

Variabiliteit van de *Alternaria*-populatie in aardappel en de gevolgen voor fungicidengevoeligheid: een casestudie voor Vlaanderen

Prof. Geert Haesaert

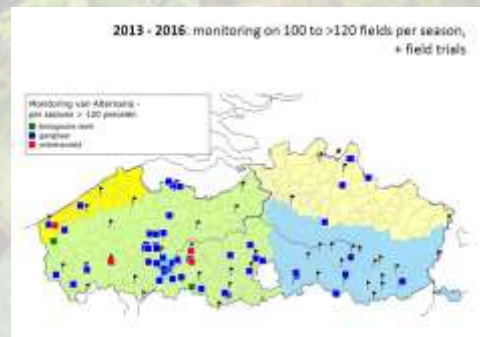
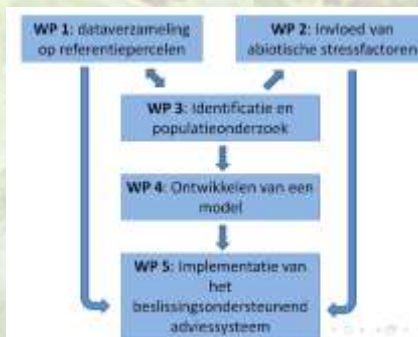
Faculteit Bio-ingenieurswetenschappen

Vakgroep Toegepaste Biowetenschappen

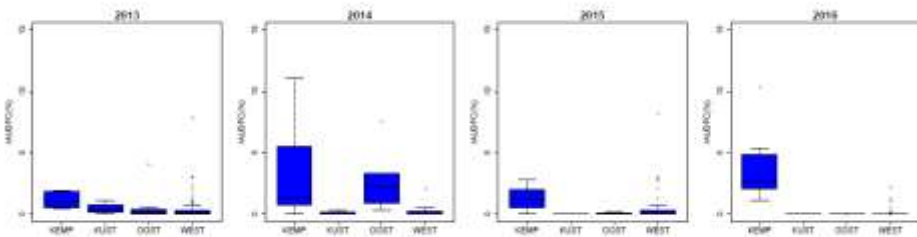
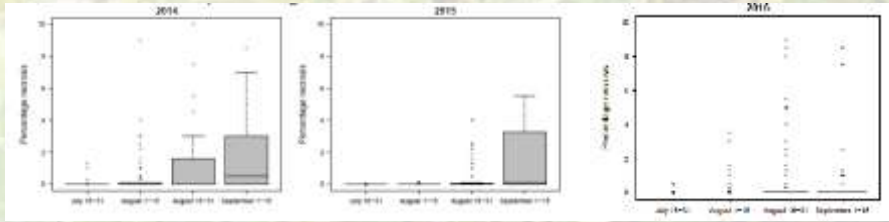


Context onderzoek (1)

- Zes jaar durend project (2013-2018): “Naar een beredeneerde en kennisgestuurde aanpak van *Alternaria* in de aardappelteelt”
 - Monitoring *Alternaria* populatie

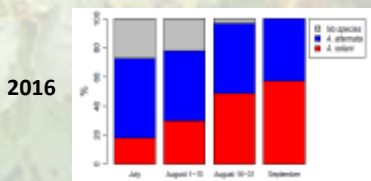
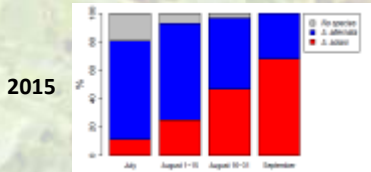


Ziekedruk Alternaria 2013-2016(1)

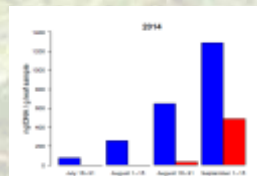


Ziekedruk Alternaria 2013-2016(2)

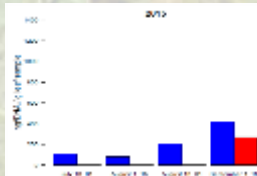
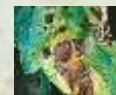
% bladeren



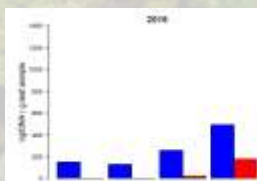
DNA/species



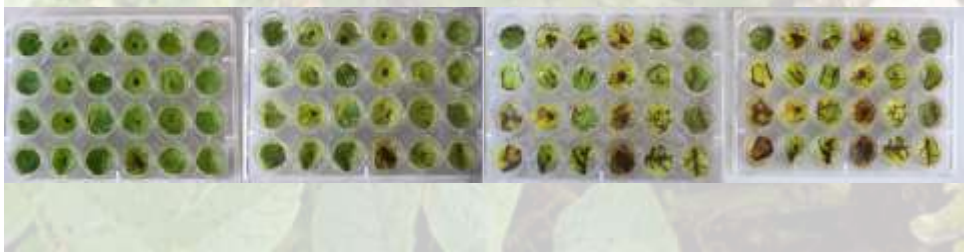
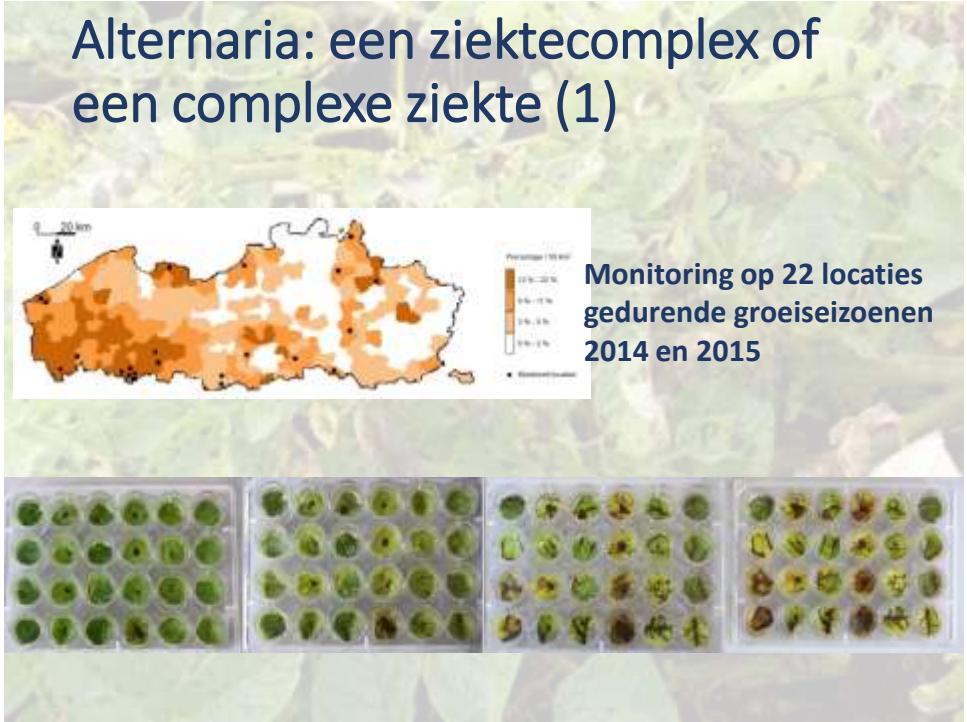
Early blight



Brown spot



Alternaria: een ziektecomplex of een complexe ziekte (1)



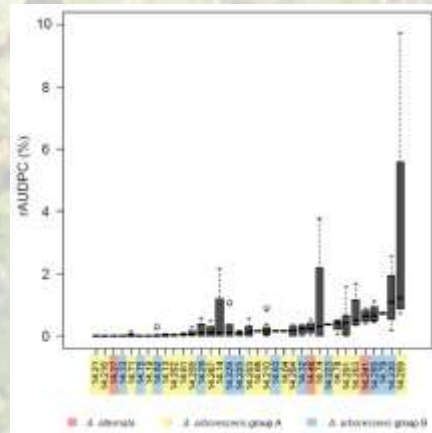
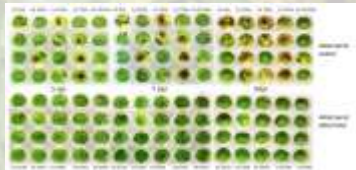
Alternaria: een ziektecomplex of een complexe ziekte (2)



Large-spored species are more virulent



No significant differences in virulence within the small-spored species



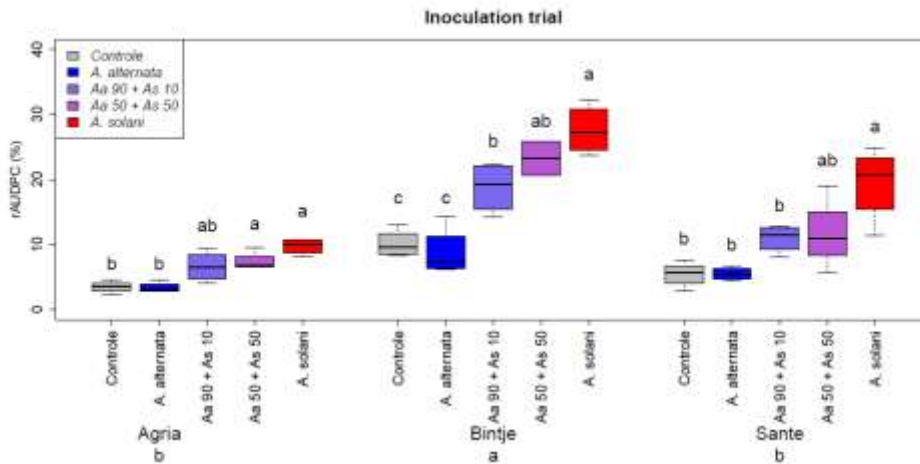
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Pathogeniciteit van *A. alternata* en *A. solani* (1)

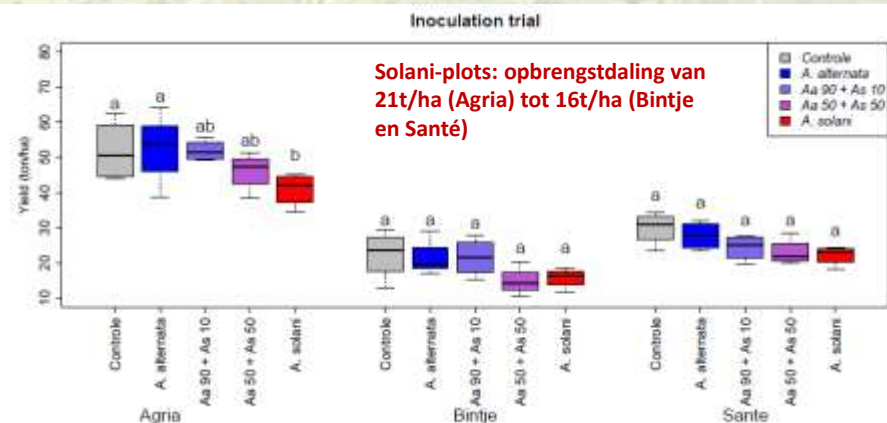
- Groeiseizoen 2015
- 3 rassen: Santé, Agria en Bintje
- Controle, 100% *A. alternata*, *A. solani*/*A. alternata* (10/90), *A. solani*/*A. alternata* (50/50) en *A. solani* (100%)
- Artificiële infectie met sporenconcentratie van 10^4 sporen/ml (22/07/2015)



Pathogeniciteit van *A. alternata* en *A. solani* (2)



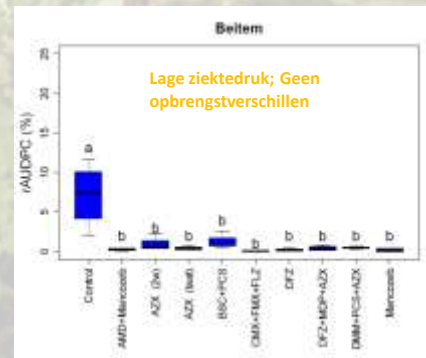
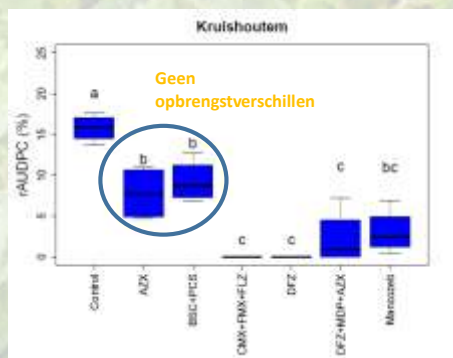
Pathogeniciteit van *A. alternata* en *A. solani* (3)





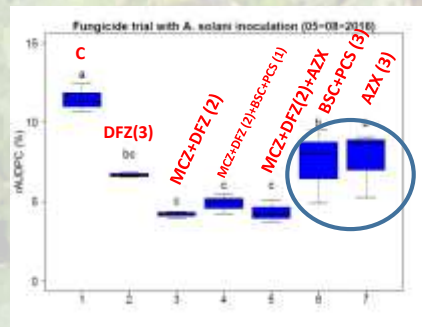
Fungicide proeven - 2015: (1)

- Eerste bespuiting op 29/07/2015; Variëteit Bintje
 - Azoxystrobin (3x) - AZX
 - Pyraclostrobin+boscalid (3x) – BSC+PSC
 - Cymoxanil+famoxadon+fluazinam (8x) – CMX+FMX+FLZ
 - Difenconazole (x3) - DFZ
 - Difenconazole+Mandipropamid+Azoxystrobin (x3) – DFZ+MDP+AZX
 - Mancozeb (8x)



Fungicide proeven - 2016 (2)

- Bintje – artificeel geïnfecteerd met *A. solani*
- Difenconazole (x3) – DFZ
- Pyraclostrobin+boscalid - BSC+PCS
- Azoxystrobin – AZX
- Mancozeb



In vitro testen fungiciden (1)

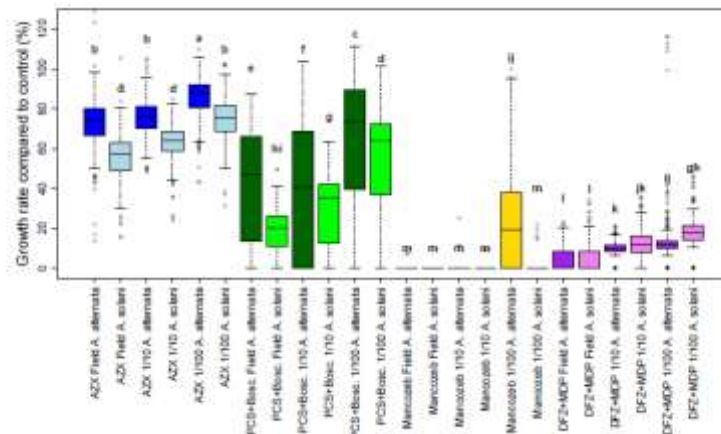
- Efficacy mycelium growth
 - 229 *A. alternata* en 77 *A. solani* isolaten
 - Velddosis, 1/10 en 1/100 van velddosis

- **Amistar** (Azoxystrobin) (Field dose: 0.25 l/ha i.e. 835 µl/l)
- **Terminett** (Pyraclostrobin + Boscalid) (Field dose: 0.20 kg/ha i.e. 670 mg/l)
- **Dithane** (Mancozeb) (Field dose: 1.2 kg/ha i.e. 5330 mg/l)
- **Carial Star** (Difenoconazole + Mandipropamid) (Field dose: 0.6 l/ha i.e. 2000 µl/l)



In vitro testen fungiciden (2)

- Effect op mycelium groei



In vitro testen fungiciden (3)

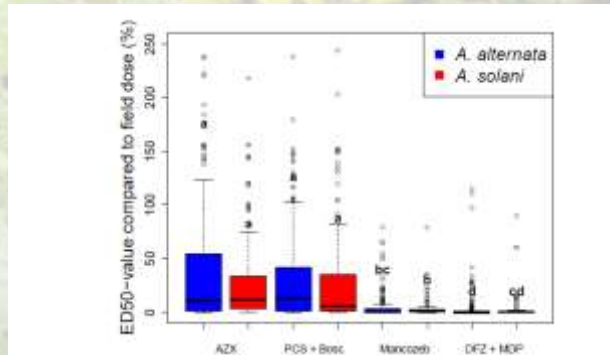
- Effect op sporenkieming
 - 229 *A. alternata* en 77 *A. solani* isolaten
 - ED₅₀: Fotospectrometrie

- Amistar (Azoxystrobin) + SHAM
- Terminett (Pyraclostrobin + Boscalid)
- Dithane (Mancozeb)
- Carial Star (Difenoconazole + Mandipropamid)



In vitro testen fungiciden (4)

- Effect op sporenkieming



Mutaties in Alternaria populatie (1)

Qol inhibitoren

- ➔ G143A mutatie (in *Cytb eiwit*) bij *A. alternata*



11% (2012, 18 isolates screened)



60% (2013, 47 isolates screened)



62% (2014, 84 isolates screened)



75% (2015, 59 isolates screened)



91% (2016, 35 isolates screened)



Mutaties in *Alternaria* populatie (2)

QoI inhibitoren

- F129L mutatie (in *Cytb eiwit*) bij *A. solani*
- Twee genotypes aanwezig
 - Europees genotype (type 1) met intron in *cyt bc1* gen
 - Amerikaans genotype (type 2) zonder intron



Mutaties in *Alternaria* populatie (3)

QoI inhibitoren

- F129L mutatie (in *Cytb eiwit*) bij *A. solani*

2014: genotype I: 88 %, no F129L mutants
 2014: genotype II: 12 %, 83% F129L mutants

10% mutants in the *A. solani* population (52 isolates screened)



2015: genotype I: 50 %, no F129L mutants
 2015: genotype II: 50 %, 100% F129L mutants

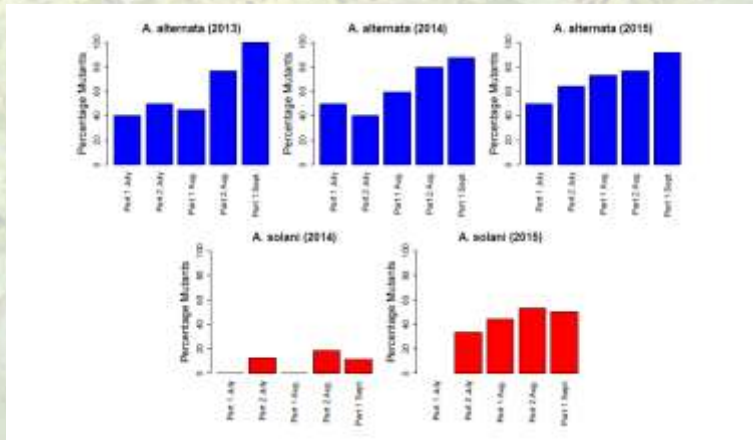
50% mutants in the *A. solani* population (46 isolates screened)

2016: genotype I: 19 %, no F129L mutants
 2016: genotype II: 81 %, 87% F129L mutants

70% mutants in the *A. solani* population (37 isolates screened)

Mutaties in Alternaria populatie (4)

Evolutie van Qol mutanten tijdens groeiseizoen



Mutaties in Alternaria populatie (5)

- Mutaties in diverse subeenheden zijn beschreven
 - Meest voorkomend: H277Y/R, H134R, H133R en D123E) in Succinaat dehydrogenase B, C en D genen

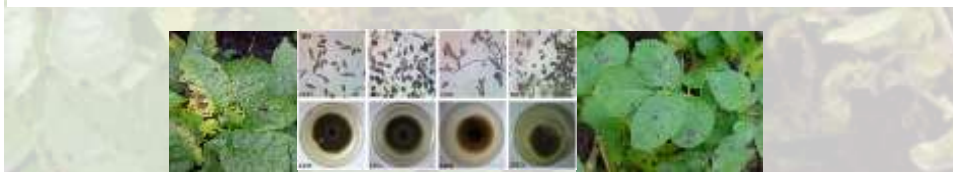
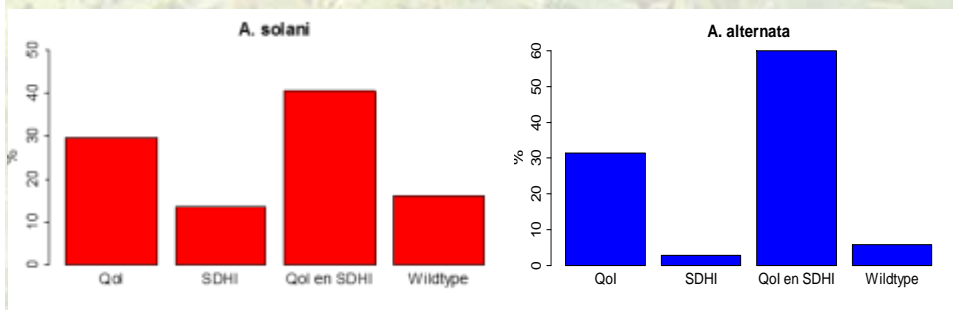


Mutaties in Alternaria populatie (6)

Sdh Subunit	Amino Acid exchange	<i>A. solani</i>			<i>A. alternata</i>		
		2014 (n=41)	2015 (n=42)	2016 (n=37)	2014 (n=20)	2015 (n=33)	2016 (n=35)
SdhB	H277Y/R	5 %	26 %	8 %	22 %	21 %	17 %
SdhC	H143R	22 %	38 %	41 %	6 %	21 %	43 %
SdhB&SdhC	H277Y/R & H143R	37 %	12 %	5 %	0 %	0 %	3 %
SdhD	H133R	0 %	0 %	0 %	0 %	3 %	
SdhB	D123E	0 %	0 %	0 %	0 %	6 %	
Wildtype	-	37 %	24 %	46 %	72 %	49 %	37 %

Mutaties in Alternaria populatie (6)

- Dubbele mutanten

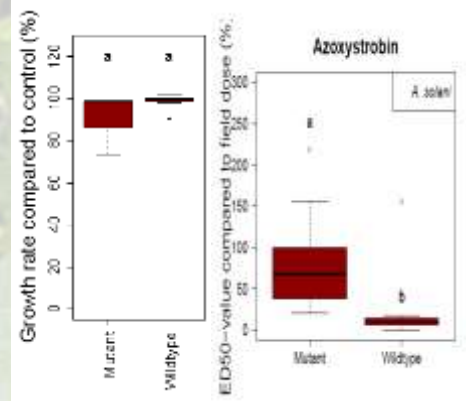
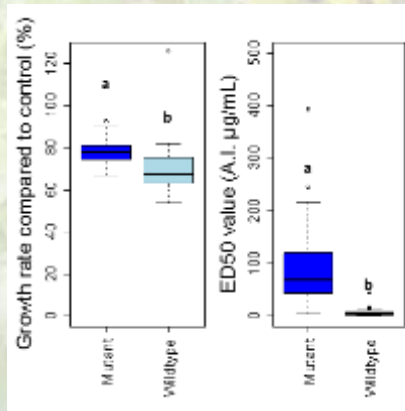


Mutaties in Alternaria populatie (7)

Azoxystrobin: G143A/F129L mutatie

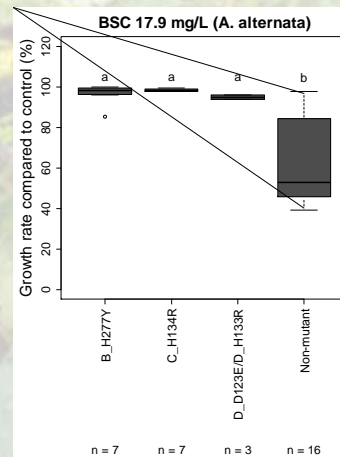
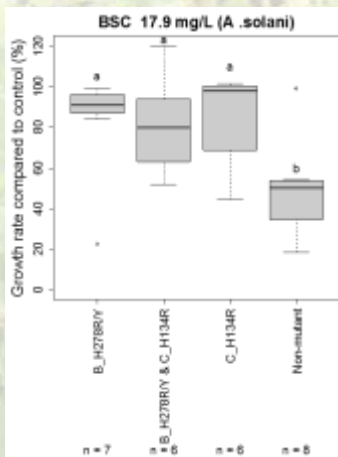
A. Alternata

A. solani



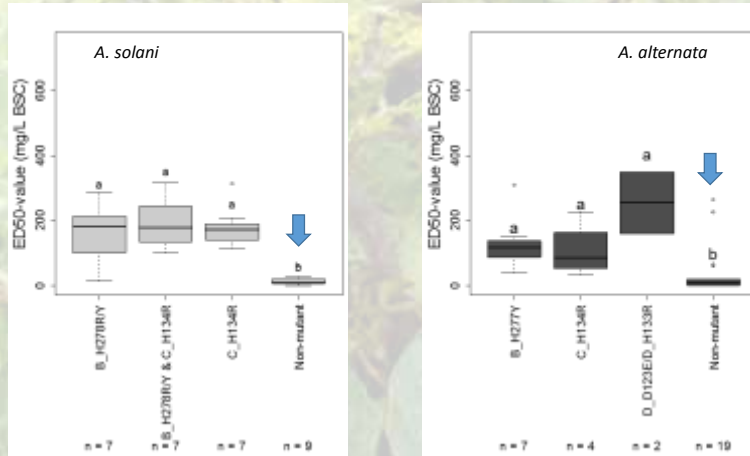
Mutaties in Alternaria populatie (8)

SDHI EN NIET SDHI MUTANTEN: mycelium groei

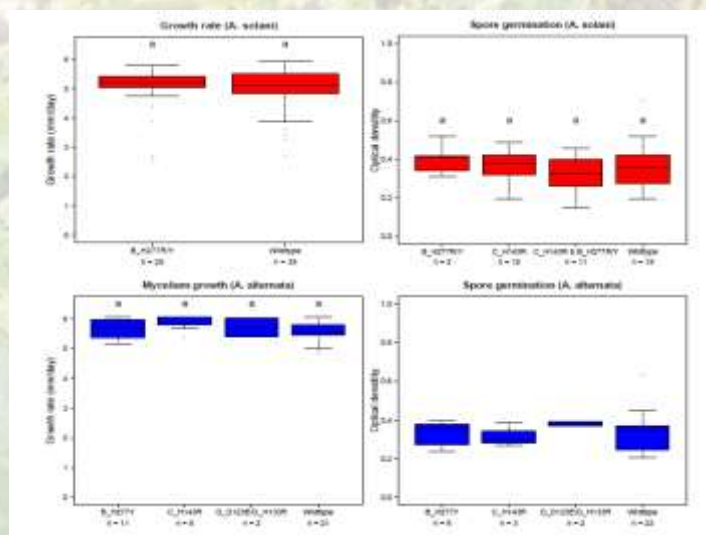


Mutaties in *Alternaria* populatie (9)

VERSCHIL SDHI EN NIET SDHI MUTANTEN: ED₅₀



Fitness cost mutanten?



Besluit

- Na 4 jaar waarnemingen gemiddeld lage ziektedruk van *Alternaria* in Vlaanderen
- Population is meer divers dan gedacht (bv. *A. arborescens*)
- Populatie samenstelling wisselt gedurende groeiseizoen: van *A. alternata* naar *A. solani*
- Mutanten voor Qol en SHDI zijn aanwezig en over 4 jaar is er vooral voor Qol mutanten een duidelijke selectie gebeurd

- Landschoot S., Vandecasteele M., Carrette J., De Baets B., Höfte M., Audenaert K., Haesaert G. Assessing the Belgian potato *Alternaria* population for sensitivity to fungicides with diverse modes of action. 2017. European Journal of Plant Pathology, in press.
- Landschoot S., Vandecasteele M., De Baets B., Höfte M., Audenaert K., Haesaert G. Identification of *A. arborescens*, *A. grandis* and *A. protenta* as new members of the European *Alternaria* population on potato. 2017. Fungal Biology, in press.
- Landschoot S., Carrette J., Vandecasteele M., De Baets B., Höfte M., Audenaert K., Haesaert G. Boscalid-resistance in *Alternaria alternata* and *Alternaria solani* populations: An emerging problem in Europe. 2017. Crop Protection 92, 49-59.
- Landschoot S., De Reu J., Audenaert K., Vanhaverbeke P., Haesaert G., De Baets B., Waegeman W. Potentials and limitations of existing forecasting models for *Alternaria* on potatoes: challenges for model improvement. 2017. Potato Research. Under review.
- Vandecasteele M., Landschoot S., Carrette J., Verwaeren J., Höfte M., Audenaert K., Haesaert G. Prevalence and disease progression studies demonstrate a seasonal shift in the *Alternaria* population structure on potato. 2017. Submitted

