



Influence of soilborne inoculum of *Plasmodiophora brassicae* measured by qPCR on disease severity of clubroot resistant cultivars of winter oilseed rape (*Brassica napus* L.)



A-C. Wallenhammar¹, E. Edin², Z. Omer³, A. Jonsson⁴

¹Rural Economy and Agricultural Society | HS Konsult AB, Gamla vägen 5G, 702 22 Örebro, Västerås, ³Uppsala, ⁴RISE (Research Institutes of Sweden AB), Skara, Sweden
Ann-Charlotte.Wallenhammar@hushallningssallskapet.se

Clubroot, caused by the soilborne obligate pathogen *Plasmodiophora brassicae*, is a constraint for oilseed rape (OSR) production worldwide and constitute a permanent threat due to the long persistence of the resting spores in the soil (Figure 1). Access to resistant cultivars is considered the most effective tool for managing clubroot.

The aim was to develop guidelines for growers as a part of IPM based soil analysis of *P. brassicae* DNA for maintaining a sustainable production of winter OSR



Figure 1. Severe symptoms of clubroot. The root is transformed to a club that results in a considerably yield reduction. One gram of the club contain millions of resting spores that remain in the soil for many years.

Materials and Methods

Three clubroot resistant (Cr) commercial cultivars of winter OSR (Mentor, Alister and Archimedes) and a susceptible 'Cultivar mix' were evaluated for disease severity and yield performance in field soils, selected for varying abundance, from 3500 to 2 500 000, of natural inoculum of *P. brassicae* DNA expressed as number of gene copies per g of soil. Seven field experiments were carried out in south and central Sweden 2017-2019. Comparative soil bioassays were performed in soil assessed plot wise in a growth chamber at SLU, Skara.

Results

For susceptible cultivar mix a negative correlation ($y = -252.4 \ln(x) + 58897.6$) was found between inoculum density and seed yield (Figure 2), whereas no correlation was found for resistant cultivars. In bioassays cultivar mix exhibited a high correlation between DSI_f and number of gene copies per g of soil ($R^2 = 0.72$). For resistant cvs. Mentor and Alister results indicate that resistance was under pressure. DSI_f rapidly increased as the number of gene copies per g of soil increased above approx. 4000 (Figure 3a). There was no correlation for the Cr-cultivars (Figure 3b).

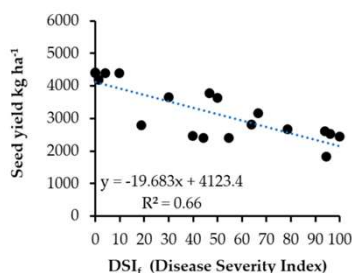


Figure 2. Relationship between seed yield and disease severity index (DSI_i) assessed in November 2017 and 2018 for susceptible 'Cultivar mix' harvested at five trial sites 2018 and 2019. Yield decreased by 20 kg ha⁻¹ for each infected plant.

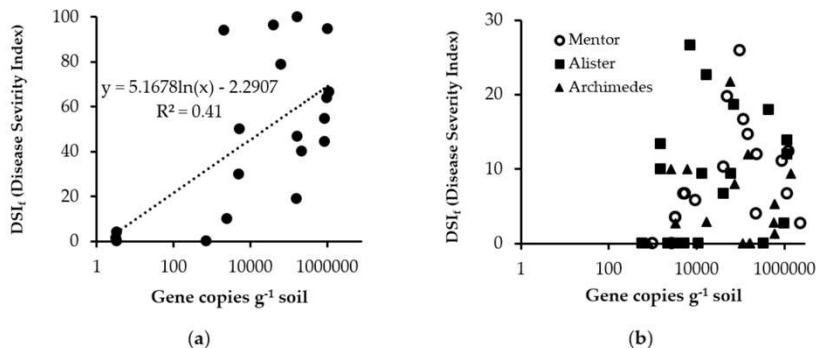


Figure 3. Relationship between disease severity index assessed on plants at five trials sites in November 2017 and 2018 (DSI_i) and abundance of gene copies per g of soil determined by real-time qPCR in soil sampled in each plot for (a) susceptible 'Cultivar mix' and (b) clubroot resistant cultivars Mentor, Alister and Archimedes.

This study was financed by the Swedish Farmers' Foundation for Agricultural Research (grant number O-16-20-7659), by the Foundation for Swedish Oil Plant Research and by Carl Robert Prytz Donation fund.

