

Molecular tools pave the way for IPM solutions of clubroot



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16th INTERNATIONAL RAPESEED CONGRESS

GLOBAL CROP - GOLDEN OPPORTUNITIES

Oilseed rape continues to be a crop with a high contribution margin



How to avoid clubroot?



Healthy root of winter OSR



Winter OSR in spring

Prevalence of clubroot in European rapeseed production areas

Summary

Clubroot is spread throughout the area of cultivation of OSR

Resistance is eroded in all reported countries

We must stop further spread by proactive actions!

Plant health

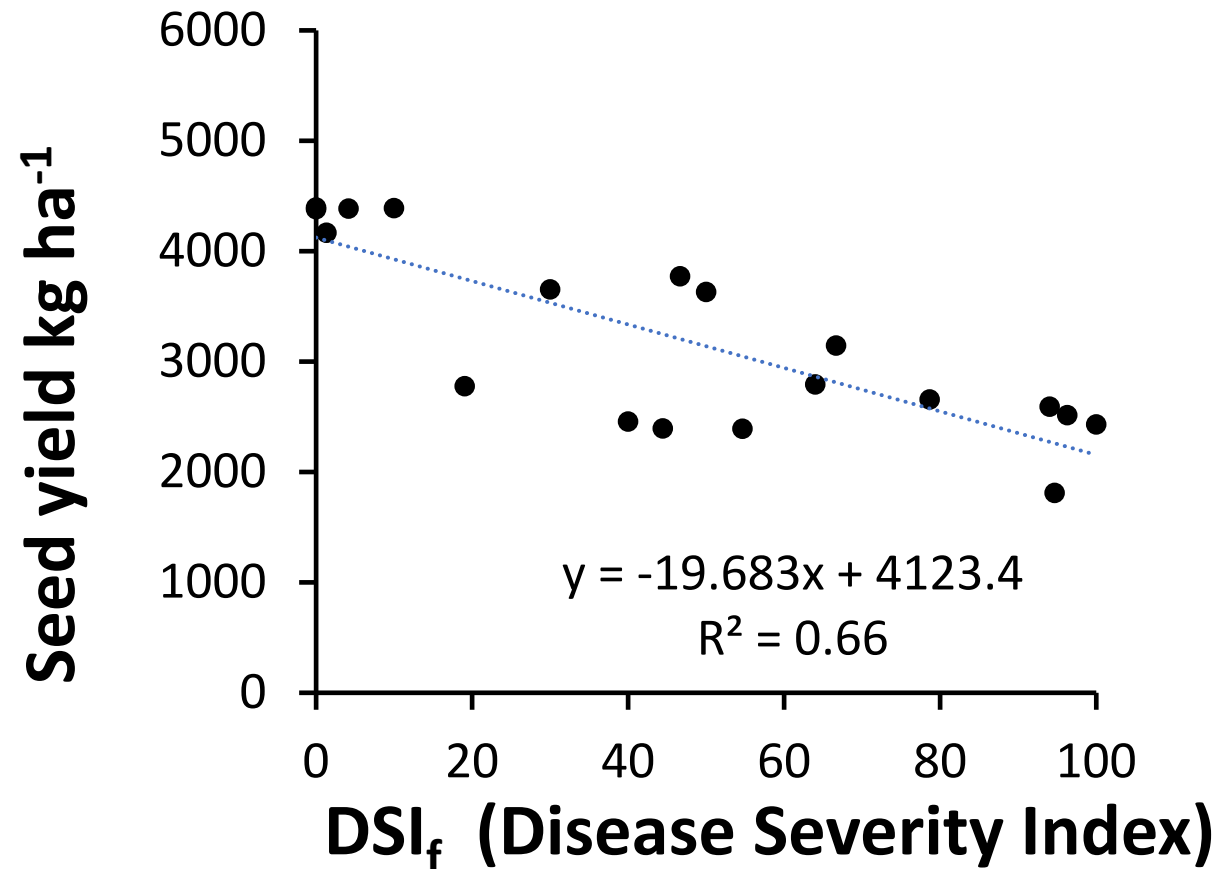


- ICPP2023 promoted the integration of Plant Health & Plant Pathology into the One Health Concept





Correlation between disease severity index (DSI) in the field and seed yield for a mixture of 3 susceptible cultivars harvested at five different field sites in south and central Sweden 2018 and 2019



How to avoid clubroot?



Healthy root of winter OSR

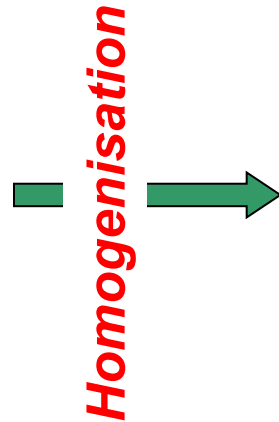


Winter OSR in spring

Extraction and DNA-analysis



Soil sampling
2 kg



DNA extraction
from 0,5 g soil



Analyse with qPCR
and species
specific DNA-
sequences

**2012: Commercial analyses on the market
(Eurofins, Intertek Diagnostics)**

Can I grow rapeseed when there is *P. brassicae* DNA in the soil?





Resistant cultivars

Resistant cultivars is considered the most effective tool in managing clubroot

2013 European clubroot resistant (Cr) winter ORS cultivars tested in field trials in naturally infested soils by the Swedish Seed and Oilseed growers

Several **Cr- winter OSR** cultivars available on the Swedish market



Journal of Agricultural Research, Washington D.C., vol 59, No 11, Dec 1, 1939

RESISTANCE TO CLUBROOT IN VARIETIES OF TURNIP AND RUTABAGA¹

By J. C. WALKER

Agent, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture, and professor of plant pathology, University of Wisconsin

INTRODUCTION

Clubroot (*Plasmodiophora brassicae* Wor.) continues to be a major disease of crucifers in many countries. Although it has been known for several centuries and has been the subject of numerous scientific investigations during the past 60 years, entirely satisfactory remedial measures have not been worked out for the important crops on which it occurs. Because of the extreme longevity of the pathogen in the soil the disease becomes one of that group in which control is best obtained through the development of disease-resistant varieties



In 1924 and 1925 Lindfors (22, 23) reported extensive trials of varieties of turnip and rutabaga on clubroot-infested soil in Sweden. Of the fodder turnip varieties he found Svalöf's Yellow Tankard, Dale's Hybrid, Weibull's Sekel, and Weibull's Östersundom the most resistant. Of the rutabaga varieties Studsgaard Bangholm, Wilhelmsburger, Svalöf's Yellow Swedish, and Weibull's Swedish Smooth were the most resistant, while Svalöf's Bangholm, Weibull's Bangholm, Weibull's Imperial, and Weibull's Trondhjem were very susceptible. None of the turnips or rutabagas was completely resistant, however, for even the Studsgaard Bangholm was completely destroyed by the disease on poorly drained, acid soil.



Strategy for growing winter OSR in infested fields

- ✓ Characterisation of resistant cultivars in soils with different pathogen abundance
- ✓ New guidelines for interpreting soil assays



Selected fields: number of gene copies per g of soil

2017

Bollerup 2 500 000

Simris 1 100 000

Kumla 15 000

Hallsberg 2 500

(clubroot 20 years ago)

2018

Bollerup 38 300

Simris 432 000

Kumla 50 000



Material and methods



Four cultivars were evaluated in seven field trials in 2017 and 2018 in south and central Sweden:

1. 'Cultivar mix' (susceptible)
(Avatar, Dariot, Explicit, Exstorm)
(Avatar, Explicit, Mercedes, Harnas)
2. NPZ Mentor
3. SY Alister
4. LI Archimedes



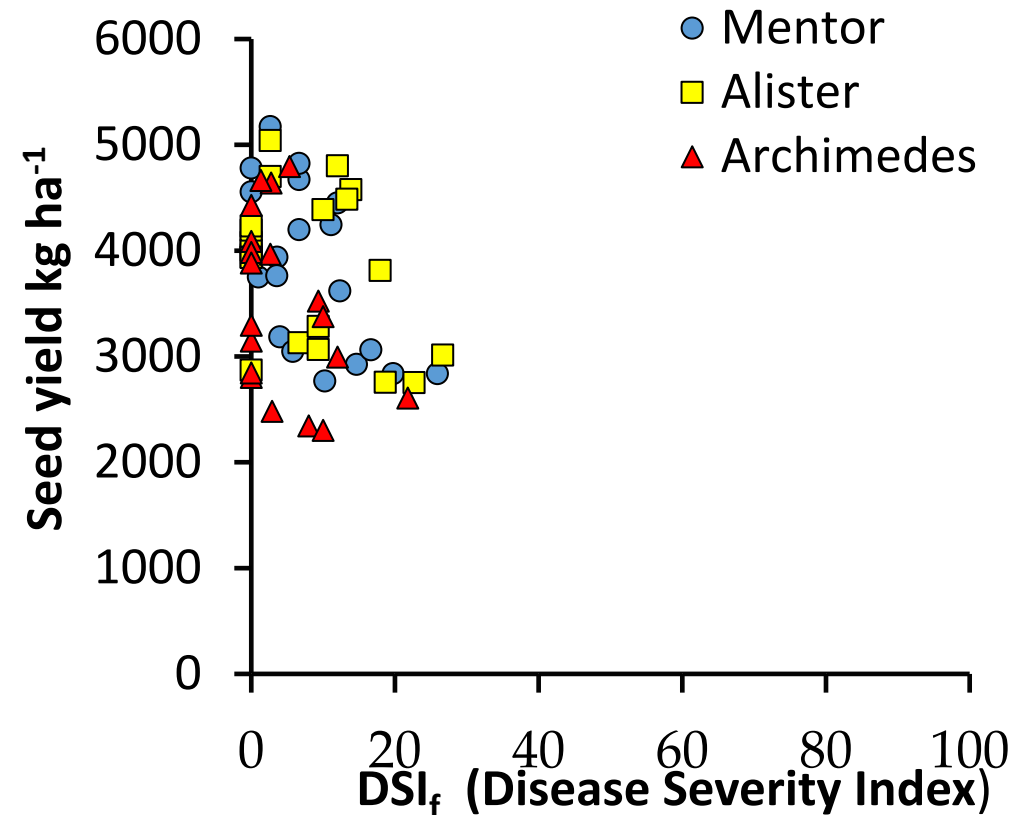
Results



Resistant cultivar

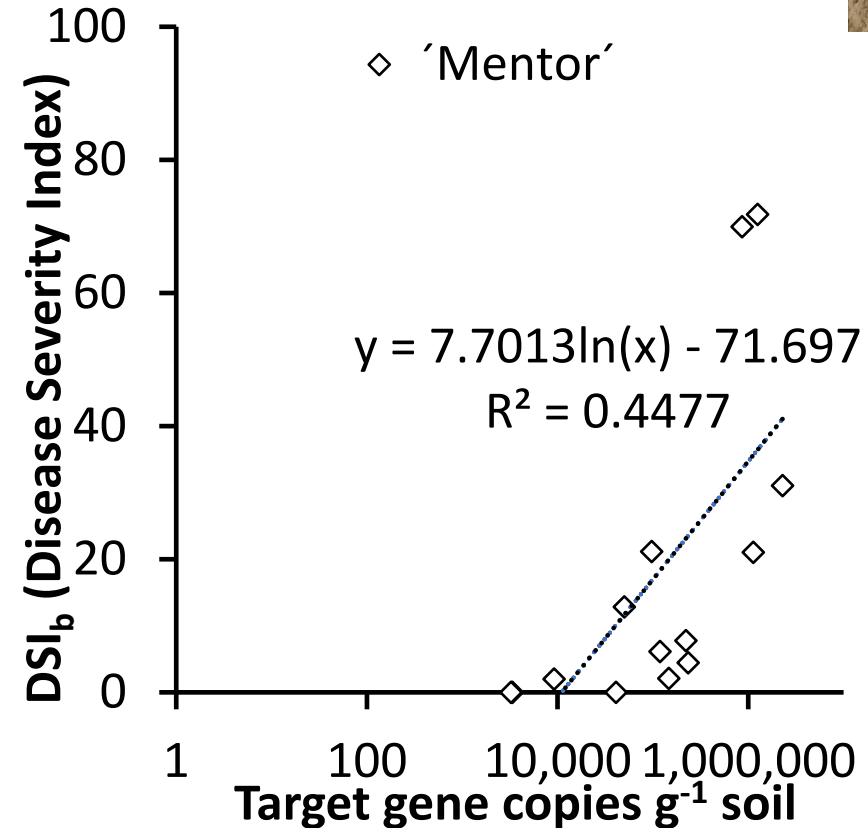
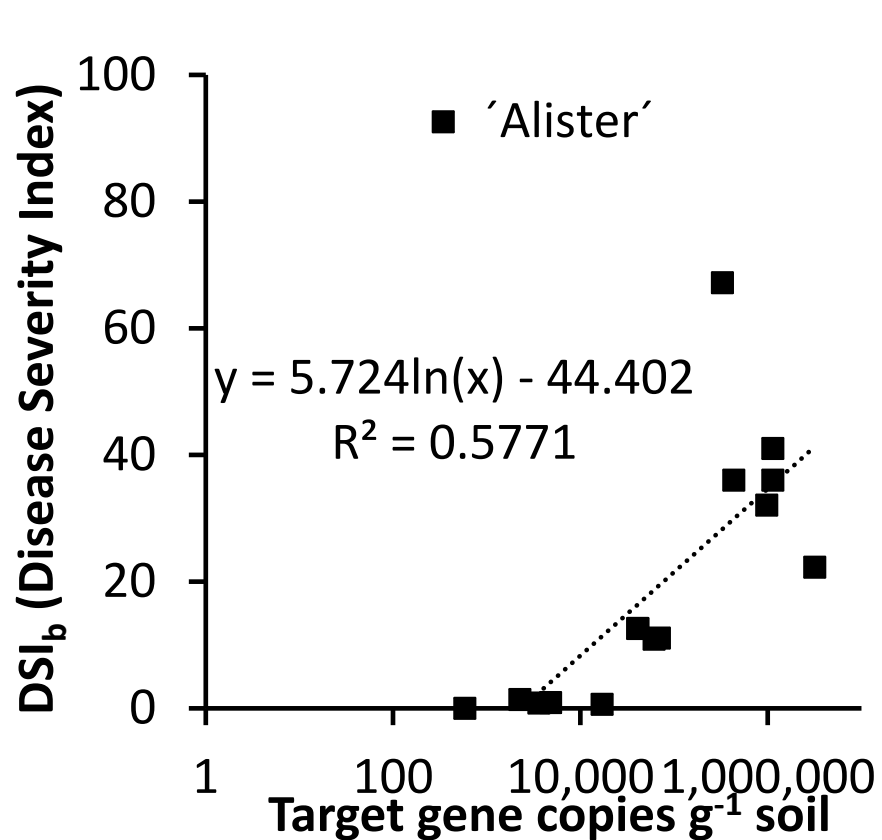
Susceptible 'Cultivar mix'

Correlation between disease severity index (DSI) in the field and seed yield for Cr-resistant cultivars Mentor, Alister and Archimedes sown at five different field sites in 2017 and in 2018



Soil bioassays

Relationship between the number of gene copies per g soil and DSI in soil sampled from field plots (n=4)



IPM approach

1. Proactive soil sampling and DNA-analysis



2. Interpret analysis report

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Phone: +46 40 6928001

REPORT
Issued by an Accredited Test Laboratory

Customer: Sveriges Lantbruksuniversitet
David Widmark
Saleby Lanna Försöksgård
531 93 Lidköping

Sweden

Order: SE-22-0449
Date Received: 2022-08-08
Date Reported: 2022-08-12
Service Level: Express
Project:

Intertek Sample ID: SE-22-0449-001
Customer Sample ID: D3-2320-2023-001
Sample Batch: Karl Oskar Andersson
Variety: -
External Reference: -
Sample Type: Complex Matrix - Soil

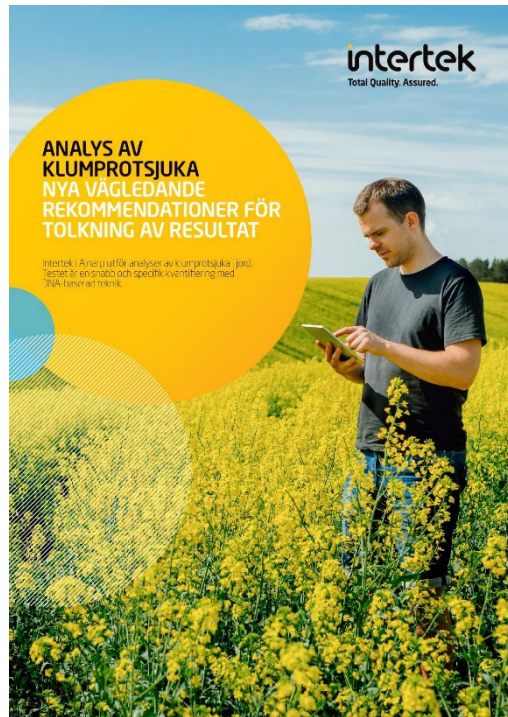
Sample Size Received: 675 g
TKW: -
Sample Size Collected: -
Sample Size Homogenised: All received
Sample Size DNA extracted: 0.35 g
No. of DNA-extractions: 2

Description:

Test ID:	Test Parameter:	Result:	LOD/LOQ:
* PF138 - Plasmodiophora brassicae / Clubroot	Qualitative	Not Detected	500 copies/g

PF138: The test is specific for Plasmodiophora brassicae, a soil pathogen causing Clubroot disease. The Limit of Detection (LOD) is 500 DNA copies/g soil and the Limit of Quantification (LOQ) is 1300 DNA copies/g soil of Plasmodiophora brassicae DNA.

New guidelines 2022



- ✓ Grow a resistant cultivar when *P. brassicae* DNA is detected **>500** gene copies per g soil.
- ✓ Risk for multiplication of the pathogen at **>100 000** gencopies per g soil
- ✓ Resistance at pressure

Wallenhammar et al., 2021, *Pathogens*, 2021,10,433.
<https://doi.org/10.3390/pathogens10040433>

3. Exclude cruciferous species as catch crops and intercrops in OSR-crop rotations

- ✓ Multiplies *P. brassicae*.
Wallenhammar et al., manuscript
- ✓ "Bidge" for black spot (*Alternaria spp*), Phoma stem canker, cabbage fly, cabbage stem flea beetle



Thank you for your attention!



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“Integrated Control in Oilseed Crops: Are we nearly there yet?”

IOBC-WPRS WG ICOC and Clubroot Workshop 2024

Dresden:

- 10–11 September 2024: IOBC-WPRS WG “Integrated Control in Oilseed Crops”
- 12 September 2024: International Clubroot Workshop (ICW)

Location: Technische Universität Dresden, Faculty of Biology

Organizer: Jutta Ludwig-Müller

Contact

Convenor: Małgorzata Jędryczka

SG Entomology Convenor: Sam Cook

SG Pathology Convenor: Małgorzata Jędryczka



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Swedish Association for Plant Pathology organizes



Save the date 3-5 June 2025, Uppsala, Sweden

<http://efpp.2025.com>