

UNION EUROPÉENNE

PATHOFLAX

AVEC LE SOUTIEN DU FONDS EUROPÉEN DE DÉVELOPPEMENT RÉGIONAL MET STEUN VAN HET EUROPEES FONDS VOOR REGIONALE ONTWIKKELING





05-02-2020 Lies Willaert Inagro

PATHOFLAX

Development of sustainable control strategies for Verticillium on flax

Flax – Linum usitatissimum

- 2 types of flax are cultivated
 - fibre production (fibre flax)
 - oil production extracted from the seed (linseed)







> 80% of the world's production of scutched flax fibers are originated from NW-Europe

France: ± 96 000 ha België: ± 15 500 ha Nederland: ± 2 250 ha



Verticillium in flax

- Verticillium dahliae
- Frequency is increasing
- Early infection (microsclerotia in the soil infect the roots of young flax plants)
- Symptoms at the end of the growing season
- Significant yield losses
- No control strategies



Verticillium in flax

Verticillium dahliae

Symptoms

- Discoloration and drying out of the stems at the end of the growing season
- Fragile stems during retting with a blue-gray color







France-Wallonie-Vlaanderen

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Development of sustainable control strategies for Verticillium on flax (1/1/2019- 31/12/2022)

Main objectives:

- conducting an epidemiological study of the fungus in the entire area where fiber flax is grown
- research and implementation of sustainable control strategies based on the stimulation of the plant's natural defenses by means of nonpathogenic antagonistic strains or natural elicitors
- use of the natural biodiversity of flax to identify resistant varieties to this fungus



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Collaboration of 11 partners in France, Flanders and Wallonia, each with their expertise



5 Work Packages



- 1. Project Management (Inagro)
- 2. Communication (Arvalis)
- 3. Monitoring (ILVO)
- 4. Disease Management (UPJV)
- 5. Field trials (FytoFend)



WP3: Monitoring

ILVO, CRA-W, Arvalis, Inagro & UGent

Objectives:

- Evaluation/validation of the diagnostic tests to have at least one validated technique available for the growers in each region
- Monitoring of V. dahliae in the soil to get information about the amount of Verticillium dahliae in the soils of flax fields in the different regions
- Dose-response curve for V. dahliae in the soil
- Detection of V. dahliae in the seed
- Isolation and characterisation of V. dahliae isolates and determination of the genetic variability of V. dahliae in and between fields of the same region and between fields of different regions



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VLAANDEREN BELGIQUE/BELGIË

FRANCE

Evaluation/validation of the diagnostic tests

- Compare 3 diagnostic techniques for Verticillium dahliae detection in soil
- Have at least one validated technique available for the growers in each region





Zonal centrifugation + qPCR



Monitoring

- 50 fields/region/year: sampling & analysis + survey
- Knowledge about the amount of *Verticillium dahliae* in the soils of flax fields in the different regions -> will be presented on a map
- Based on the surveys: regression analyses to determine the links between flax quality or quantity (= response variables) and V. dahliae amount, rotation, soil management, cultivar, etc. (= predictor variables)
- Use this data as a tool to increase awareness among growers





VLAANDEREN

BELGIQUE/BELGI





Dose response

- 1 miniplot/field: soil analysis and scoring of the symptoms (incl. microsclerotia after retting)
- Establish a dose-response curve between the amount of *Verticillium* and the amount of symptoms



Wei et al. (2015) Phytopathology 105:220-229.





Blum et al. (2018) Phytopathology 102:2421-2429.





Detection of Verticillium dahliae in the seed

- Establish whether *Verticillium* can be detected in the seed from infected plants source of spread of Verticillium
- If so, establish whether it is present in or on the seed



Note: a preliminary analysis in 2018 showed the presence in a single batch of commercial seed (based on N_2 grinding of subsamples, DNA extraction, qPCR). It is not known yet whether this is due to internal or external presence.





Isolation & characterisation of Verticillium isolates

- What is genetic diversity among *V. dahliae* isolates from flax fields & from flax?
 - Within field Within the same region Between regions



What is the pathogenic diversity among V. dahliae isolates from flax? Differences in virulence (pathotypes)? Differences in aggressiveness?



Blum et al. (2018) Phytopathology 102:2421-2429.



WP4: Disease management

UPJV, Linea, Terre de lin, Ugent, Fytofend, UNamur

Objectives:

To screen/test in controlled conditions:

- flax varieties for their Verticillium sensitivity and defense stimulation
- biocontrol products (BCPs) for the control of *V. dahliae* in flax



To develop an integrated control strategy to test in field conditions





Verticillium/flax bioassay

- LINEA, Terre de lin, UGent, UPJV
- Tool to test:
 - tolerant flax varieties
 - biocontrol products (BCPs)

Screening of flax varieties

- Currently no flax variety is resistant to Verticillium
- Screening of 50 flax varieties for Verticillium sensitivity and defense stimulation (Terre de Lin, LINEA, Fytofend, UNamur)
- Selecting of most tolerant varieties and varieties with best response on elicitors (activity 3)







Screening of BCP-activity against Verticillium in flax

- Currently no Plant Protection Product (PPP) available to control Verticillium in flax
- Screening of:
 - Antagonistic strains (UGent)
 - a. V. isaacii is able to control V. longisporum in cauliflower
 - b. Cyclic lipopeptide (CLP)-producing Pseudomonas strains
 - Elicitors (Fytofend, UNamur): biopesticides FytoSave® and FytoSol®
 - stimulates plant innate immunity: COS OGA
 COS = chitooligosaccharides => chitosan

OGA = oligogalacturonides => pectin

mimics plant-pathogen interaction

- against a range of diseases among which powdery mildew on various crops (grape, strawberry,...), downy mildew on grape,
- Evaluation of combinations of different flax varieties and BCPs (UPJV)
- Minimal characterization of the working mechanisms of BCPs is necessary (EPPO directive 1/296) for registration of BCPs in flax (UGent, UNamur)



WP5: Field trials

FytoFend, Arvalis, Inagro, ILVO, Linea, Terre de Lin

Objective:

Field trials in fibre flax to define the best method for the integrated control of Verticillium





Varieties



- Currently no flax variety is resistant to Verticillium
- 2 types of field trials will be conducted:
 - Trials with commercially available varieties
 - to be able to correctly assess the differences in Verticillium tolerance of the different varieties
 - Trials with new breeding lines and/or varieties of the INRA collection
 - Selecting varieties that are more resistant than the varieties that are now available for the Belgian and French flax growers



Bio Control Products (BCPs)

- Testing BCPs againt V. dahliae in flax field trials
 - Elicitors (for example FytoSave[®] from FytoFend)
 - Antagonistic strains (provided by Ugent, selected after lab tests)
- Test factors:
 - Different BCPs
 - Time of the treatment (BBCH-stage)
 - Number of treatments
 - Effect of varieties







Demonstration trials

- Last year of the project (2022)
- Validation of the control strategy and demonstration trials:
 - A limited number of varieties for which a positive response to BCP was found
 - Optimum doses of the BCPs
 - Optimum number of applications
 - At the most relevant stage of the crop

Demonstration of sustainable control strategies for Verticillium on flax







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