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Integrated management of Clubroot in winter oilseed rape based on soil DNA-analyses

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Background:

Clubroot, caused by the soilborne pathogen *Plasmodiophora brassicae* is the most severe disease of *Brassica* oilseed crops. The increasing spread of the pathogen has serious consequences for oilseed rape (OSR) production, and control is difficult due to its long persistence in the soil. Access to clubroot resistant (CR) cultivars is the most effective tool for managing the disease.

Objective:

The aim was to identify an integrated pest management (IPS) strategy for clubroot control based on DNA technology for clubroot control. Performance of the clubroot resistance (CR) trait in commercial cultivars of winter OSR was evaluated in field experiments with natural inoculum of *P. brassicae*. In a controlled environment the selection pressure of the pathogen was identified.

Methods:

Three commercial Cr winter OSR cultivars and a susceptible 'Cultivar mix' were evaluated for disease severity index (DSI) and yield performance in field soils. These field soils were selected for varying abundance of natural inoculum of *P. brassicae* determined by a previously developed qPCR assay, ranging from 2,500 to 2,500,000 gene copies g-1 soil. Seven field trials were carried out. Disease severity and yield was determined. Soil samples were collected plot wise from each experiment for DNA-analysis and for comparative bioassays performed in a growth chamber.

Results:

The results from the field trials show a substantial variation in clubroot infection between years. For ´Cultivar mix´, a negative correlation (y = -252.3ln(x) + 58 897.6) was found between inoculum density and seed yield in five trials, whereas no correlation was found for the CR cultivars.

In bioassays, ´Cultivar mix´ exhibited a significantly high correlation between disease severity index (DSIb) and number of gene copies g-1 soil (R2 = 0.72). For the CR cultivars Mentor and Alister, correlation was R2 = 0.45 and 0.58, respectively, indicating that resistance was under pressure. In the field trials, the response of CR cultivars was lower (DSIf < 27). We promote CR cultivars of winter OSR as part of IPM in situations where the abundance *P. brassicae* DNA exceeds detection limit (> 500 gene copies g-1 soil) but does not exceed 100,000 gene copies g-1 soil.

Conclusions:

Managing clubroot once established in a field is a challenge due to the persistence of the pathogen in the soil. Commercial CR cultivars of winter OSR are available from most seed companies. High level of clubroot control is provided by Cr cultivars if grown in fields where the pathogen inoculum does not exceed 100,000 gene copies g-1 soil, as determined by soil analysis. The response of resistant cultivars to disease development, as showed in this study, constitutes the basis for current guidance to growers on the best long-term control strategy for clubroot. New resistant cultivars exhibit higher yield potential and are thus an efficient tool for growers. Soil testing based on DNA technology must be used to avoid outbreaks in fields cropped with susceptible cultivars.

Reference:

Wallenhammar, A-C., Omer, Z., Edin, E. and Jonsson. A. (2021). Influence of soil-borne inoculum of *Plasmodiophora brassicae* measured by qPCR on disease severity of Clubroot-resistant cultivars of winter oilseed rape (*Brassica napus* L.). *Pathogens* 10, 433.