

Modelling development of disease complexes on barley cultivar mixtures under organic farming practice

Part of the DARCOF II project BAR-OF (Characteristics of spring barley varieties for organic farming VI. 2)

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Background

Fungal pathogens constitute a major problem in agriculture, causing diseases with potentially serious consequences for yield. The diseases occur under both conventional and organic agricultural practices, but the majority of studies of these have been made in conventional systems and the diseases have been studied separately. There are some problems in transferring this knowledge to an organic system. In a system where prevention via knowledge of biological processes is the major tool it is not sufficient to look at a disease as a disconnected factor, it must be seen in the context it occurs. In reality what a plant experiences at a given point in time, is more likely to be multiple diseases rather than only one. Furthermore, from a purely ecological perspective, several pathogens occupying the same host are highly likely to have an influence on each other, based on their exploitation of the same resource. This is the background for the present PhD project, which is focused on interaction between two diseases. It is important to mention though, that the BAR-OF project explores interactions between disease and other elements of the system (e.g. weeds.)

The pathogens and consequent diseases studied are *Rhynchosporium secalis* (causes scald) and *Pyrenophora teres*, conidial stage: *Drechslera teres*, (causes net blotch) on their host spring barley. These diseases have both increased in importance in the temperate world, probably due to changes in farming practice and increased areas grown with barley.

Objective

The objective of the present project is to gain new knowledge on interactions between scald and net blotch on spring barley grown in an organic farming system. This objective is approached via field trials and mathematical modelling. The field trials have consisted of selected varieties of spring barley inoculated with the pathogens and disease data collected from general variety trials under the BAR-OF. The mathematical modelling describes and explores interaction between leaf pathogens, on the host defined via its resistance properties. The final aim of the project is to aid in setting guidelines for choice of suitable varieties in a multi-disease environment.

Progress - 2004

The project has data from field trials in 2002 and 2003. The trial in 2003 was used to study disease epidemics in great detail; such that over 15.000 individual leaves were collected and dried for later disease assessment. These have been completed and the analysis is in progress.

Inaccuracy and imprecision are inherent in visual disease assessment, but the magnitude of this is often not known from field data. Storing the leaflets from the trial in 2003 has provided a unique opportunity to evaluate the method. Reassessing leaflets and comparing results has confirmed that the error associated with assessments is of an acceptable magnitude.

The development of a mathematical model for interaction between leaf pathogen, has shown that the model used by others in the literature in the past, is not suitable for evaluating interaction between species in its present form.

Modelling and data analysis are two closely connected processes, as data analysis is dependent on suitable hypotheses for testing, which are provided by models of the relations between the analysed components. Therefore, analysis is coupled to the development of a suitable model for leaf pathogen interaction.

The discussion of model suitability and data analysis was presented and discussed at the workshop "Studies of interaction between fungal leaf pathogens" at the 11th International Cereal Rusts and Powdery Mildews Conference, John Innes Centre, Norwich, England, August 2004. This discussion will be continued at the SUSVAR workshop in Witzenhausen, Germany in October 2004.

Talks

- Workshop presentation at the 11th International Cereal Rusts and Powdery Mildews Conference, John Innes Centre, Norwich, England: 22nd to 27th August 2004: "Studies of interaction between fungal leaf pathogens"
- Midtvejsseminar/Midway seminar KVL (19 August 2004)
- Seminar, Plant Research Department, Risø: "Interaction between *Drechslera teres* and *Rhynchosporium secalis* on barley – how to find it?" (4 June)
- Bull session, Department of Plant Biology, KVL: "Epidemiology of a disease complex on spring barley ...looking for interaction" (23 April 2004)
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Meetings / Conferences

- 11th International Cereal Rusts and Powdery Mildews Conference, John Innes Centre, Norwich, England: 22nd to 27th Aug. 2004
- SUSVAR Opening Workshop (28-30 June 2004, Roskilde)
- BAR-OF Internat, (7-8 Jan. 2004, Brorfelde)
- BAR-OF Network meeting (25 Nov. 2003, Risø)
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Other

- Co-organizer of SUSVAR Opening Workshop (28-30 June 2004, Roskilde)
- SOAR bi-annual seminars: Autumn 2003, Spring 2004

Courses

- SOAR Summer school 2004: Is Organic Farming the Key to Sustainability, Sept 2004 (4 ECTS)
- Ad hoc course: Non-linear models in S-Plus (3 ECTS)
- Advanced Plant Pathology. KVL Sep.–Dec. 2003 (15 ECTS)
- Academic Writing. Dansk Magisterforenings Efteruddannelse, 16 hours. May-June 2004, Riso (Not ECTS awarding)

Plans - 2005

The PhD project has 11 months left now finishing by the end of August 2005. Since the 'Midvejsseminar' in August, the structure of the final thesis is relatively clear, such that the final thesis will contain the following main chapters.

1: A discussion of the role of diseases and organic farming.

This chapter will be based in the SOAR activities and aimed for publication in e.g. DARCOF e-news

2: A review paper of the importance of interactions between multiple plant pathogens.

The background for writing this, is a lack of synthesised information of multiple diseases.

Intended for publication in a scientific journal

3: Modelling Interaction Between Leaf Pathogens

The result of the development of a model for epidemiological development of multiple leaf diseases.

This may either become a separate publication or the result will be incorporated into chapters 2 and 4.

4: Field trial data on interactions between *Rhynchosporium secalis* and *Drechslera teres* on spring barley

Report and analysis of field trial data. Intended for publication in a scientific journal

Meetings

- SUSVAR Focusing Workshop (11-13 October 2004, Witzenhausen, Germany)

Teaching

- Lecture on the course: Disease Resistance in Plants, KVL (November 2004)

Publications

Pinnnschmidt, Hans and Vollmer, Jeanette H. and Hovmøller, Mogens S. and Munk, Lisa and Østergård, Hanne (2002) [Multiple diseases, host resistance and the role of variety mixtures for disease control in organically grown spring barley](#). Poster presented at 1. international symposium on organic seed production and plant breeding, Berlin, Germany, 21 - 22 Nov 2002; Published in *Proceedings of the 1. international symposium on organic seed production and plant breeding*, page 73.

Vollmer, Jeanette and Østergård, Hanne (2004) [Studies of interaction between pathogens](#). Paper presented at 11th International Cereal Rusts & Powdery Mildews Conference, John Innes Centre Norwich, UK, 22-27 August 2004, page A2.73.