

Epidemic fitness of *Phytophthora infestans* in foliage foliage and tubers as related to future developments developments of aggressiveness

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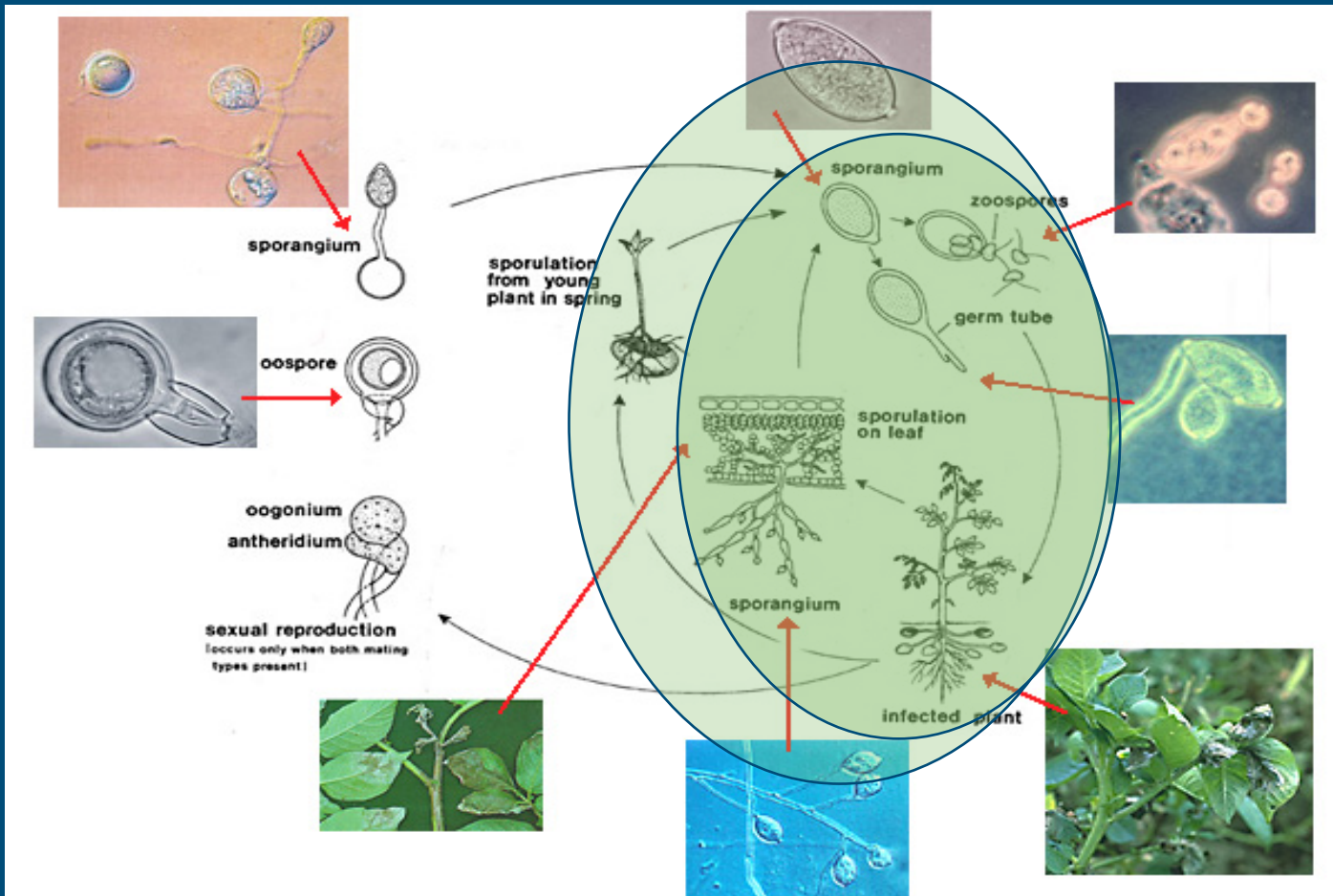


Outline

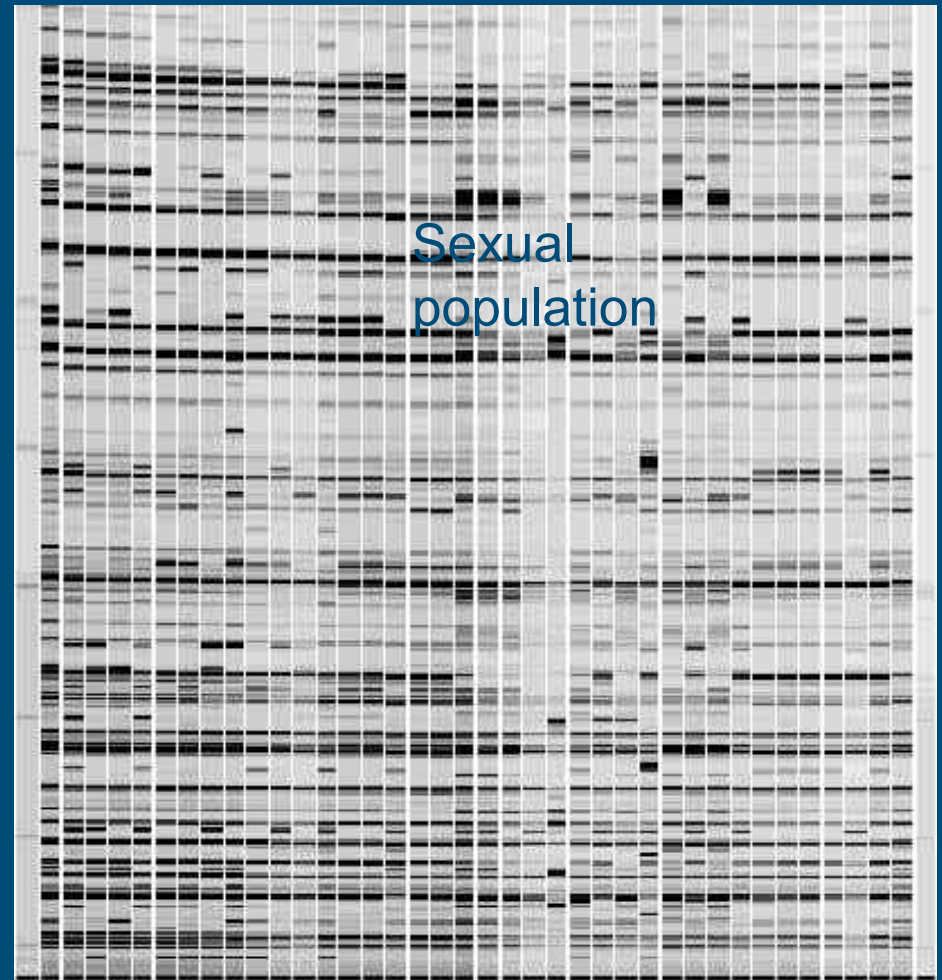
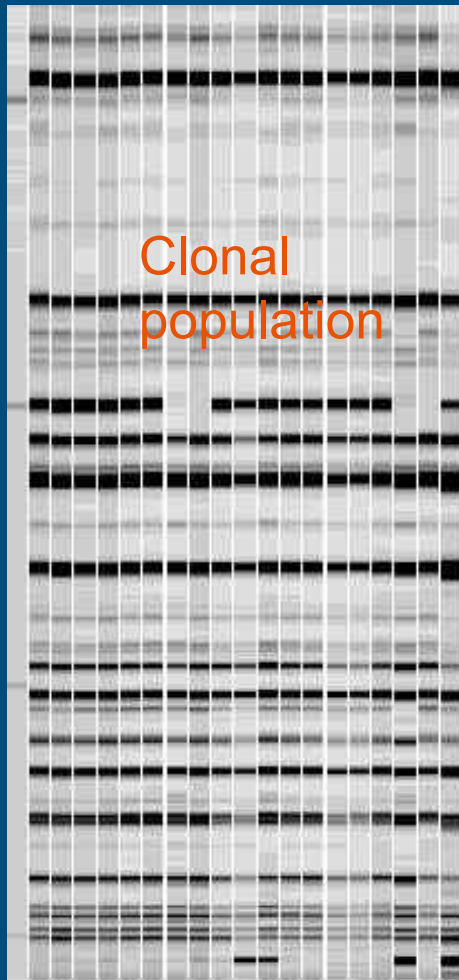
- Introduction
- Goals
- Laboratory experiments
 - Aggressiveness to foliage
 - Aggressiveness to tubers
- Field experiments
 - Setup
 - Foliar epidemic
 - Tuber infection
- Discussion and conclusions



Introduction



Introduction



Goals

- Optimal set(s) of fitness parameters for survival of *P. infestans* in summer and winter?
- Trade off's between summer and winter survival?
- Estimate optimal parameter set(s) for summer AND winter survival

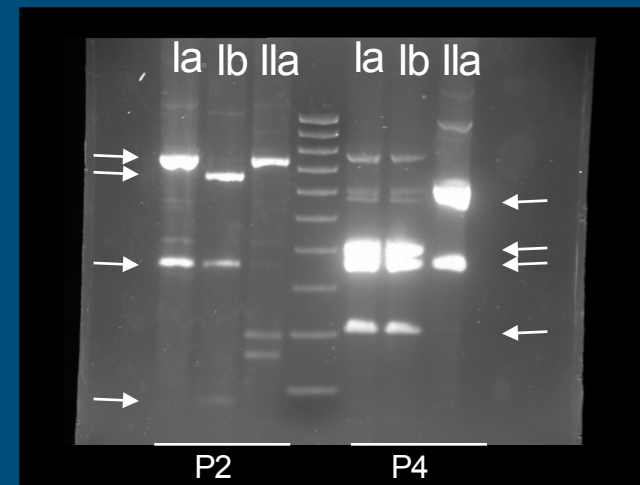
Potato cultivars and resistance levels

Cultivar	Foliar resistance rating	Tuber resistance rating
Karakter (Starch)	6	5
Mondial (Ware)	4.5	5.5
Remarka (Ware)	6.5	8.5

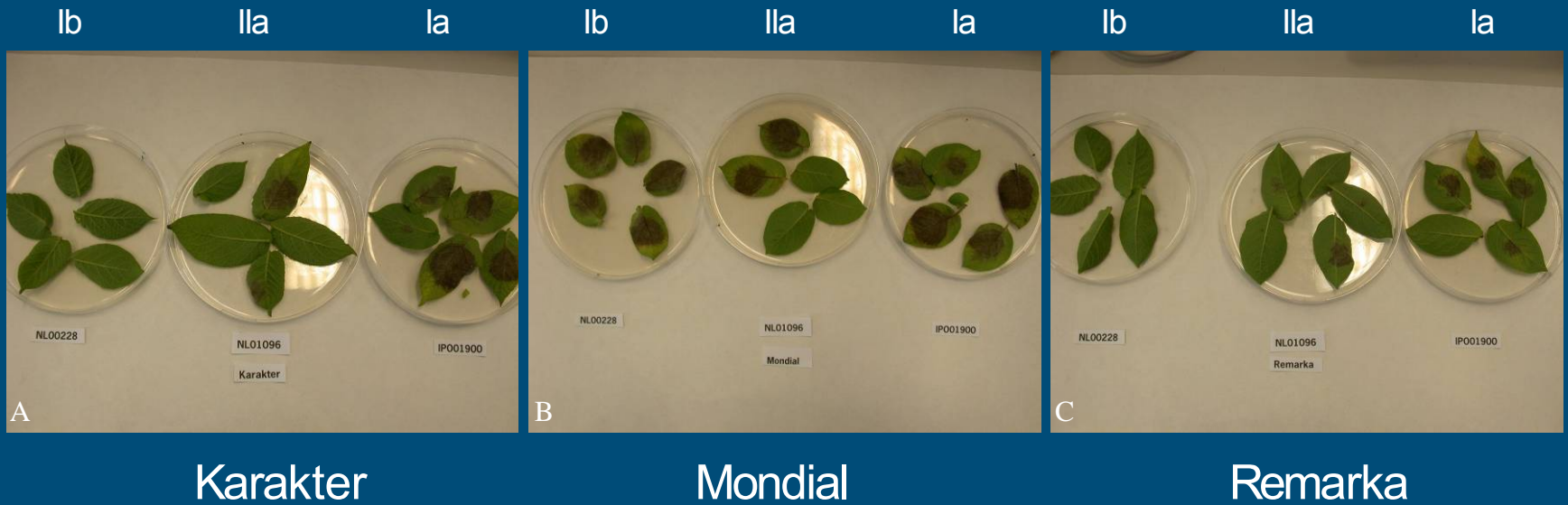


P. infestans isolates and characteristics

Isolate	Location	Host	Year	Haplo type	Mating type
NL00228	Dinteloord	<i>S. tuberosum</i>	2000	lb	A2
NL01096	Katshaar	<i>S. tuberosum</i>	2001	lla	A2
NL01900	Wageningen	<i>S. sisymbriifolium</i>	2001	la	A1



Differential interaction between cultivars & isolates



Karakter

Mondial

Remarka

Laboratory experiments

- Infection experiments on foliage
 - IE, LP, LGR & SPOR
- Infection experiments on tubers
 - IE_{tuber} & LGR_{tuber}



Infection experiments on foliage

	Karakter	Remarka	Mondial
IE [-]			
la	0.029	0.008	0.036
lla	0.008	0.008	0.023
lb	0.003	0	0.02
LGR [mm/ dag]			
la	3.8	2.5	3.7
lla	3.6	2.7	3.2
lb	2.1	0.2	3.7
SPOR [sp/ mm²]			
la	206	89	217
lla	143	101	208
lb	113	0	164
LP [dagen]			
la	5.1	6.1	5
lla	5.2	5.2	4.7
lb	7.4	>10*	4.6
R₀ [-]			
la	1158	133	1543
lla	231	167	920
lb	63	0	635
r [dag⁻¹]			
la	0.75	0.39	0.78
lla	0.55	0.45	0.68
lb	0.27	0	0.71

Skelsey et al 2005:

$$R_0 = \sigma \delta i \pi R^2$$

$$r \approx \frac{\ln(\sigma \delta i \pi R^2)}{\lambda + \frac{2}{3} \frac{R}{\rho_m}}$$

Infection experiments on tubers

- IE_{tuber} on intact tuber eyes: (statistically significant cultivar effect)

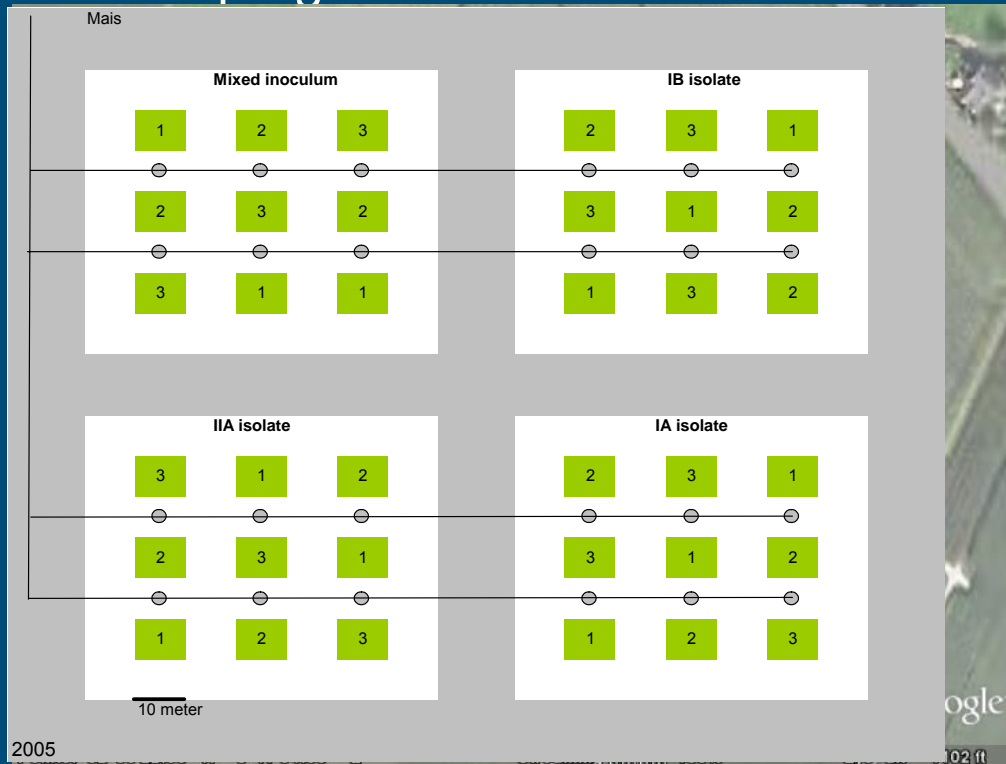
	Karakter (5)	Mondial (5.5)	Remarka (9)
Diseased tubers (%)	2.5 a	26.5 b	2.2 a

- LGR_{tuber} : (statistically significant cultivar* isolate interaction)
(LSD = 1.2)

LGR tuber (mm/ day)	Karakter	Mondial	Remarka
lb	2.2	4.2	3.4
la	1.7	4.9	3.8
lla	5.1	5.6	4.4

Field experiment set up 2005 & 2006

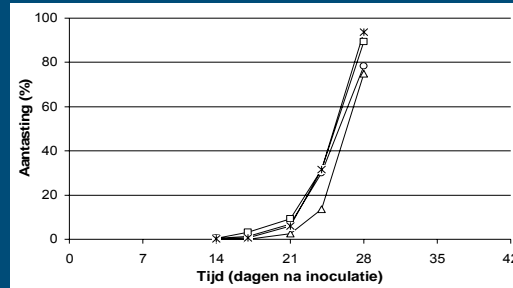
- 4 isolate blocks containing:
 - 3 cultivars
 - 3 replicates
 - 3 Sampling times



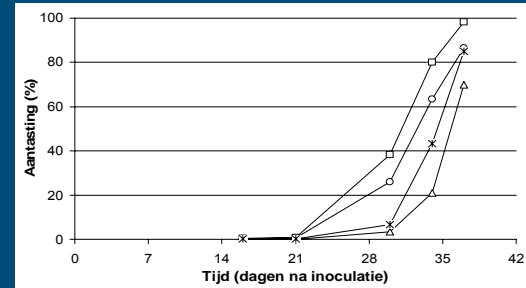
Field experiments, foliar epidemics

Karakter

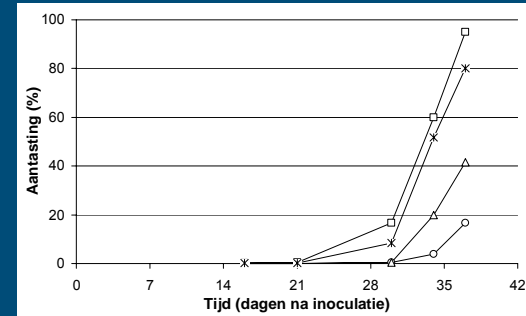
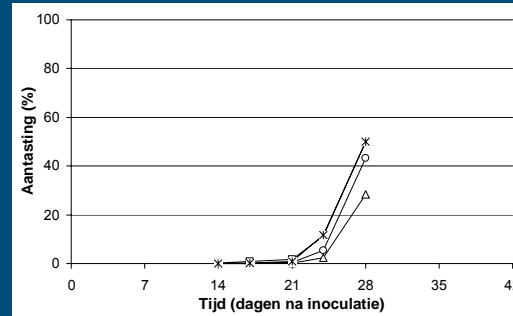
2005



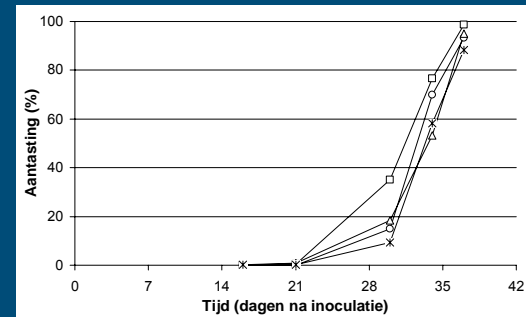
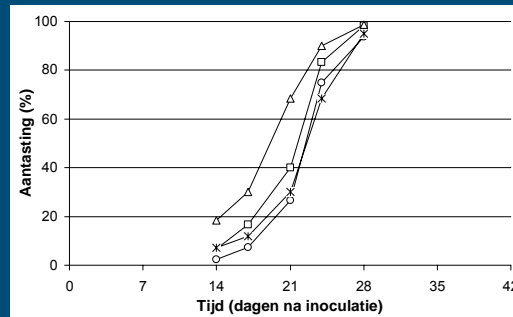
2006



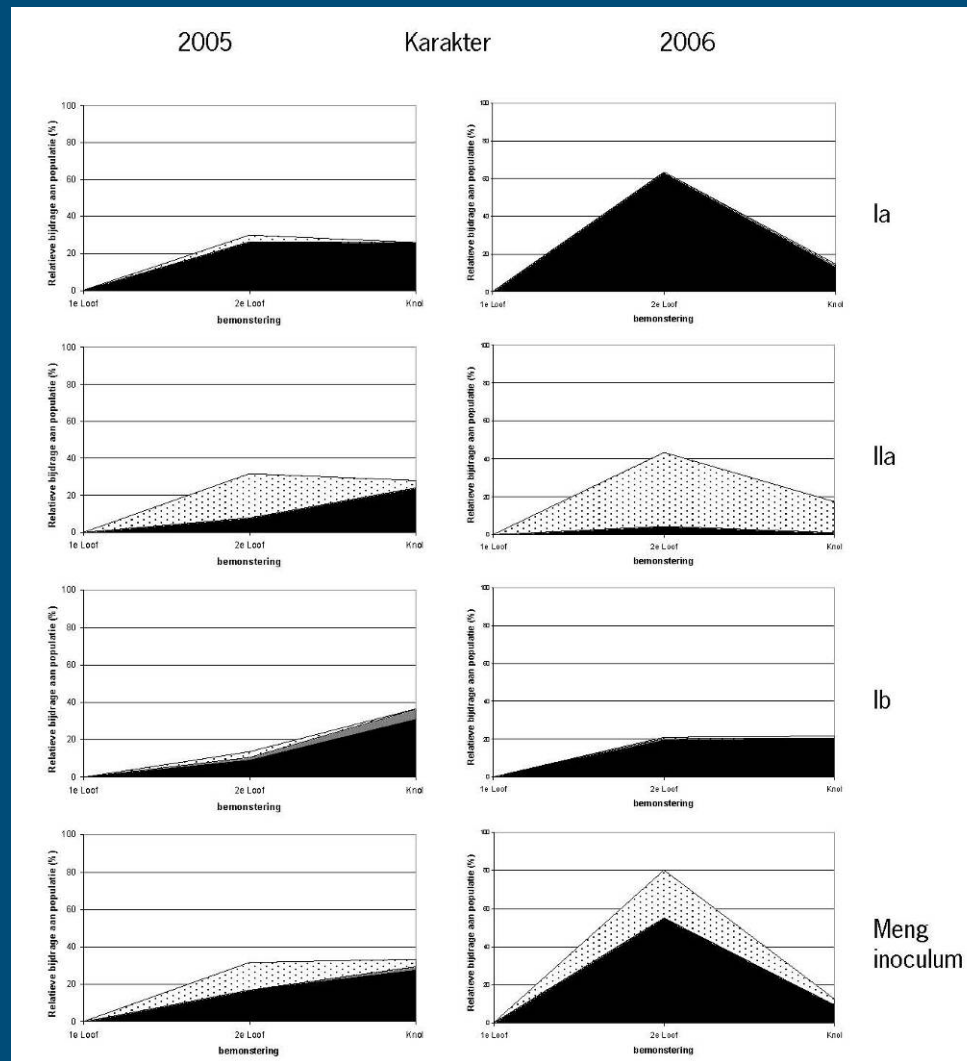
Remarka



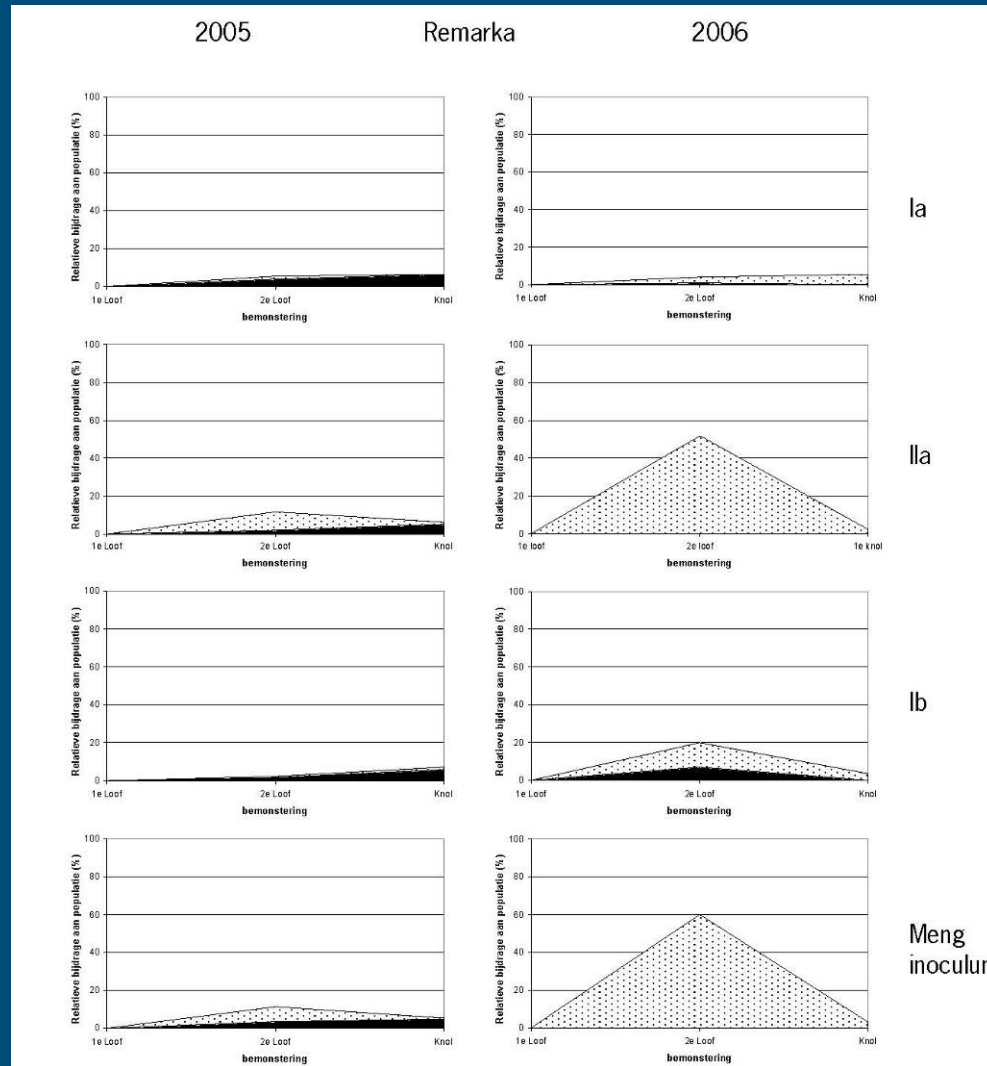
Mondial



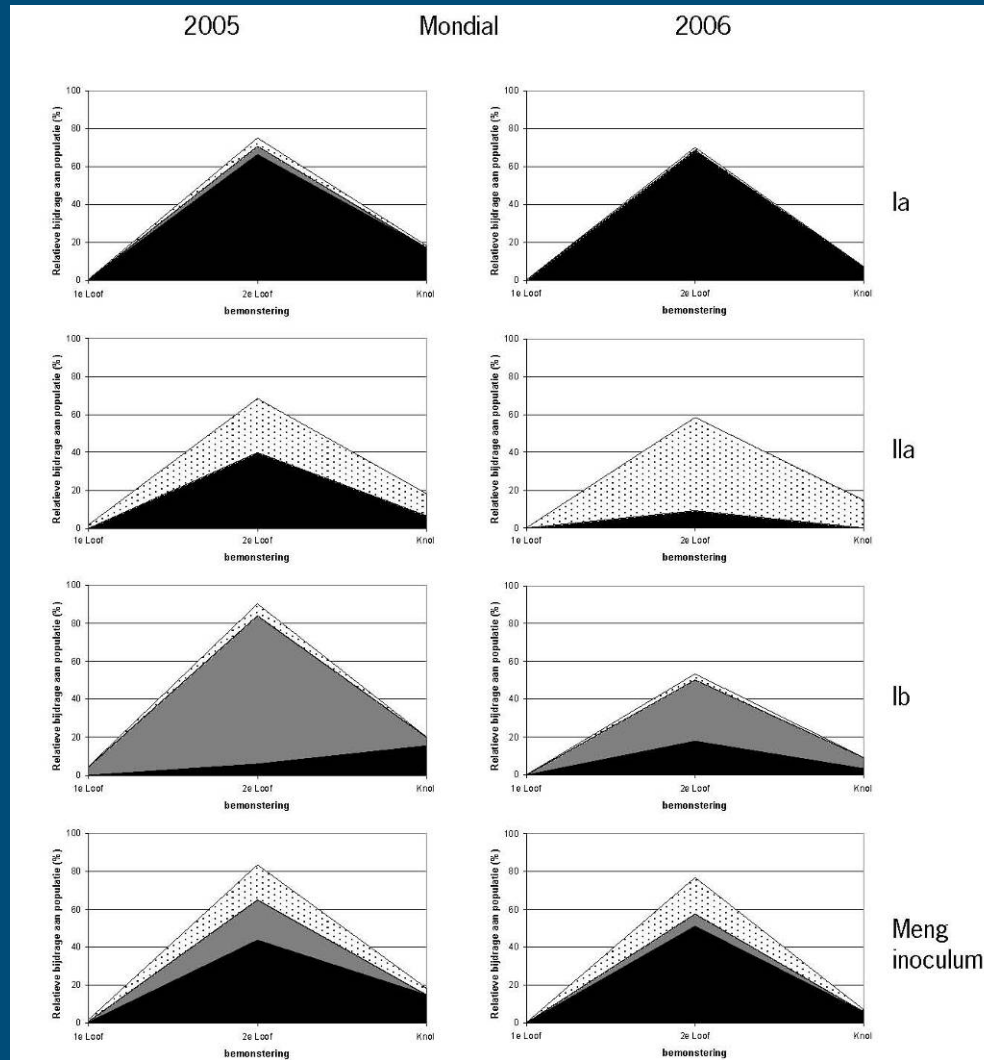
Karakter



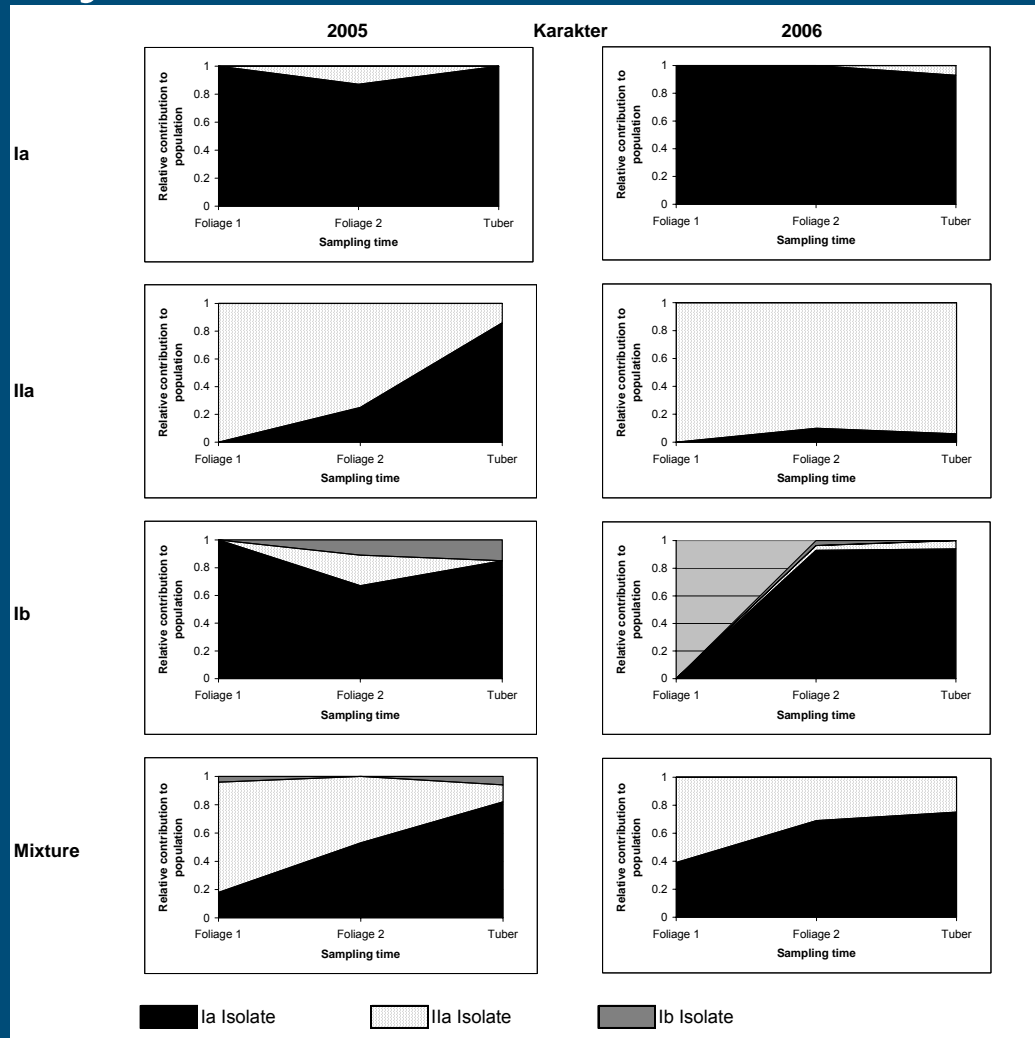
Remarka



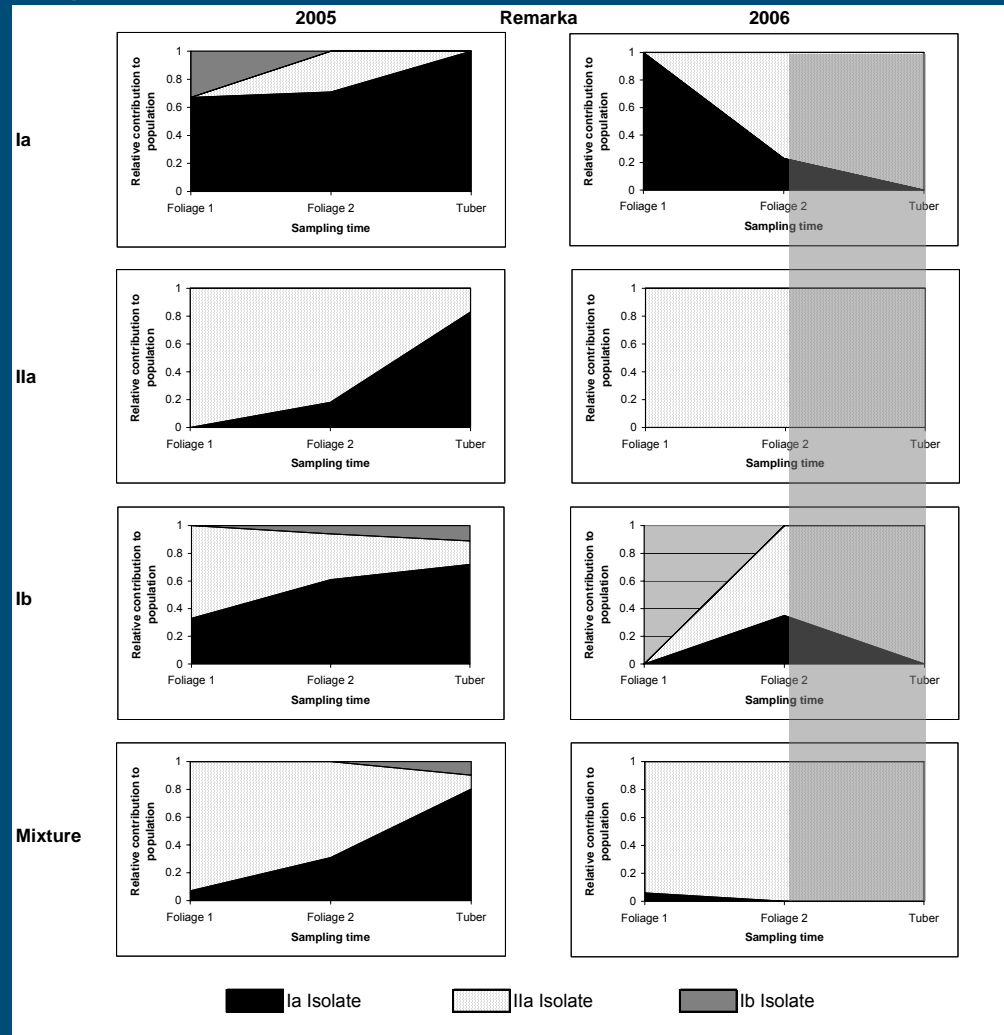
Mondial



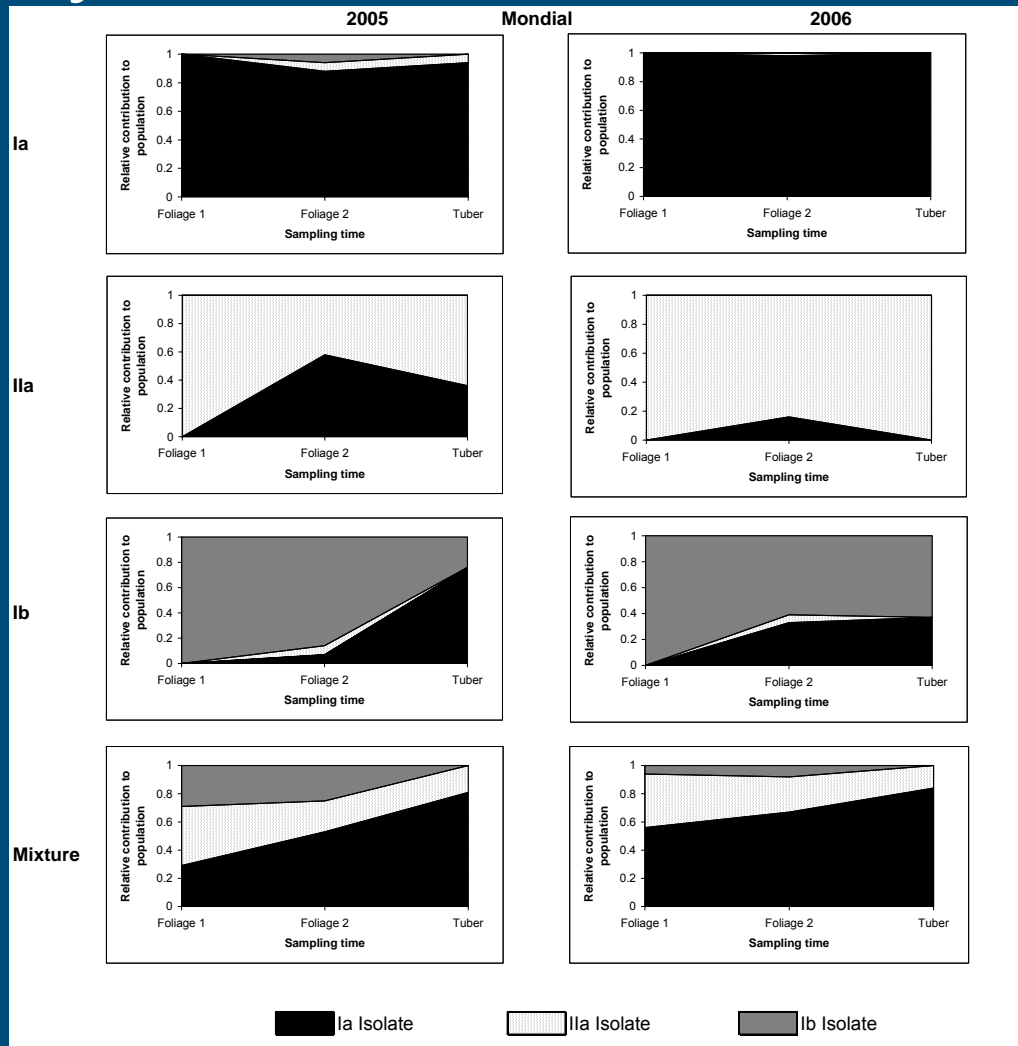
Genotype dynamics on “Karakter”



Genotype dynamics on "Remarka"



Genotype dynamics on “Mondial”



Conclusions

■ Laboratory experiments

- Aggressiveness to foliage (composite parameters R_0 & r)
 - Karakter $Ia > IIa \gg Ib$
 - Remarka $IIa \geq Ia$, Ib non compatible
 - Mondial $Ia \geq IIa = Ib$

- Aggressiveness to tubers
 - IE_{tuber} : Cultivar effect Mondial \gg Karakter = Remarka
 - LGR_{tuber} : Cultivar * Isolate interaction:
 - Karakter $IIa \gg Ia > Ib$
 - Remarka $IIa > Ia > Ib$
 - Mondial $IIa > Ia > Ib$



Conclusions

■ Field experiments

● Foliar epidemic

- Establishment

- Karakter Ila > Ia >> Ib (almost incompatible)
- Remarka Ila > Ia >> Ib (almost incompatible)
- Mondial Ila = Ia > Ib

- Epidemic progress

- Karakter Ia > Ila >> Ib
- Remarka Ia > Ila >> Ib
- Mondial Ia > Ila > Ib

Conclusions

- Field experiments
 - Transition to tubers
 - Karakter Ia > IIa >> Ib
 - Remarka Ia > IIa >> Ib
 - Mondial Ia > IIa >> Ib

Conclusions

- Field experiments (General)
 - Ila better in establishment
 - Ia better in competing for limited space
 - Ia better in transition to tubers
- Overall: Ia isolate better position to survive summer AND winter on all three cultivars
- Transition from tuber to foliage not included in experiments



Conclusions

- Comparison Lab & Field experiments:
 - Foliage
 - Single parameters lab. Exp.'s do not predict competitive outcome (IE difficult and not reliable for establishment)
 - Composite parameters better predictors (epidemic progress)
 - Tubers
 - IE_{tuber} and LGR_{tuber} not good predictors of tuber population
 - Success in foliage is large part of success in tubers !

Overall Conclusions

- Limited set of cultivars and isolates!
 - No trade off between aggressiveness to foliage and aggressiveness to tubers, aggressiveness pays off!
 - within this set of cultivars and isolates
 - without the influence of modern storage regimes
 - Establishment, multiplication and transition to tubers key processes
 - Population dynamics in foliage strongly linked to population population (dynamics) in tubers



Thank you for your attention

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