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* AG2-2IIIB) 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 $p < 0.05$.

		Penetration resistance	Pore volume	Air capacity	Pneumatic conductivity	White sugar yield
Gö14	**Disease severity**	0.20	-0.06	-0.06	-0.02	**-0.44***
Ha14	**Disease severity**	0.10	-0.03	0.01	0.29	**-0.41***

- No significant correlation between physical soil properties and disease severity
- Significantly negative correlation between disease severity and white sugar yield at both sites

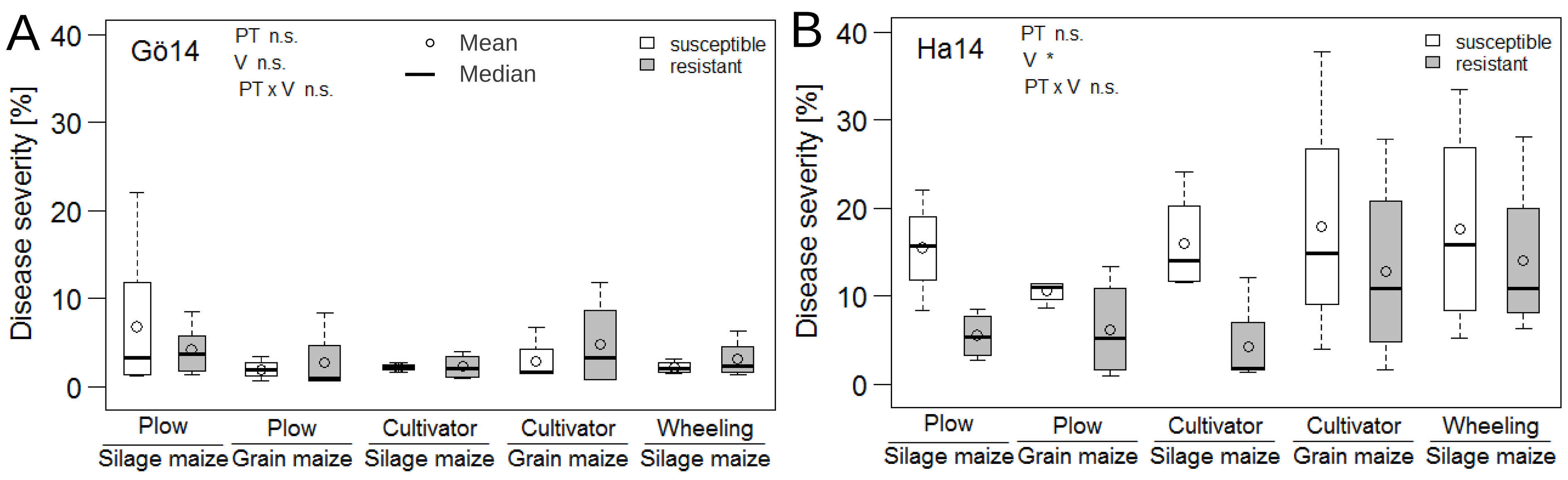

Fig. 1 *Rhizoctonia solani* disease severity of a susceptible (sus) and a resistant (res) sugar beet variety after different combinations of tillage and pre-crop at sugar beet harvest at Göttingen (A) Haardorf (B) in 2014. PT: Pre-crop/Tillage, V: Variety

- 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

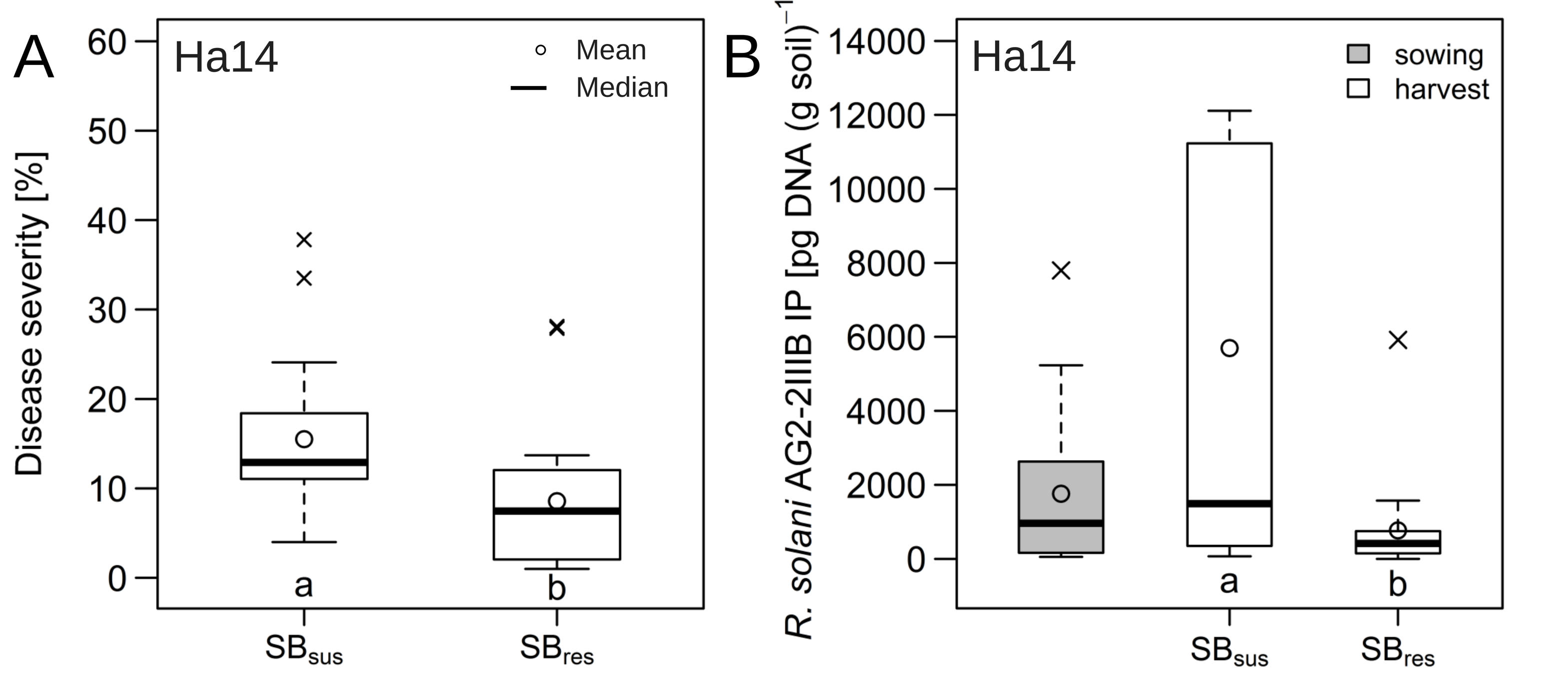

Fig. 2 (A) *Rhizoctonia solani* disease severity of a susceptible (SB_{sus}) and a resistant (SB_{res}) sugar beet variety (n=20) at harvest and (B) *R. solani* AG2-2IIIB inoculum potential (IP) before sugar beet sowing and at sugar beet harvest after growing a susceptible (SB_{sus}) and a resistant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

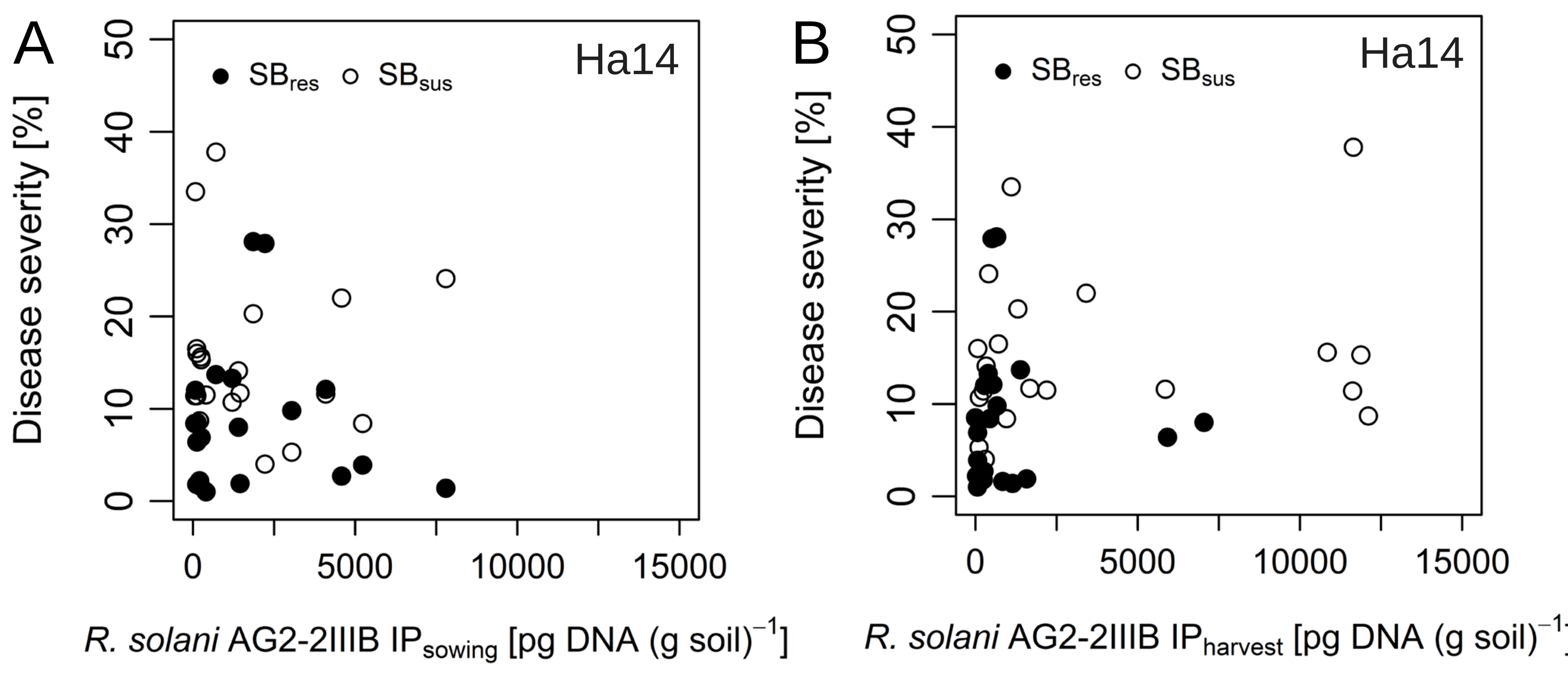

Fig. 3: (A) Relation between the *Rhizoctonia solani* AG2-2IIIB inoculum potential in soil at sugar beet sowing (IP_{sowing}) and (B) after sugar beet harvest ($IP_{harvest}$) and disease severity of the resistant (SB_{res}) and the susceptible (SB_{sus}) sugar beet variety at harvest at the field trial Haardorf in 2014. Points represent values from individual plots.

- 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

Conclusion

- 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:
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