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Comparison of multi-temporal remote sensing data with the actual spatial spread of clubroot disease in oilseed rape fields using a bioassay method

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Introduction & Objectives

- Clubroot is a serious disease of *Brassica* crops caused by the soil-borne pathogen *Plasmodiophora brassicae*.
- Chemical control of the pathogen is not possible.
- Cultural practices can limit the infestation with *P. brassicae.*
- In-field distribution of the pathogen would help farmers to make decisions in disease management strategies.
- Methods of geographical information systems (GIS) can be used to describe abiotic field parameters.
- Our aim is to develop a signature of the pathogens demands by using different geodata sources to improve our knowledge about its incidence and spatial distribution within production fields.

Materials & Methods

Soil sample collection & bioassay

- In total 60 (2017) resp. 83 (2018) soil samples were collected from a clubroot-infested field in Mecklenburg-West Pomerania, Germany. Sampling was accomplished using GPS receiver in a stratified-purposive sampling approach, based on remote sensing data from 2016.
- Field soil was mixed with a mixture of standard soil, rhododendron soil and quartz sand (7:2:1) in a ratio of 1:1 and 30 pregerminated oilseed rape plants (cv. Avatar) per sample were tested under greenhouse conditions (20/18°C (day/night) with a 16 h photoperiod).
- Plants were harvested after 6 weeks, number of plants with clubroot symptoms was determined.
- Disease severity was assessed, using a scale with 4 classes. Disease ratings were weighted and combined as disease severity (DS) according to Diederichsen & Sacristan (1996).

Spatial data sources

- Georeferenced satellite images (RapidEye) and a colour aerial photo from 2015/2016 growing period, the field being cropped with oilseed rape, were used for designing the sampling layout. The spatial layout of historical field borders were reconstructed from aerial images from the 1950s.
- The 60 georeferenced soil samples from 2017 were analyzed for nutrients (P, K, Mg) and pH-value.
- The official digital elevation model (DEM, 10m resolution) served for the derivation of different terrain parameters. Terrain analysis was accomplished using SAGA GIS. For all other spatial analyses Quantum GIS (v2.18) was used. Statistical analyses were done with R.

Results & Outlook

- The results show a highly variable pattern of clubroot incidence in the field with some local clusters, remote sensing information yielded similar patterns (Fig. 1).
- There was no correlation between the topographical wetness index or other terrain parameters and clubroot incidence (Fig. 2).
- A correlation between soil pH and clubroot infestation of the soil is shown (Fig. 3).
- The historical layout of fields from the 1950s seems to correlate well with the clusters of highly infected areas (Fig. 4).
- Currently, we are conducting the test for the third year running and are focusing on the dynamics of the spatial pattern of the infestation.

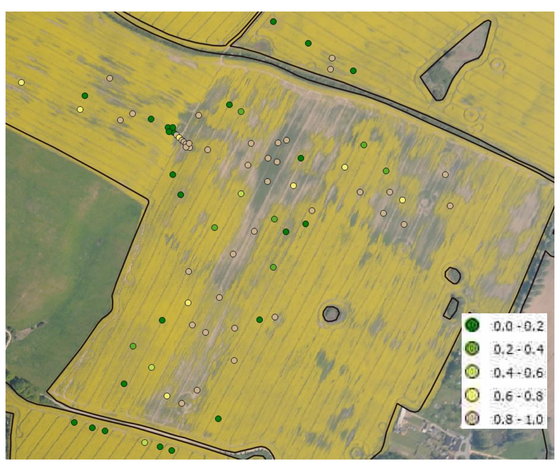

Fig. 1: DS index of soil samples from 2018 and aerial image of oil seed rape (BBCH 65, 10.05.2016)

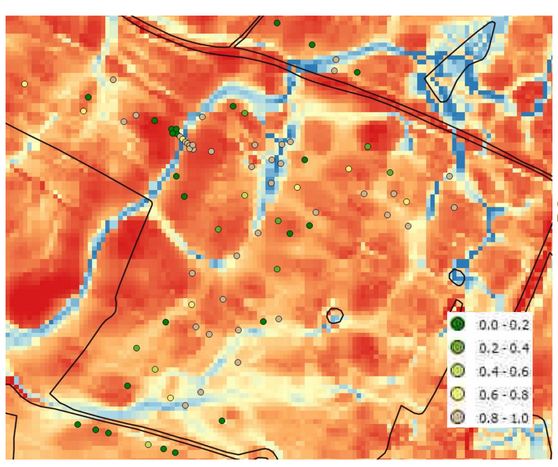

Fig. 2: DS index of soil samples from 2018 and Topographical Wetness Index derived from offical 10m-DEM

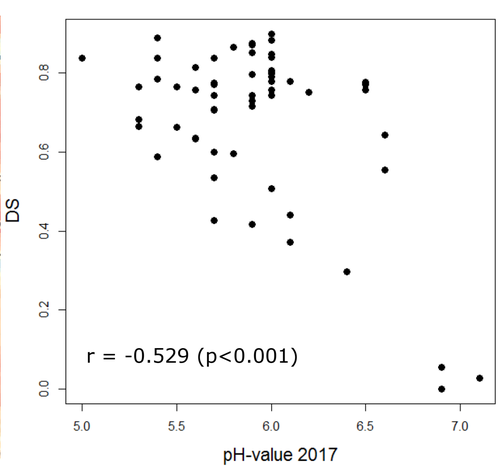

Fig. 3: Scatter plot of pH-values and DS index of 60 samples (2017)

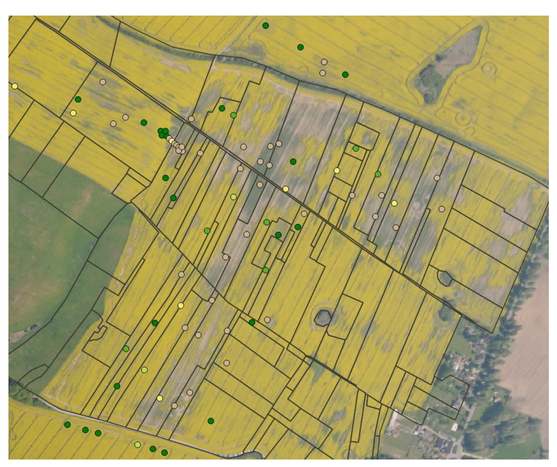

Fig. 4: DS index of soil samples from 2018, aerial image of oil seed rape (BBCH 65, 10.05.2016) and layout of field borders from early 1950s

References: Diederichsen, E., and Sacristan, M.D. 1996. Plant Breeding 115:5–10.

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