Relevance of *Rhizoctonia* stem base infections in intensive wheat production systems

Andreas von Tiedemann *et al.*

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Yield trends winter wheat, Germany 1994 - 2013

Source: Federal Cultivar Registration Authority, 2015
Potential explanations

- Increased area of wheat & shorter crop rotations
- Expansion of production to marginal production sites
- Decrease in breeding progress
- Reduced tillage
- Bio-energy market: phytosanitary role of maize
- Neglection of root health: Have root/stem base diseases been overlooked/underestimated?
Potential soilborne causes for crop losses

Impacting factors:

- Site-specific factors
  - Cropping history
  - Management history
  - Soil type
  - Moisture conditions
  - Climate

Management practices
- Fertility treatments
- Pesticides, fungicides, herbicides
- Tillage and soil preparation
- Irrigation
- Machinery and traffic on land

Causal detrimental factors:

- Foliar
- Damage and disease
- Pathogens
- Nematodes
- Damage and virus transmission
- Mycorrhizal fungi
- Autotoxicity
- Weeds
- Competition for space and resources
- Deleterious rhizosphere microorganisms
- Soil properties

- Decline in physical, chemical and biological properties, e.g. nutrient depletion, soil compaction, decrease in organic matter, decrease in microbial biomass, changes in structure, water availability etc.

Bennett et al. 2012, Biological Reviews
Eyespot (*Oculimacula yallundae/acuformis*)

- Most important stem base disease in GER
- Losses up to 30%
- Increased through early sowing
- Wheat after wheat
- Mostly on medium to heavy soils

Fusarium foot and root rot (*Fusarium spp.*)

- Yield losses up to 80%
- AUSTRALIA, USA; in GER 10%
- Mostly after precrop maize and no-tillage
- Seedling blight in warm, dry autumn

Sharp eyespot (*Rhizoctonia sp.*)

- Prevalence in EU not clear
- Economic damage difficult to estimate
- Increased through minimum tillage and short cereal crop rotations

Take-all disease (*Gäumannomyces graminis*)

- Mostly in wheat and barley monocultures
- Yield losses up to 50%
- Often on sites with light and nutrient deficient soils
- In fields with destroyed soil structure
Importance of *Rhizoctonia spp.* in winter wheat in Germany: Occurrence, pathogenicity, relevant species/pathotypes and damage potential

- PhD project **Ines Eikenberg** (2010-2014)
- Cooperation: Georg-August-University of Göttingen and Syngenta Agro GmbH, Germany
- Involved persons: I. Eikenberg, A. von Tiedemann, J. Hempel, M. Käsbohrer
- Field experiments (2011/12 & 2012/13), lab and greenhouse exp.s
General life cycle of *Rhizoctonia*

**FIGURE 11-154** Disease cycle of *Rhizoctonia solani* (*Thanatephorus cucumeris*).

Agrios, 2007
### Taxonomy of *Rhizoctonia* (= RHI)

<table>
<thead>
<tr>
<th>Nuclear organisation</th>
<th>Multi-nuclear (&gt; two nuclei per cell)</th>
<th>Binuclear (two nuclei per cell)</th>
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<tr>
<td>Genus</td>
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<td><em>Ceratobasidium</em> AG A to S</td>
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<td>Group/Subgr.</td>
<td>AG 1IB AG 2-2 IIIB AG 5 AG 8 AG 11</td>
<td>AG C AG D AG E</td>
</tr>
<tr>
<td>Hosts</td>
<td>Bean, lettuce, maize/corn potato, bean, soybean, wheat¹ Poaceae wheat² wheat</td>
<td>-- wheat³, maize/corn⁴ --</td>
</tr>
<tr>
<td>Anamorph</td>
<td><em>Rhizoctonia solani</em></td>
<td><em>R. globularis</em> <em>R. cerealis</em> <em>R. muneratii</em></td>
</tr>
<tr>
<td>Teleomorph</td>
<td><em>Thanatephorus cucumeris</em></td>
<td><em>C. cornigerum</em> <em>C. cereale</em> <em>Ceratobasidium sp.</em></td>
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</tbody>
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(Gonzalez Garcia *et al.*, 2006; modified)
AG = Anastomosis-Group

¹Woodhall *et al.*, 2012 (UK)
²Paulitz & Schröder, 2007
³Hamada, 2011
⁴Tomaso-Peterson, 2006 (USA)
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Rhizoctonia cerealis AG-D on wheat

→ Typical symptoms of sharp eyespot in the field (GS 75)

Field experiment Göttingen-Weende, 2011/12

Photos: Eikenberg
Monitoring of *Rhizoctonia spp.* in plant & soil samples

1. Plant samples
   - Samples field experiment Gö 2011/12: **105 isolates**
   - Samples 2013 (GS 75) from 35 fields in Germany & 6 in Poland: **48 isolates**

2. Soil samples
   - Samples from 2 field trials in Germany (Gö-Gladebeck, Gö-Torland), collected 12/2011: **40 isolates**
     (identification by *Epilogic*, Weihenstephan)
Monitoring of *Rhizoctonia spp.* in plant & soil samples

**Results**

1. **Plant samples** (Germany, Poland):
   - all 105 isolates from 2011/12: *R. cerealis* AG-D
   - all 48 isolates from 2013: *R. cerealis* AG-D

2. **Soil samples:**

<table>
<thead>
<tr>
<th><em>R. solani</em></th>
<th><em>R. cerealis</em></th>
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<tr>
<td>AG 6</td>
<td>AG-E</td>
</tr>
<tr>
<td>AG 9</td>
<td>AG-K</td>
</tr>
<tr>
<td>AG 11</td>
<td>AG-I</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
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PhD project Ines Eikenberg
Monitoring of RHI incidence in wheat in Germany & Poland 2013
(cooperation Syngenta & PhD project Ines Eikenberg)

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<th>Polish fields</th>
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<tr>
<td>n = 35</td>
<td></td>
<td>n = 6</td>
</tr>
<tr>
<td>Fields infected [%]</td>
<td>48.6</td>
<td>83.3</td>
</tr>
<tr>
<td>Average DI [%]</td>
<td>4.04 (0 – 36.5)</td>
<td>20.2 (0 – 37.3)</td>
</tr>
<tr>
<td>DI infected fields [%]</td>
<td>8.3</td>
<td>24.2</td>
</tr>
</tbody>
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Summary

- *R. cerealis* AG-D is dominant in symptomatic wheat plants (Germany, Poland).

- *R. solani* AG 5 and AG1-IB are non-pathogenic on wheat, no active penetration into healthy wheat tissue detectable *in vitro*.

- Significant yield losses induced by *R. cerealis* in combination with frost stress on frost-sensitive winter wheat varieties.

- Combined frost stress + RHI infection reduces [grains/ear] and plant density [ears/m²].

- Early sowing increases risk of RHI-infection and multiple stress damage.

- *R. cerealis* AG-D infection can be significantly reduced by seed treatment.
Acknowledgements

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