Decrease of wheat leaf blotch epidemic severity within a cultivar mixture

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Context

Wheat leaf blotch

Economical importance → until 40% yield loss (Oste et al., 2000)

Efficiency decrease of... → chemical management (Leroux and Walker, 2009)
                               → genetic management

Due to *Mycosphaerella graminicola* (*Septoria tritici*) → fungus spread by rain-drop splashing

Introduction

Splash dispersal mechanisms (from Fitt et al., 1989)

Lesions of wheat leaf blotch
Context

Cultivar mixtures

To stabilize yield and quality

To limit disease spread

→ for wind-borne diseases (long distances): confirmed (Finckh et al., 2000; Mundt, 2002; de Vallavieille-Pope, 2004)

→ for splash-borne diseases (short distances): to confirm (Cowger and Mundt, 2002; Belhaj Fraj et al., 2003)

Mechanisms involved:

→ physical barrier effect
→ dilution effect

Two-way cultivar mixture (Grignon, 2010)
Problem

Can wheat cultivar mixtures allow to reduce epidemic impact of wheat leaf blotch, a rain-splash dispersed disease?

If yes, could we quantify it?
**Experimental design**

Location: Grignon (near to Paris), France

2 wheat cultivars:
- Sogood (susceptible)
- Maxwell (partially resistant)

Several modalities:
- pure stands
- cultivar mixture of susceptible (25%) and resistant (75%)
- sprayed or not with fungicide

4 repetitions (~ 35 m²) for each modality, randomly distributed

3 years: 2008, 2009 & 2010
Methodology

Scoring of foliar diseased and senescent surfaces

In each modality, 20 main stems identified with a ring

During about 3 months, weekly scoring of:
   → foliar diseased surface
   → foliar senescent surface
   (natural and due to *M. graminicola*)

Main stem identified with a ring
2009 & 2010: two years contrasted for spring rainfalls
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Percentage of diseased surface for the 3 last leaves

2009

2010
Results & discussion

Percentage of diseased surface for the 3 last leaves

Susceptible in pure stand without fungicide

![Graph showing percentage of diseased surface over thermal time for 2009 and 2010]
Results & discussion

Percentage of diseased surface for the 3 last leaves

- Susceptible in pure stand without fungicide
- Susceptible in cultivar mixture without fungicide

![Graph showing percentage of diseased surface for 2009 and 2010](image)
Results & discussion

Percentage of diseased surface for the 3 last leaves

Susceptible in pure stand without fungicide

Susceptible in cultivar mixture without fungicide

Susceptible in pure stand with fungicide

2009

2010
Percentage of diseased surface for the 3 last leaves

Susceptible in pure stand without fungicide

Susceptible in cultivar mixture without fungicide

Susceptible in pure stand with fungicide

Statistical analysis

ANOVA on Area Under Progress Curves

2009

F = 66.56
p < 0.001

2010

F = 23.29
p < 0.001
Green Leaf Equivalents for the 3 last leaves

2009

2010
Green Leaf Equivalents for the 3 last leaves

Susceptible in pure stand without fungicide

Results & discussion
Results & discussion

Green Leaf Equivalents for the 3 last leaves

Susceptible in pure stand without fungicide

Susceptible in cultivar mixture without fungicide

2009

2010
Green Leaf Equivalents for the 3 last leaves

Susceptible in pure stand without fungicide

Susceptible in cultivar mixture without fungicide

Susceptible in pure stand with fungicide

Results & discussion

2009

2010
Green Leaf Equivalents for the 3 last leaves

Susceptible in pure stand without fungicide

Susceptible in cultivar mixture without fungicide

Susceptible in pure stand with fungicide

Statistical analysis

ANOVA on Area Under Progress Curves

<table>
<thead>
<tr>
<th>Year</th>
<th>F-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>84.29</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>2010</td>
<td>0.65</td>
<td>0.53</td>
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</table>
Summary

2 years contrasted for wheat leaf blotch pressure (linked to the quantity of rainfalls during April and May)

With an important wheat leaf blotch pressure (data sets from 2009 + 2008), a functional cultivar mixture allows to reduce disease severity and to preserve photosynthetic active surface

With a low wheat leaf blotch pressure (data set from 2010), a functional cultivar mixture has no negative impact on photosynthetic active surface

Perspectives

modeling and experiments in other locations to refine this analysis
Thanks for your attention