# Relating soil-borne and seed-borne inoculum levels to the severity of Verticillium wilt of flax

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## Introduction

- A **vascular disease** caused by the **soil-borne** fungus ***Verticillium dahliae***
- A **broad host range**, including potato and flax
- Survival structures = **microsclerotia** (source of infection)
- Can remain **viable** in the soil or in debris for **20 years**
- **Symptoms: wilting**, early **senescence** and a **metallic blue coloration** of the stems and easily separable fiber bundles from the woody core of the stem, especially during **retting** (Figure 1)
- Reduced **fiber integrity** and **up to 60% yield loss**
- Early symptoms difficult to see. No effective crop protection products and resistance in cultivars is limited

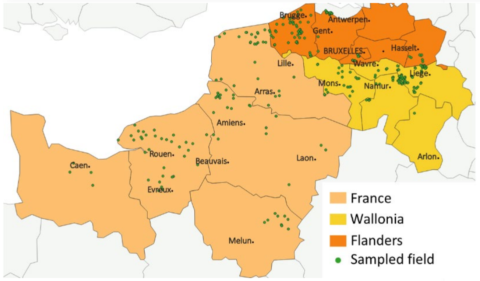

**Figure 1**. Symptoms (A&B) and microsclerotia (C) of *Verticillium dahliae* on flax

- Determining soil and potentially seed inoculum levels before sowing could be a tool in risk management. This is studied as a potential control measure within the **Interreg Pathoflax project**

## Objectives

i. Verify the **relationship between *V. dahliae* microsclerotia in soil** and **Verticillium wilt** under field conditions
ii. Determine whether **seed-borne inoculum** is present

## Soil inoculum density x disease severity




**2020 and 2021**

3 flax-producing Interreg regions: **France-Wallonie-Vlaanderen**

± 50 plots / region / year

≈ 300 field plots (2x2 m) were studied

- **Quantified *V. dahliae*** amount in **soil samples** taken from the small plots at the start of the season using **density flotation to extract the microsclerotia**, in combination with **DNA extraction** and **qPCR.**
- Monitored the **Verticillium wilt** during the **retting period.**
- **No clear correlation** was observed between the amount of *V. dahliae* and the amount of disease (Figure 2).

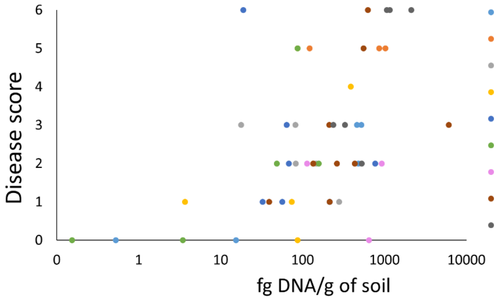



**Figure 2**. Soil inoculum density x disease severity (0–6 scale, in which 0 = no symptoms and 6 = 100 % symptomatic). Colors relate to flax cultivar.

- **Other factors** than soil-borne inoculum such as local climate, cultivar, retting process, contamination of seed, and soil factors (including its microbiome) may play a **role in disease development.**

## Flax seed as a source of inoculum?

- **A method to detect the pathogen in seed batches** was developed based on relatively large samples of seeds:

**Blending of seeds** → **Oil removal** → **DNA extraction** → **qPCR**

- ***V. dahliae* was detected in each of 22 seed batches**. The quantity varied from **11 to 16472 fg/ 100 mg of flax seed** (Figure 3A).
- After rinsing and especially **after surface disinfection** with NaOCl, the quantity of ***V. dahliae* dropped** dramatically (Figure 3B).

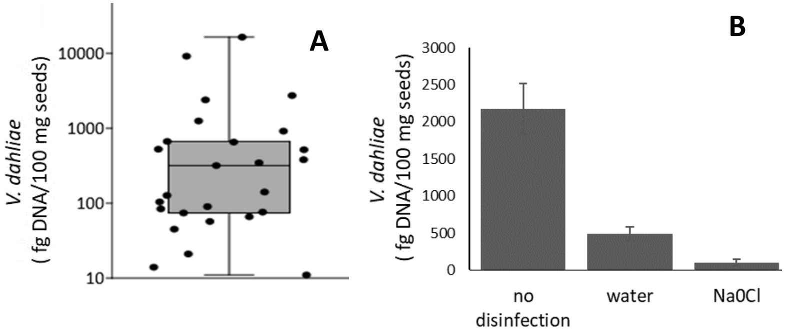



**Figure 3**. Quantity of *V. dahliae* in seed batches, with (A) and without (B) seed treatment

- This suggests ***V. dahliae* is seed-borne, but present externally on the seed**, presumably due to co-harvested pathogen-containing stem debris.
- The contamination of the seed batches points to a **potential additional source of inoculum**. However, the exact role of this seed contamination in disease development is still unclear.

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