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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 is known to cause substantial yield decline due to plant losses, especially if maize is grown as susceptible pre-crop (BUHRE et al., 2009). 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* infestation of different sugar beet genotypes (tolerant, susceptible).

EXPERIMENTAL CONCEPT

- Multi-factorial split-plot field experiments (4 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) or removed (silage maize) from the field
- The structural properties of the topsoil (0-20 cm) were differentiated by soil tillage and additional soil compaction after maize harvest

MEASUREMENTS

Soil:

- C/N, $CaCO_3$, pH, plant available nutrients
- Bulk density, porosity (pF 1.8, pF 2.5), pneumatic conductivity and penetration resistance
- Soil temperature and moisture by continuous measurement with TDR probes in the field

Sugar beet:

- *Rhizoctonia* disease rating
- Yield and quality (Amino-N, K, Na) at 3 dates during the growing season

RESULTS AND DISCUSSION

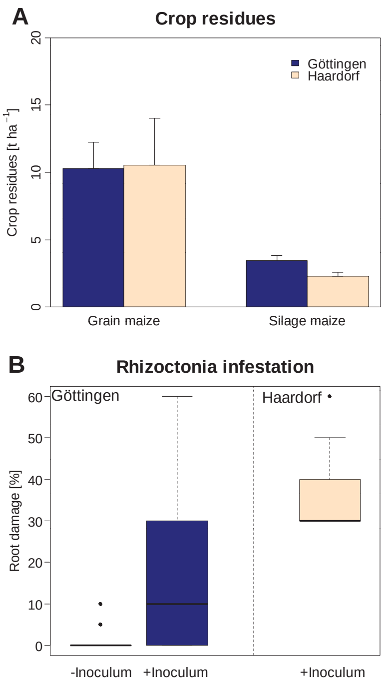

Fig. 1: Grain and silage maize crop residues [t ha^{-1}] remaining in the field (A) and percentage of *Rhizoctonia* root damage on maize (B).

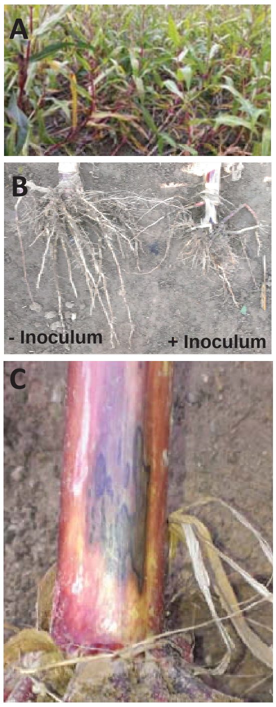

Fig. 2: Typical Rhizoctonia symptoms on maize.
Lodging of maize plants (A), reduced root system (B) and eye spot(C).

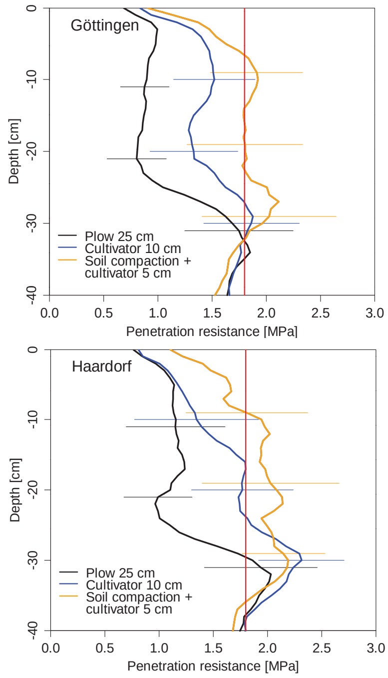

Fig. 3: Penetration resistance [MPa] of differently tilled plots at Göttingen and Haardorf.
Red line indicates threshold for a harmful soil compaction (> 1.8 MPa).

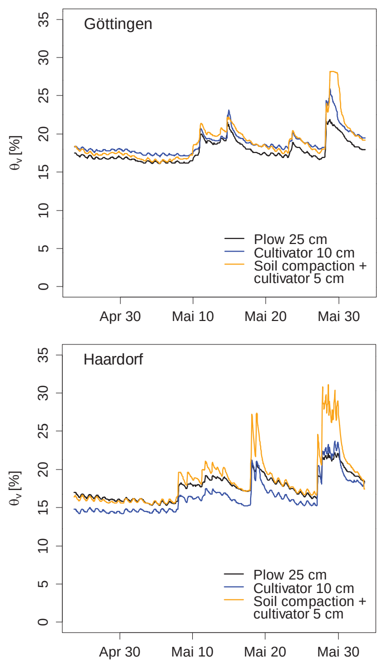

Fig. 4: Volumetric soil water content [Θ_V %] of differently tilled plots at Göttingen and Haardorf.
Data measured by data loggers in the field at 10 cm depth.

Crop residues and Rhizoctonia infestation

- Remaining maize crop residues were 10 t ha^{-1} in the grain maize plots and 3 t ha^{-1} in the silage maize plots at both sites (Fig. 1 A)
- Inoculation caused considerable *Rhizoctonia* infestation (Fig. 1 B) with very typical symptoms on infested maize plants at both sites (Fig. 2 A-C)

CONCLUSION AND OUTLOOK

We created inoculated and non-inoculated plots with different maize crop residues and a variation of structural properties to quantify its impact on the Rhizoctonia inoculum potential and Rhizoctonia infestation of sugar beet crops.

The next steps will be the measurement of relevant soil physical parameters and the first sugar beet harvest in July with a *Rhizoctonia* disease rating.

Penetration resistance

- Different soil tillage systems resulted in a clearly differentiated penetration resistance as a measure of soil compaction in the topsoil (Fig. 3)
- Plowed plots showed lowest penetration resistance at both sites
- Soil compaction followed by shallow cultivation (cultivator 5 cm) resulted to highest soil compaction with penetration resistance > 1.8 MPa

Soil water content (SWC)

- SWC at sowing was 18 Vol.-% at Göttingen and 15 Vol.-% at Haardorf, but did not differ between the soil tillage systems (Fig. 4)
- Compacted plots showed highest SWC after rainfall events, probably due to lower infiltration

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