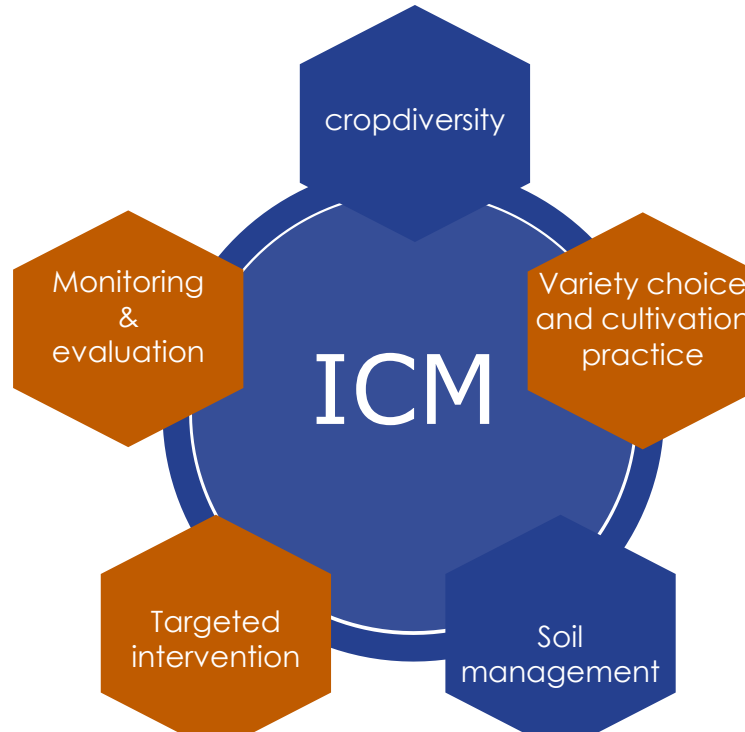


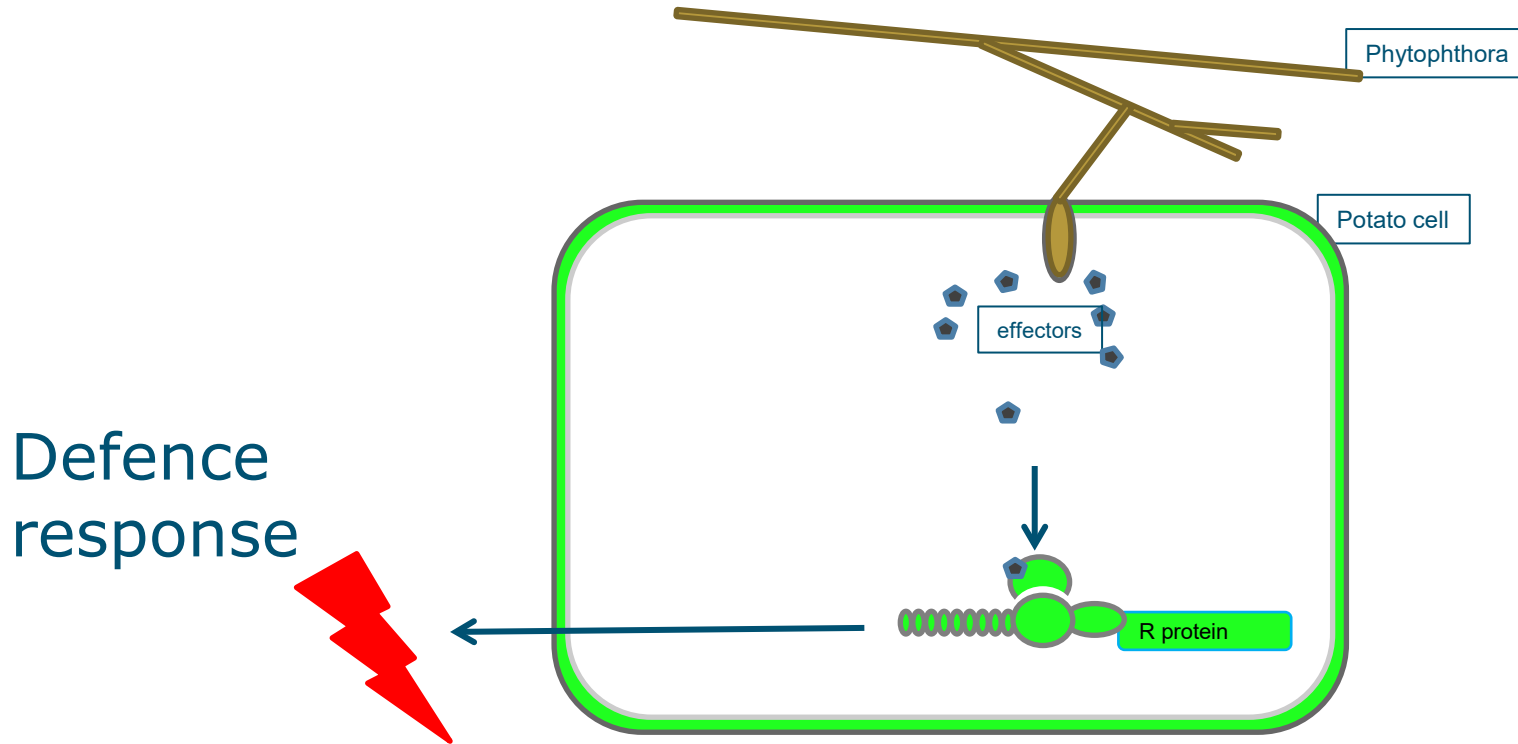
Phytophthora resistance and virulence

Jack Vossen

Euroblight workshop, Lunteren, April 14th 2024



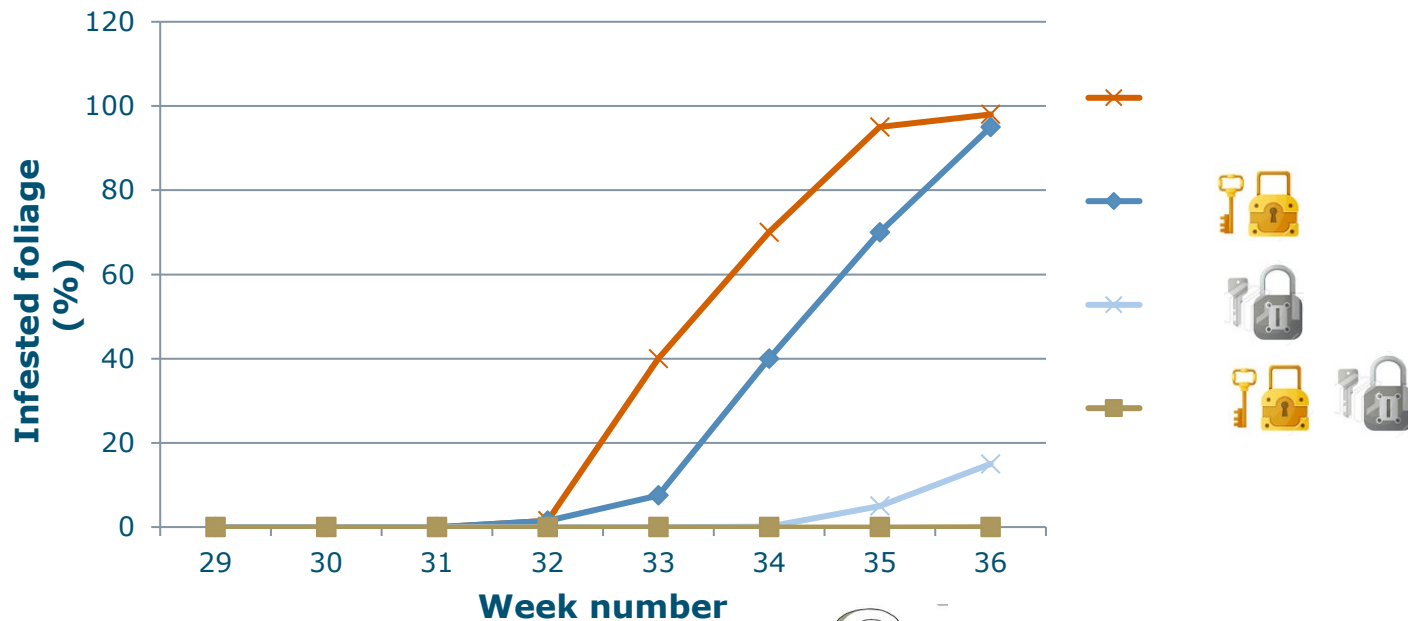
R proteins recognize Phytophthora effectors



Functional groups of *R* genes

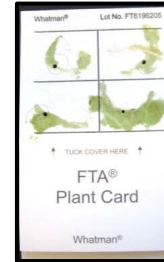
Resistance gene Functional group	Cognate Avr (family)	Varieties with this resistance
R1	Avr1	Nicola
R3a	Avr3a	Innovator
R3b	Avr3b	Innovator
R2, Rpi-abpt	Avr2 family	Innovator
R8, Rpi-smira2	Avr8	Sarpo Mira
R9a, Rpi-edn2	Avr9a family	Avito
Rpi-blb2	Avrblb2 family	Toluca
Rpi-chc1, Rpi-ber1	Avrchc1 family	Carolus
Rpi-vnt1, Rpi-wbr1	Avrvnt1	Alouette
Rpi-cap1	Avrcap1	Oscar

Single vs stacked resistance

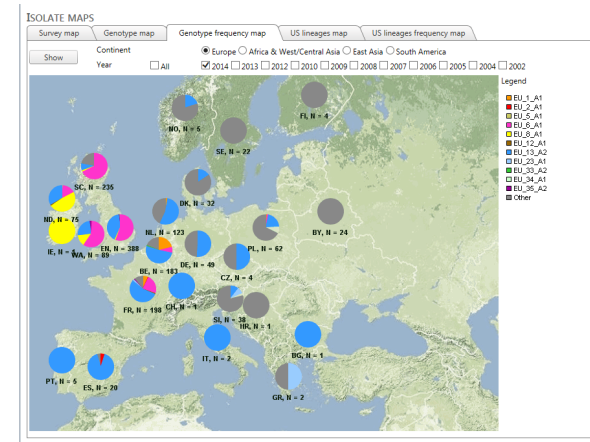
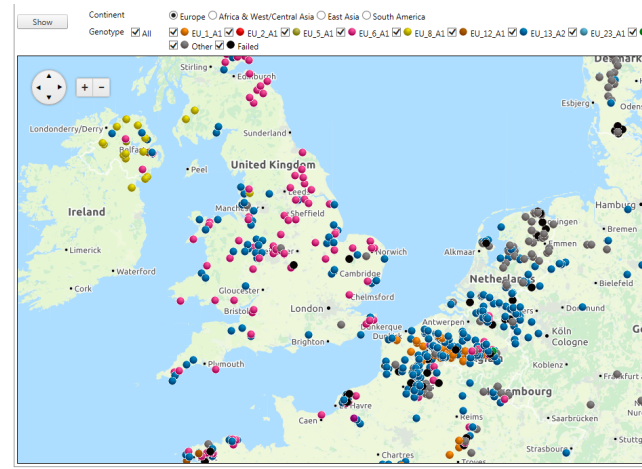


Monitoring of *Phytophthora* populations

Sample collection + SSR typing:



Genotype distribution (2014):



Web site provided by Aarhus University, Faculty of Science and Technology, Department of Agnecology. Report technical problems to webmaster: Equl.Larsen. Optimized for screen size 1280x800

Phytophthora monitoring 2023



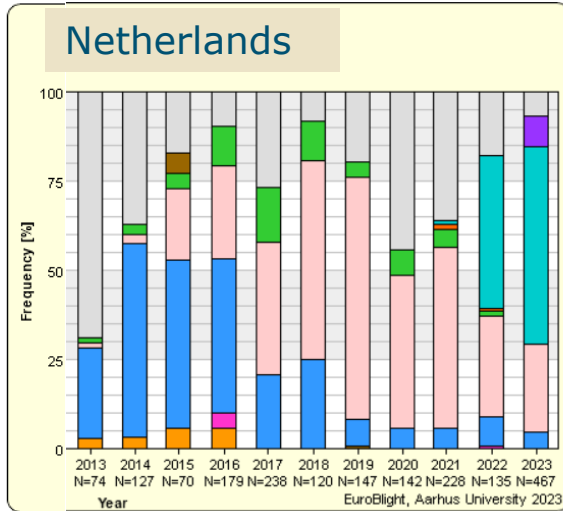
Day 0



Day 5



Virulence profiles of EU groups



	R3a	R3b	R2	blb2	vnt1	ber1	R8	cap1
EU13	v	v	v	a	a	a	a	a
EU36	v	v	a	a	a	a	a	a
EU37	v	v	v	a	a	a	a	a
EU41	v	v	v	a	a	a	a	a
EU43	v	v	a	a	a	a	a	a
EU46	?	v	a	a	a	a	a	a
other	v	var	var	var	var	var	var	var

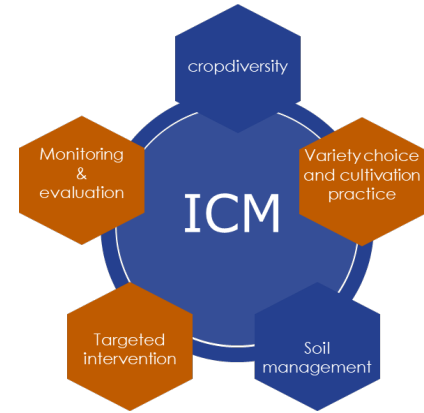
Virulence build-up in major EU groups

Group	aquired virulence	2020	2021	2022	2023
EU36	ber1	-	Fl	NH	NH, Fl, Fr
EU43	R2	-	NB	NB	NB, Fl, Fr
EU43	R2, blb2	-	-	-	NB
Other	R8, R9a	Fr, Fl	Fr, Fl	Fr, Fl	Fr, Fl

NH: Noord Holland
Fr: Friesland
Fl: Flevoland
NB: Noord-Brabant

Conclusions and knowledge gaps

- Isolate analysis (after the growth season) shows the build-up of virulence in the *P. infestans* population
- The current *P. infestans* genotyping system does not detect virulence
- A faster virulence typing system is needed
- Information about resistance in varieties is needed



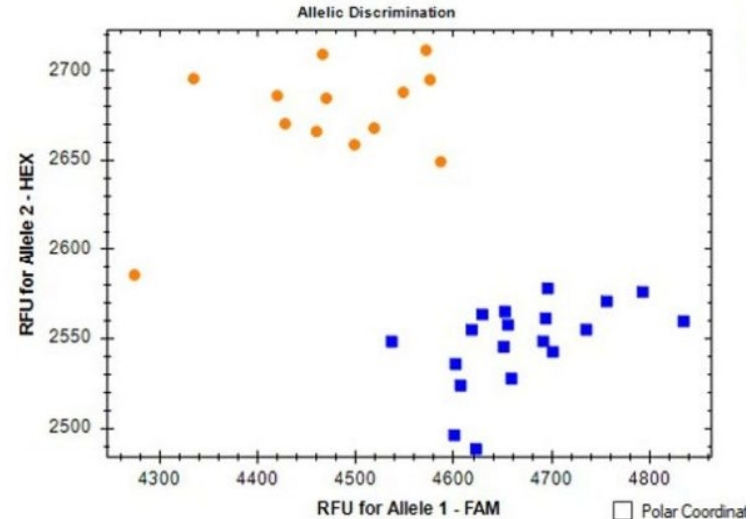
Molecular markers for late blight resistance

	Troughput (markers per experiment)	Price per sample (€)*	Price per marker per sample (€)*	Specificity
Gel based PCR	1	2	2	+++
KASP	30	7	0,23	++
Amplicon sequencing	3000	18	0,006	++

*ex DNA isolation, data processing

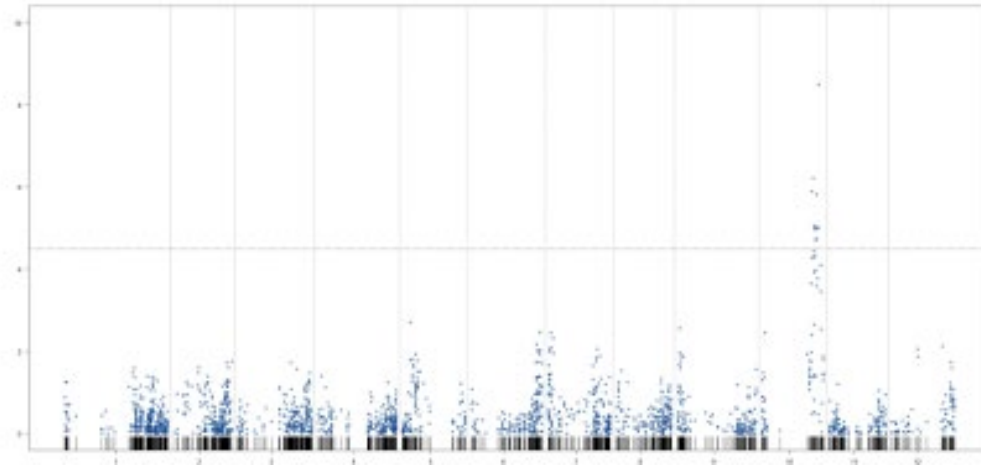
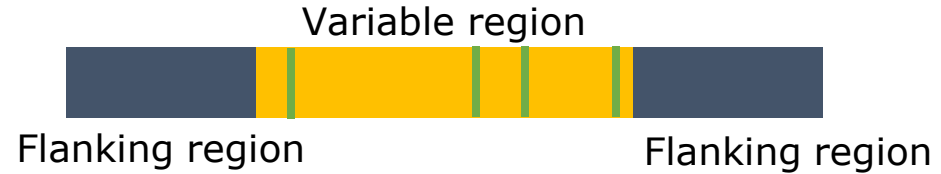
KASP markers produced in “TKI-groene veredeling”

R gene	Solanum source	Example variety
R2	demissum	Innovator
Rpi-blb2	bulbocastanum	Bionica, Toluca
Rpi-vnt1.3	venturii	Alouette
R9a	demissum	Avito
R8	demissum	Sarpo Mira, Cammeo
Rpi-ber1	berthaultii	Carolus
Rpi-cap1	capsicibacatum	Oscar
Rpi-iop1	iopetalum	Breeding clones
Rpi-mtp1	multiinterruptum	Breeding clones



Amplicon sequencing for breeding (SolSeq)

2880 amplicons in PCR multiplex,
Linked to Iontorrent sequencing



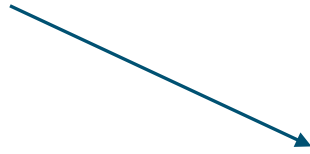
Liveseq

Integrated virulence/resistance monitoring:

- Phytophthora sample collection network (FTA card-like)
 - Amplicon sequencing
 - *R* genes in variety
 - *Avr* genes in *P. infestans*
 - Active compound resistance in *P. infestans*

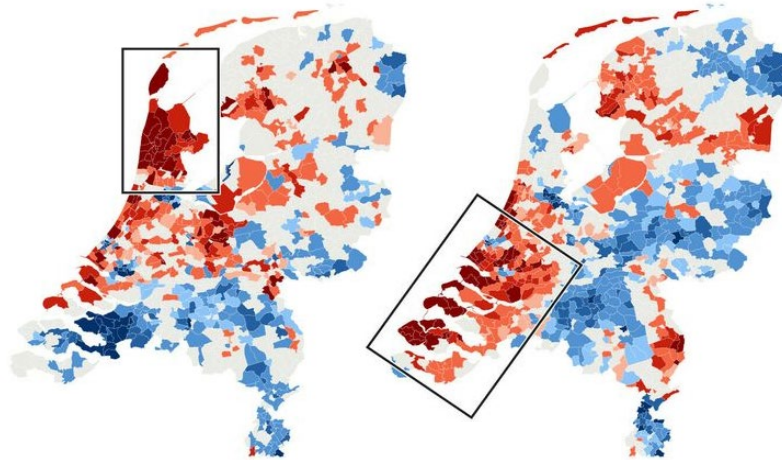
Liveseq monitoring to feed decision support systems

- Growers network for sample collection
- Liveseq



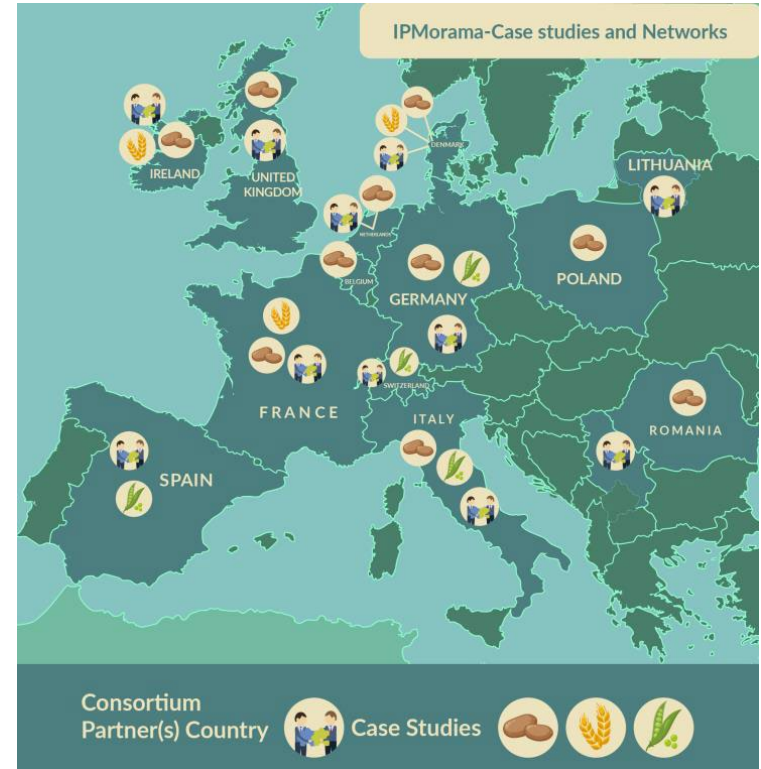
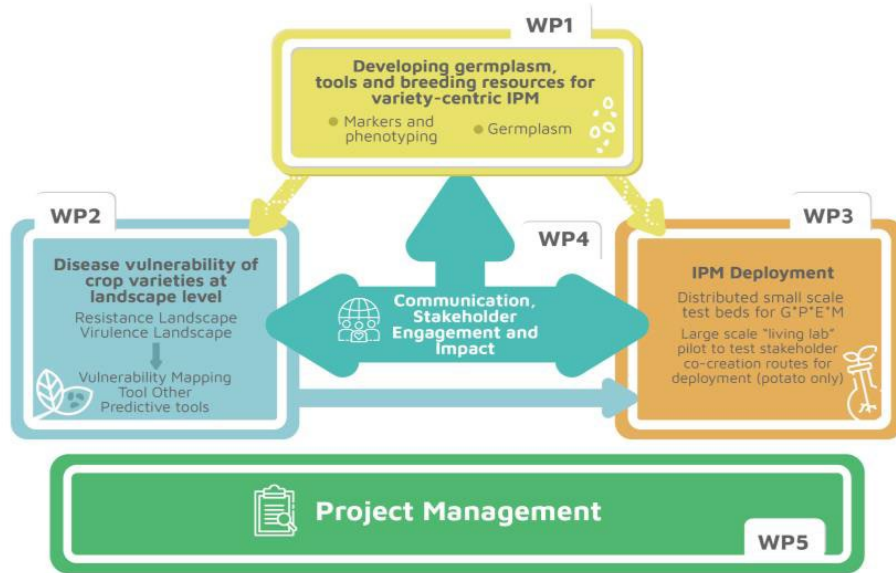
Resistance map

Virulence map



- Vulnerability map
- > Targeted spray advice

IPM-orama, HORIZON-CL6-2023-BIODIV-01-14



Thank you for your attention!



- Geert Kessel
- Trudy van den Bosch
- Elianne Roebbers
- Brian Lavrijssen
- Ronald Hutten
- Christel Engelen