Soil structure effects on *Rhizoctonia* infestation of sugar beet

-CONCEPT AND FIRST RESULTS-

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INTRODUCTION

The soil-borne pathogen *Rhizoctonia solani* (AG 2-2IIIB), causing the late root and crown rot in sugar beet, has become an increasing problem in sugar beet growing areas in Europe (BÜTTNER *et al.,* 2002). Severe *Rhizoctonia* infestation causes substantial yield decline due to plant losses. Maize is known to be a susceptible pre-crop, considerably boosting sugar beet infestation (BUHRE et al., 2009). In addition, physical and chemical soil characteristics are assumed to have a strong influence on (i) the *Rhizoctonia* inoculum potential and spread in the soil and (ii) the *Rhizoctonia* infestation of sugar beet. However, the interactions between soil structural properties and disease occurrence are not yet understood. This study aims to quantify pre-crop and soil structural effects on the *Rhizoctonia* inoculum potential in the soil and the *Rhizoctonia* occurrence on two sugar beet genotypes (tolerant, susceptible).

EXPERIMENTAL DESIGN AND MEASUREMENTS

- Multi-factorial split-plot field experiments (four replicates) were conducted at the sites Göttingen (Lower Saxony) and Haardorf (Lower Bavaria)
- The soil was inoculated (Göttingen 150 kg ha^{-1}, Haardorf 50 kg ha^{-1}) with barley inoculum and maize was grown as a susceptible pre-crop to create a high and uniform infestation potential in the soil
- Maize straw was left (grain maize, GM) or removed (silage maize, SM) from the field
- The structural properties of the topsoil (0-20 cm) were differentiated by soil tillage: Plow 25 cm (P25), cultivator 10 cm (C10), compaction by heavy machinery + cultivator 5 cm (C5)

Soil measurements:

- C/N, $CaCO_3$, pH, plant available nutrients (0-30 cm)
- Penetration resistance at sugar beet sowing (March 2014, 0-40 cm), bulk density, porosity, air capacity (pF 1.8, pF 2.5) and pneumatic conductivity (May 2014, 8-13 cm)
- Contiunous measurement of soil temperature and moisture with TDR probes (10 cm)

Sugar beet harvest in July, August/September and October 2014:

- *Rhizoctonia* disease rating (0-100 % infected root surface)
- Yield and quality

RESULTS AND DISCUSSION

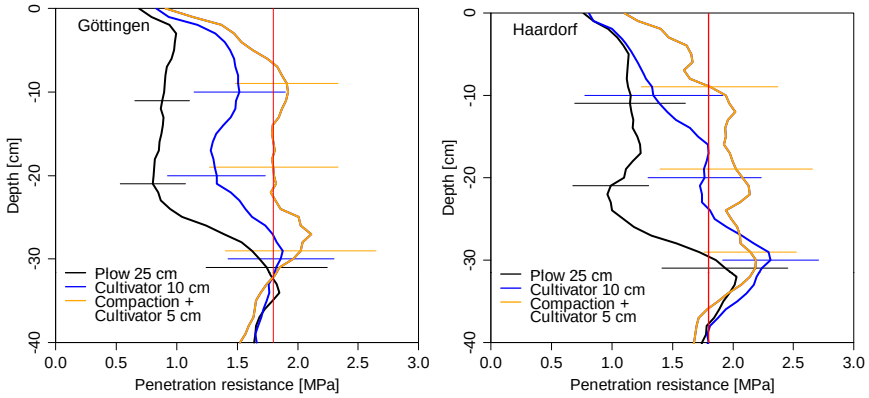

Fig. 1: Penetration resistance [MPa] of differently tilled soil at Göttingen and Haardorf at sugar beet sowing.
Red line indicates threshold for a harmful soil compaction (> 1.8 MPa).

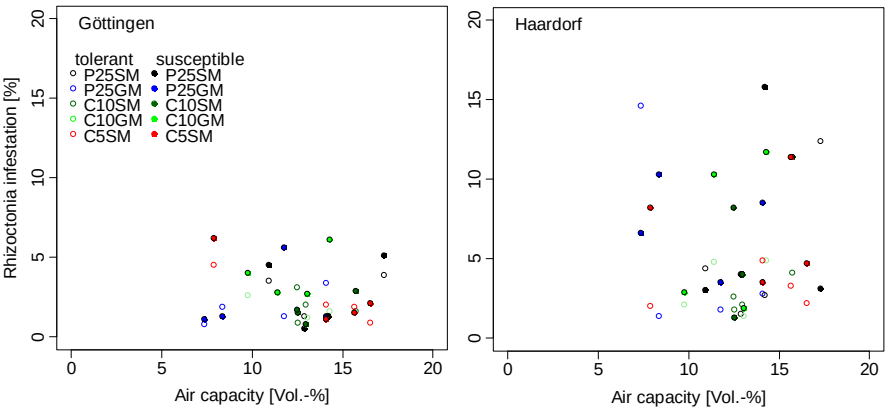

Fig. 2: Relation between air capacity [Vol.-%] at 8-13 cm depth and *Rhizoctonia* infestation [%] in July 2014 at Göttingen and Haardorf.
P25: Plow 25 cm, C10: Cultivator 10 cm, C5: Compaction + cultivator 5 cm; SM: Silage maize, GM: Grain maize

Penetration resistance

- At both sites, penetration resistance in 5-25 cm increased in the order Plow 25 cm < Cultivator 10 cm < Compaction + cultivator 5 cm (Fig. 1)
- Compaction + cultivator 5 cm (C5) resulted in penetration resistance > 1.8 MPa, indicating soil compaction harmful for sugar beet growth

Tab. 1: Effect of tillage and pre-crop on air capacity [Vol.-%] at 8-13 cm depth at Göttingen and Haardorf (May 2014).
P25: Plow 25 cm, C10: Cultivator 10 cm, C5: Compaction + cultivator 5 cm.

		Göttingen	Haardorf
Tillage	Pre-crop	Air capacity [Vol.-%]	
P25	Silage maize	12.8 ± 2.6	12.5 ± 2.5
	Grain maize	11.2 ± 3.0	11.6 ± 2.2
C10	Silage maize	6.3 ± 1.7	15.1 ± 1.6
	Grain maize	4.9 ± 1.8	14.5 ± 1.9
C5	Silage maize	6.1 ± 1.6	9.4 ± 2.0

Air capacity

- At Haardorf, the lowest air capacity (< 10 Vol.-%) was measured at the C5 plots, whereas at Göttingen the air capacity of the C10 and C5 plots was < 10 Vol.-% (Tab. 1)
- The pre-crop had no clear effect on air capacity

Rhizoctonia infestation

- *Rhizoctonia* infestation of the susceptible sugar beet genotype was higher in Haardorf compared to Göttingen (Fig. 2)
- At Göttingen no differences between the tolerant and susceptible genotype occured
- At Haardorf, the susceptible genotype showed slightly higher *Rhizoctonia* infestation compared to the tolerant genotype

CONCLUSION

We successfully created plots with a variation of structural properties, as indicated by the different penetration resistance (Fig. 1) and air capacity (Tab. 1).

Due to the early harvest date in July, the first results of the *Rhizoctonia* disease rating revealed only a slight *Rhizoctonia* infestation from 2 - 5 % in Göttingen and 2 - 15 % at Haardorf without clear differences between the treatments.

References: Büttner G, Führer-Ithurrart ME, Buddemeyer J (2002): Zuckerindustrie 127, 856-866.. Buhre C, Kluth C, Bürcky K, Märländer B, Varrelmann M (2009): Plant Disease 93:2, 155-161