Impact of physical soil properties on *Rhizoctonia* infestation of sugar beet and *Rhizoctonia* quantification in soil

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**Introduction**

The soil borne pathogen *Rhizoctonia solani* (R. *solani* AG2-2IIB) is the causal agent of the Late Root and Crown Rot disease in sugar beet, which is an increasing problem in European sugar beet growing areas (Büttner et al., 2002). Severe *Rhizoctonia* infestation is known to cause serious yield decline, especially if maize is grown as pre-crop (Buhre et al., 2009). Conditions leading to disease outbreak are not yet well understood. However, physical soil characteristics are assumed to have a strong influence on both *Rhizoctonia* inoculum potential in the soil and *Rhizoctonia* infestation of sugar beet.

**Material and Methods**

Multi-factorial split-plot field experiments (4 replicates, pre-crop/tillage (main plot), sugar beet variety (sub-plot) were conducted at the sites Göttingen (Gö14; Lower Saxony) and Haardorf (Ha14; Lower Bavaria) in 2014:

- Experimental sites were artificially inoculated (barley inoculum) and maize was subsequently grown as a susceptible pre-crop to create a uniform inoculum potential in the soil
- Maize straw was left (grain maize) or removed (silage maize) from the field
- The soil structure of the topsoil (0-15 cm) was differentiated by a variation of soil tillage (plow, cultivator, wheeling + shallow cultivation) in autumn after maize harvest
- A *Rhizoctonia*-susceptible and a resistant variety were grown

Penetration resistance was measured before sugar beet sowing in spring and undisturbed soil samples were taken from 7-12 cm depth to determine physical soil properties. *Rhizoctonia* infestation was evaluated after sugar beet harvest in October.

Relations between soil structural properties and *Rhizoctonia* infestation were examined by regression analysis.

Amount of *Rhizoctonia DNA* (expressed as soil inoculum potential; IP) was quantified in DNA extracts from soil samples of each plot by real-time PCR. DNA was extracted according to a modified method of Woodhall et al. (2012) out of 250 g soil.

**Results**

**Table 1** Correlation between *Rhizoctonia* disease severity (%) and white sugar yield [t ha⁻¹] as well as the physical soil properties penetration resistance [MPa], pore volume [Vol.%], air capacity [Vol.%] and pneumatic conductivity [cm s⁻¹] at 7-12 cm soil depth for both varieties at Göttingen (Gö14) and Haardorf (Ha14). Spearman’s rank sum coefficients. * significant at p < 0.05.

<table>
<thead>
<tr>
<th></th>
<th>Penetration resistance</th>
<th>Pore volume</th>
<th>Air capacity</th>
<th>Pneumatic conductivity</th>
<th>White sugar yield</th>
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<tbody>
<tr>
<td>Gö14</td>
<td>0.20</td>
<td>-0.06</td>
<td>-0.06</td>
<td>-0.02</td>
<td>-0.44*</td>
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<tr>
<td>Ha14</td>
<td>0.10</td>
<td>-0.03</td>
<td>0.01</td>
<td>0.29</td>
<td>-0.41*</td>
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- No significant correlation between physical soil properties and disease severity
- Significantly negative correlation between disease severity and white sugar yield at both sites

**Fig. 1**: *Rhizoctonia solani* disease severity of a susceptible (sus) and a resistant (res) sugar beet variety after different combinations of tillage and pre-crop at sugar beet harvest at Göttingen (A) and Haardorf (B) in 2014. PT: Pre-crop/Tillage, V: Variety

- Disease severity was higher at Ha14 compared to Gö14 (Gö14 < 5 %, Ha14 2-17 %)
- No effect of pre-crop/tillage and the interaction of pre-crop/tillage and variety on disease severity at both sites
- Sugar beet variety affected disease severity at Ha14 but not at Gö14

**Fig. 2** (A) *Rhizoctonia solani* disease severity of a susceptible (SBsus) and a resistant (SBres) sugar beet variety (n=20) at harvest and (B) *R. solani* AG2-2IIB inoculum potential (IP) before sugar beet sowing and at sugar beet harvest after growing a susceptible (SBsus) and a resistant (SBres) sugar beet variety (n=20) at Haardorf in 2014

- The susceptible variety showed a significantly higher disease severity compared to the resistant variety
- Growing a susceptible variety increased the *Rhizoctonia* soil IP compared to the IP at sugar beet sowing and after growing a resistant variety
- No correlation between soil IP at sowing and harvest and disease severity on plot level

**Fig. 3**: (A) Relation between the *Rhizoctonia solani* AG2-2IIB inoculum potential in soil at sugar beet sowing (IPsowing) and after sugar beet harvest (IPHarrow) and disease severity of the resistant (SBres) and the susceptible (SBsus) sugar beet variety at harvest at the field trial Haardorf in 2014. Points represent values from individual plots.

- Lack of correlation between physical soil properties and disease severity was likely caused by a low disease severity in 2014, especially at Göttingen; the experiments are continued
- Sugar beet susceptibility to *Rhizoctonia* increases disease severity as well as IP in the soil already at low disease severity levels
- No correlation between soil IP and disease severity, probably due to the low disease severity
- Resistance of sugar beet varieties is of major importance to avoid a high disease severity, and to reduce *Rhizoctonia* soil IP

**References**


