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## Resistant barley varieties may facilitate control of Ramularia leaf spot

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Ramularia leaf spot has been widespread on barley in Denmark since 2002. Resistance properties of Danish barley cultivars have been investigated and indicates that varietal resistance can be efficient in control of Ramularia leaf spot

### Introduction

Widespread and heavy infections of Ramularia leaf spot (RLS, see picture 1 below) on barley were observed in Denmark for the first time in 2002 (Pinnschmidt & Hovmøller 2003, 2004). Surveys and research efforts such as investigations into resistance properties of Danish barley cultivars have been initiated since then.



The data available to date have now been analysed to characterise the expression of RLS resistance of barley cultivars and its relation to resistance against other diseases in view of potential uses for RLS control and resistance breeding.

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Picture 1. Severe Ramularia leaf spot (RLS) infection on a susceptible spring barley cultivar after flowering.

### Data from multi-environment surveys

The major part of the data presented here is from multi-environment surveys of the Danish Institute of Agricultural Sciences (DIAS), Variety Testing Division, in which commercial barley varieties and advanced breeding lines were grown on more than 20 sites throughout Denmark from 2002 to 2005 (Anon. 2004, Anon. 2005, [www.planteinfo.dk](http://www.planteinfo.dk)). One data set was obtained from a field trial conducted at the DIAS research centre in Flakkebjerg in 2003, in which spring barley cultivars were inoculated with a suspension of RLS mycelium produced *in vitro*.

The severity of RLS and other major leaf diseases was visually assessed as percent diseased leaf area in each plot after the beginning of grain filling. Only data sets from environments with more than 10% RLS severity on the most susceptible cultivar were considered. RLS observations for a

particular cultivar in a particular environment were only considered if the severity level of any other foliar disease was less than 5% and the severity level of physiological leaf spots was less than 10% on the respective cultivar in the respective environment.

From the cultivars remaining after having applied these selection criteria, only those with valid observations for at least 2 years and 4 year-by-site environments were included in further analyses. Data on RLS severity were transformed to the third root and analysed by generalised linear models (GLM) to examine additive effects of the genotype (G) and environment (E). Data adjusted for additive E effects were used to describe the expression of resistance of individual cultivars.

## Large varietal and environmental variation

RLS severity levels reached 50% on spring barley (**Figure 1**, left side) and 50–75% on winter barley (**Figure 1**, right side) in several environments. Large varietal and environmental variation in RLS severity was indicated (**Figure 2a** and **Figure 2b**). Additive main effects of the genotype and the environment explained about two thirds of the total variation in RLS severity (results not shown).

As indicated by environment-adjusted data, the spring barley cultivars exhibiting lowest levels of RLS severity in a relatively stable manner were Power, Helium, Isabella, Nathalie, Cruiser and Isotta (**Figure 3**, left side) whereas Lonni, followed by Chess, Lomerit, Nobilia, and Carola were the winter barleys generally least affected by the disease (**Figure 3**, right side). Lonni moreover possesses good resistance against other foliar diseases (**Table 2**).

Genetically closely related cultivars (see pedigree in **Table 1** and **Table 2**), such as Power, Isabella and Nathalie; Cabaret and Smilla; and Lonni and Carola, exhibited similar pattern in their RLS reaction.

The spring barley cultivars most affected by RLS, such as Smilla, Braemar, Cabaret and others (top of **Figure 3**, left side) possess Mlo-resistance against powdery mildew (**Table 1**, top) while the least affected ones (bottom of **Table 1**) do not. Other mildew resistances as well as varietal susceptibility to other foliar diseases were not clearly related to the RLS reaction pattern of neither spring- nor winter barley cultivars (**Table 1**, **Table 2**).

## Resistant varieties for disease control

Ramularia leaf spot is widely present in Denmark nowadays and has the potential to reach severity levels high enough to cause economic damage. The present results suggest that varietal resistance can be an efficient means for controlling RLS. Promising RLS resistance donors may be the spring barleys Power, Helium, Isabella, Nathalie, Cruiser and Isotta and the winter barleys Lonni, followed by Chess, Lomerit, Nobilia, and Carola. However, more work is needed to develop reliable methods for efficient RLS resistance testing and to determine the nature and genetic basis of RLS resistance and its relation to varietal resistances against other diseases.

## References

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