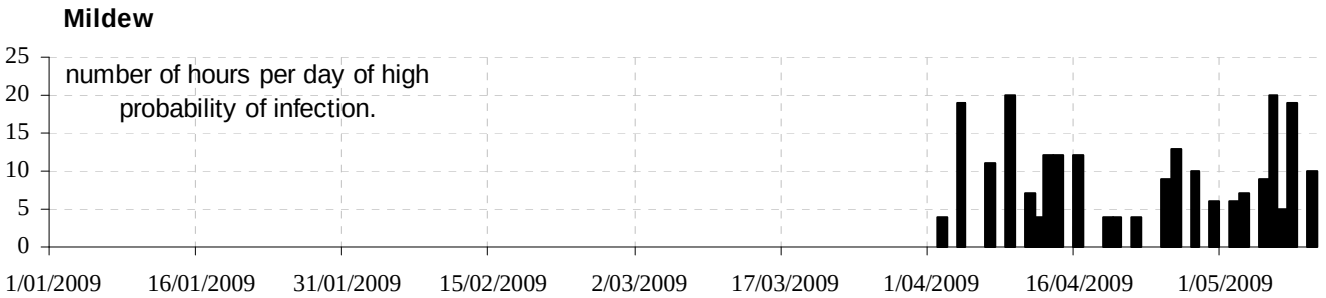
Leaf rust 3/3

Wheat Powdery Mildew 1/2

Two major climatic factors favored the 2003 and 2009 outbreaks, i.e. a daily mean temperature between 15 and 22°C and a relative humidity of at least 80% during April-June

Over 2003 to 2010, a significant difference in severity





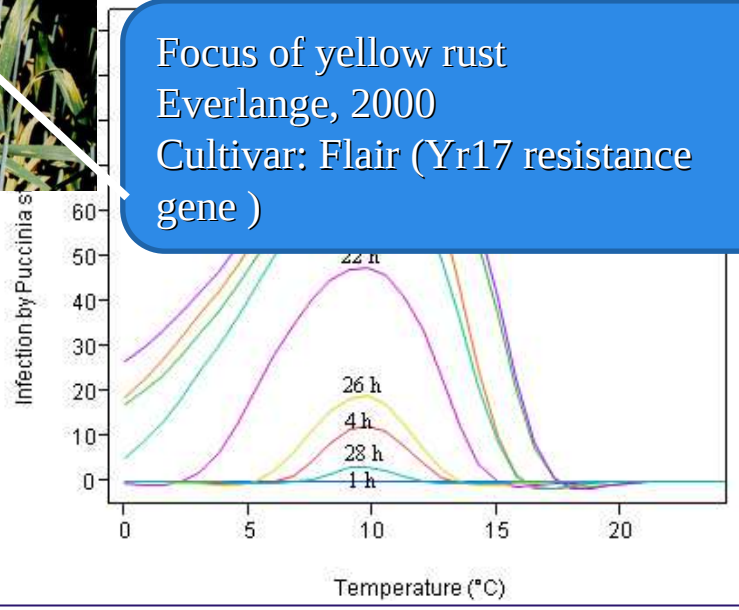
Wheat Powdery Mildew 2/2

Characterization and modeling of temporal and spatial variability of wetness duration in the context of a national control

Yellow rust 1/2

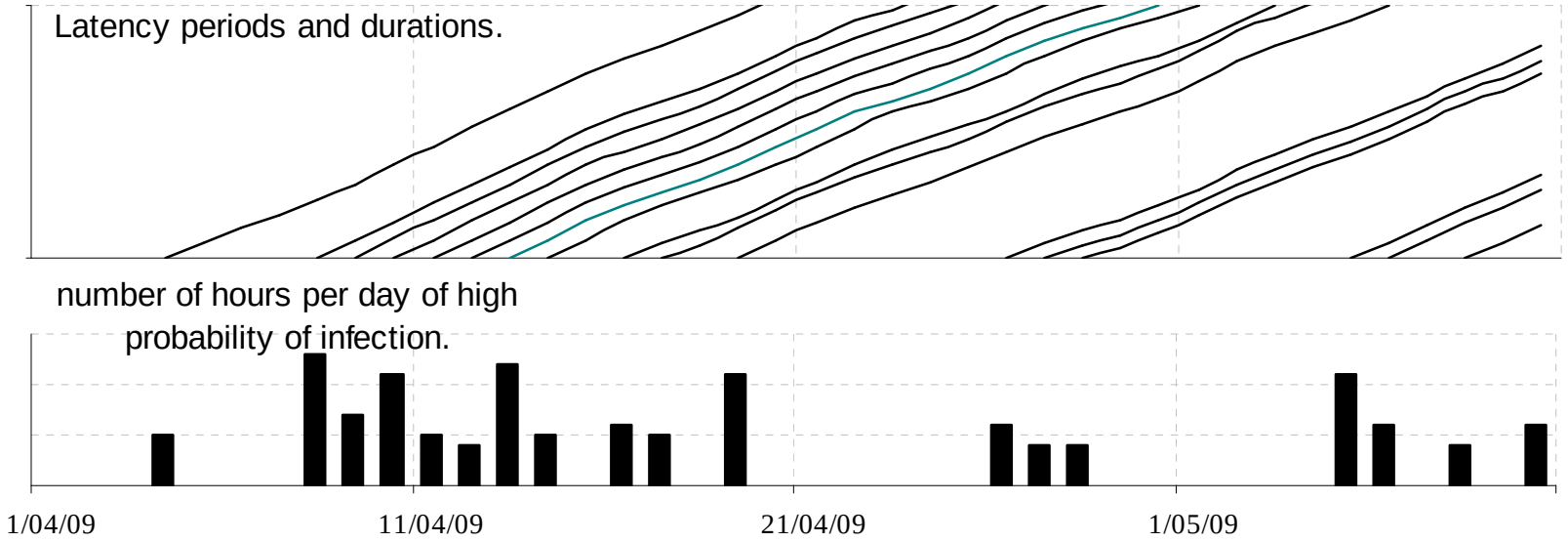
The minimal continuous wet periods for WSR revelead by the Monte Carlo's method necessary for infection is 4 h at optimal temperature (8 to 15°C).

Focus of yellow rust
Everlange, 2000
Cultivar: Flair (Yr17 resistance gene)



Yellow rust 2/2

Infection parameters: Relative humidity ≥ 90% for at least 4 hours, temperature between 4 and 16 °C for at least 48 hours and rainfall occurence (one hour with precipitation ≥ 0.1 mm)

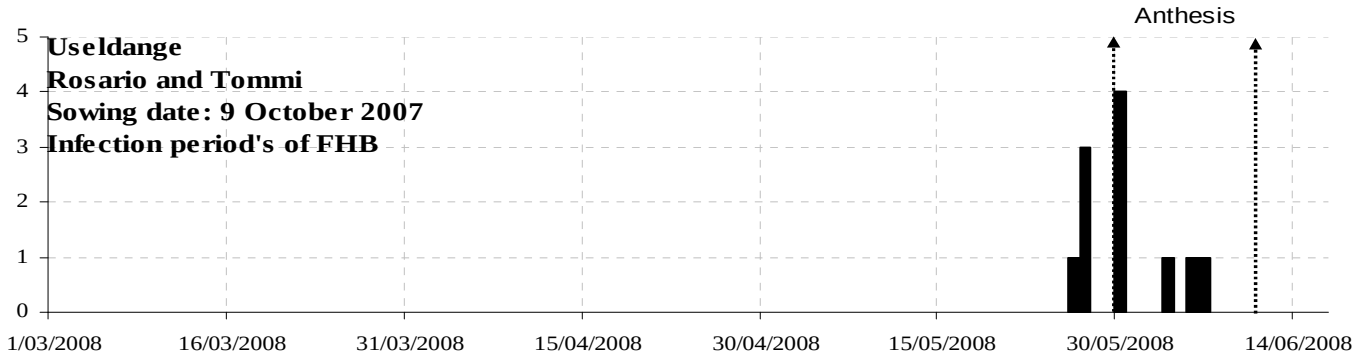


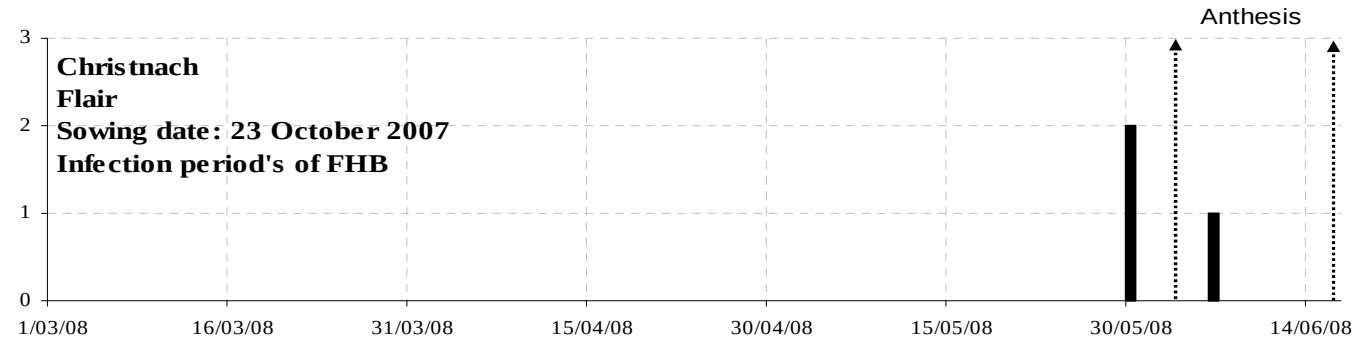
Simulations of infection and latency data by the model are in very good agreement (R = 0.92, P <0.05) with the observational data.

Fusarium head blight 1/2

Fusarium head blight 2/2

Infection parameters: any event ≥ 1 hour during which there is simultaneously a temperature ≥ 16 ° C, a relative humidity ≥ 90% and a rainfall ≥ to 1 mm during the first hour.





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Conclusions

- Assessment of the infection periods of SLB by PROCULTURE model in the G-D of Luxembourg achieved an accuracy of 85%.
- Extension of the disease warning to rusts (WLR and WSR), WPM and FHB.
- A range of night temperature favourable to the germination of WLR which ranged between 10°C and 18°C with an optimum between 14°C and 16°C.
- Below this temperature range, the disease progress is nearly stopped. Rainfall is also compulsory but only for initiation of infection, for laying down spores on leaves.
- WPM appeared much earlier in the northern Öesling (GS 30, pseudostem erection) than in the southern Gutland (GS 39, flag leaf ligule visible)
- In our study, the minimum continuous wet periods for WSR revelead by Monte Carlo Analysis for an infection is 4 h at optimal temperature (8 to 15°C).

Perspectives

- Simplify and possibly map the output of PROCULTURE to make easier the access to information for the farmers
  Spatial early-warning systems by using weather radar data as the input for the PROCULTURE simulation model
- In-depth studies of the microclimatic conditions favourable to the WLR (leaf wetness, RH, T° gradient under the canopy)
- This future research project will aim at a better understanding of weather parameters that contribute to the development of leaf rust epidemics by studying historical weather and disease incidence data.
- Another goal is to study inoculum arrival and disease dispersal in the field to better understand and control the WLR in ways that are more respectful of the environment.
- Study of virulence tests using the European and world differentials and the Yr single gene lines.

Thank You !

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