IPM CONFERENCE 2024

Holistic IPM: Reducing pesticide use

BRUSSELS · MAY 14TH

Genetics as factor in holistic IPM

Example late blight in Potato

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Wageningen Research & Delphy

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UNDER GRANT AGREEMENT N. 817617
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P. infestans in potatoes

- Highly destructive
- Highly adaptive
- High fungicide input

P. infestans, resistant variety

- Less destructive
- Highly adaptive
- Low fungicide input
- Manage resistency!!

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Holistic Integrated Pest management (IPM)

The 5 pillars of holistic IPM

Agricultural landscapes with diverse semi-natural habitats
Hedgerows, flowers strips, beetle banks

Cropping systems designed to decrease pest/weed/disease pressure
Crop rotation, cultivars, sowing dates, fertilisation, soil tillage…

Preferential use of non-chemical control options
Biocontrol, mechanical weeding…

Optimised decision making to avoid unnecessary treatments
DSSs

Increased efficiency of treatments
Patch spraying, equipment

Resistant variety

Healthy crop

reduced pesticide use and impact, safer environment, enhanced biodiversity, avoidance of resistances, better pest control

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Pillars of holistic IPM in potato

Year round control strategies for both pathogens based on holitic IPM:

1. Crop diversity in space & time, farm level:
    - Crop rotation in time & space, strip cropping
    - Biodiversithy strips, banker plants
2. Cultivar:
    - **<u>Resistant cultivars available</u>**
        - Potato: not used very much (yet)
3. Soil management:
    - Survival structures of the pathogen in the soil (oospores)
    - Clean seed
    - Volunteer control & removal of potato dumps
4. Monitoring & evaluation
    - Strategic: pathogen population monitoring (virulence to R genes, ai resistance)
    - Operational: DSS systems help optimize control strategy
5. **<u>Direct control:</u>**
    - Fungicides

Agricultural landscapes with diverse semi-natural habitats

Cropping systems designed to decrease pest/weed/disease pressure

Preferential use of non-chemical control options
Biocontrol, mechanical weeding…

Optimised decision making to avoid unnecessary treatments *DSSs*

Increased efficiency of treatments
Patch spraying, equipment

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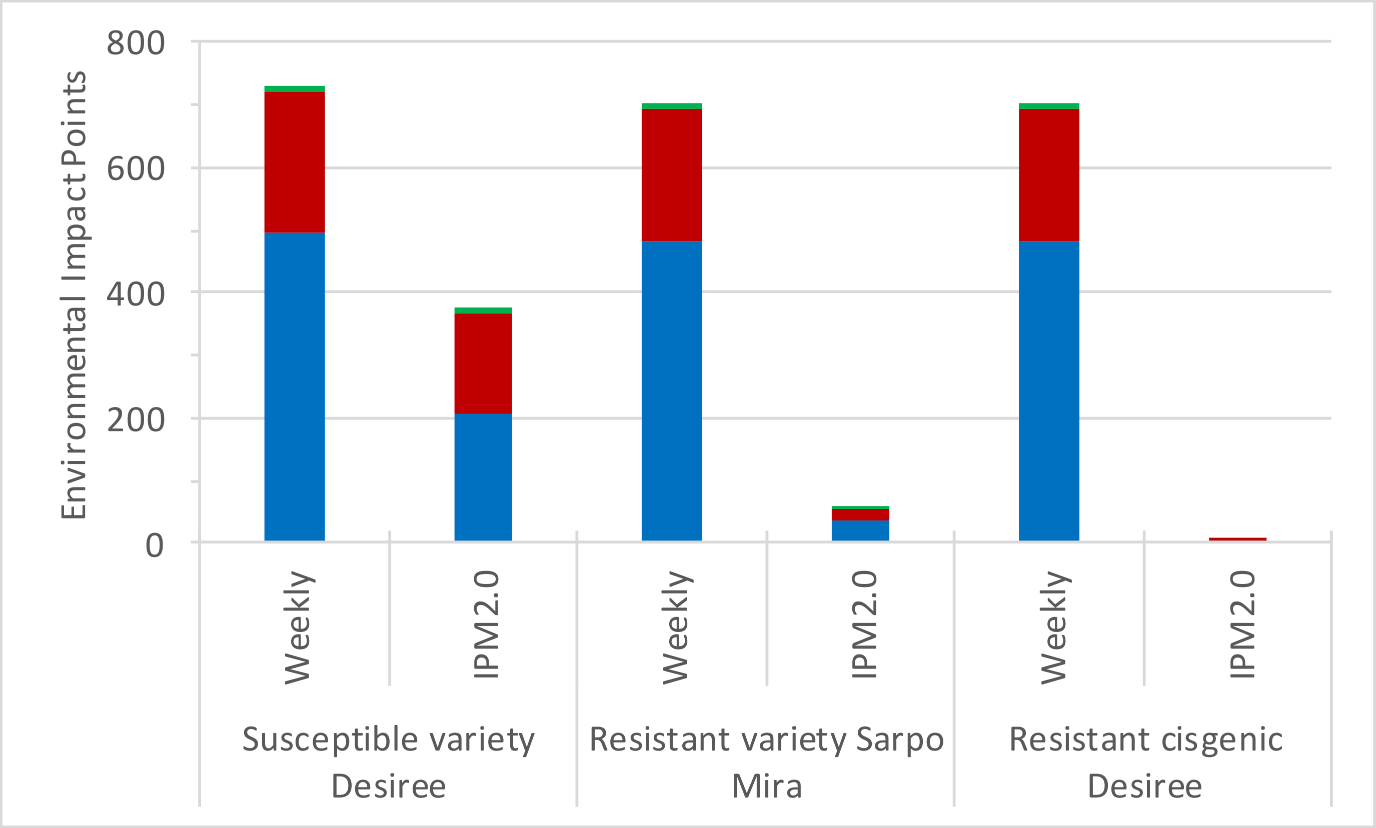
Results of Holistic IPM for potato late blight (5 field trials IE & NL, 2013-2015)



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Genotype Frequency Chart

Source: Euroblight.net

Continent

Europe

Country

All countries selected

Host

☑ All

☑ N/A ☑ Other ☑ Potato ☑ Tomato

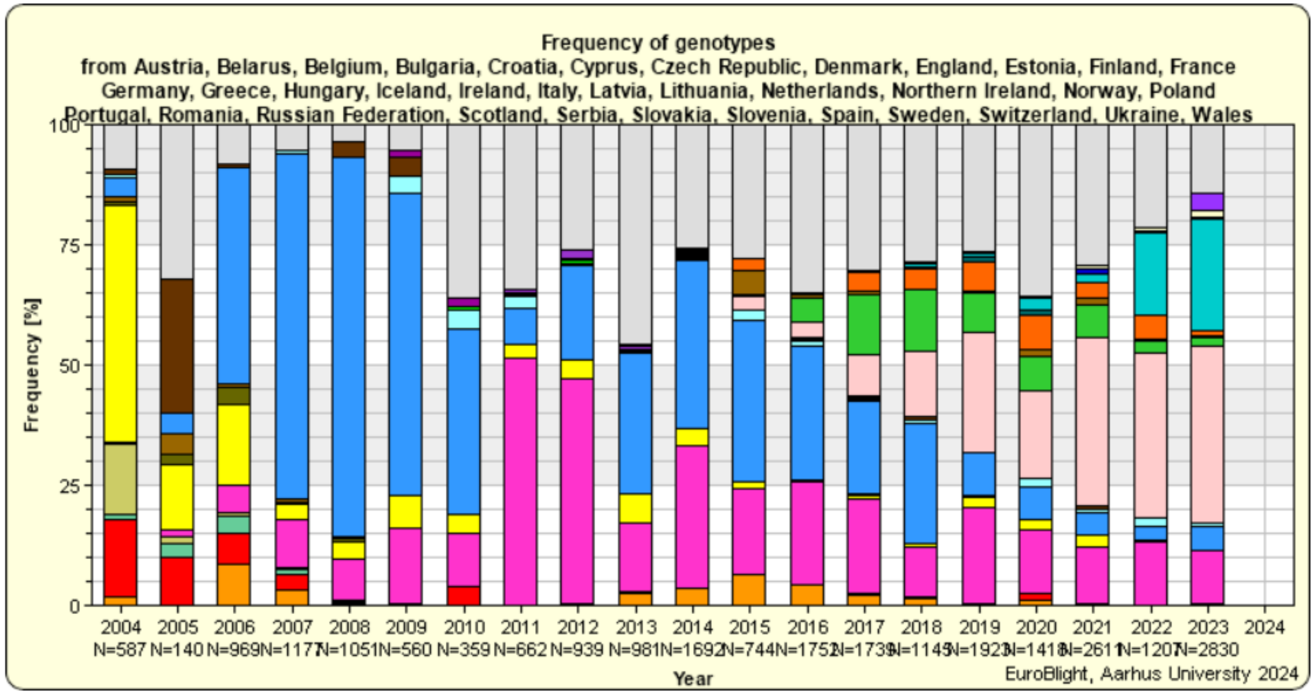
Show

Genotype legend

EU_1_A1	EU_2_A1
EU_3_A2	EU_5_A1
EU_6_A1	EU_8_A1
EU_10_A2	EU_12_A1
EU_13_A2	EU_22_A2
EU_23_A1	EU_33_A2
EU_34_A1	EU_35_A2
EU_36_A2	EU_37_A2
EU_38_A2	EU_39_A1
EU_40_A2	EU_41_A2
EU_42_A2	EU_43_A1
EU_44_A1	EU_45_A1
EU_46_A1	SIB_1_A1
Other	

Genotype frequency distribution

Help



IPM works

IPM DECISIONS

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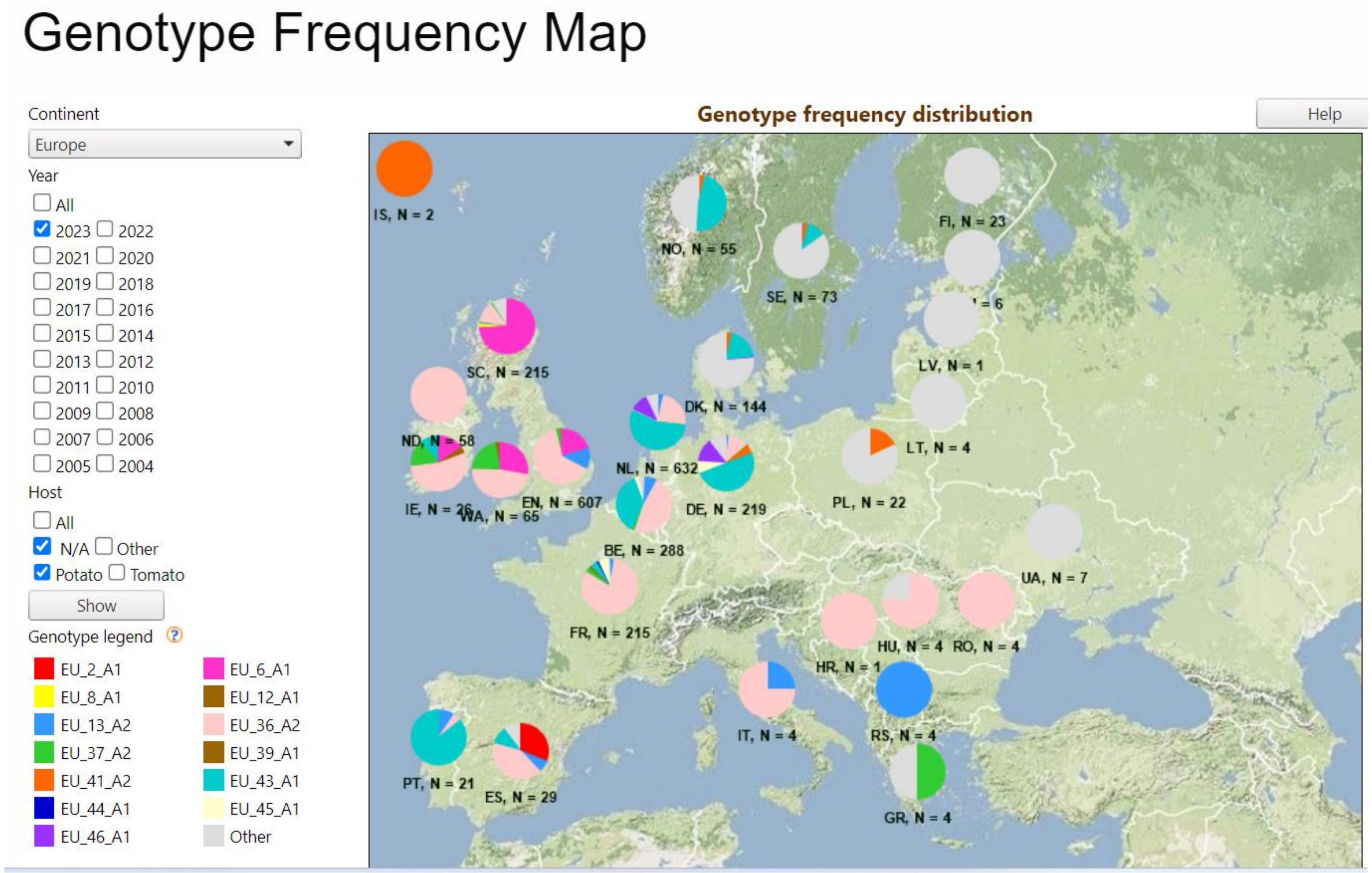

Source: Euroblight.net

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Pathogens change & adapt

Mechanism: mutation followed by selection

- Resistance to active ingredient
    - At least for 2 chemical a.i. groups
- Virulence to individual resistance genes
    - X out of 8 already broken

- Fungicides alone not durable!
- Resistant cultivars alone not durable!

- **<u>We really need a holistic, fully integrated approach:</u>**
    - Sanitary measures (no primary sources of infection)
    - Resistant cultivars (delay of first infection)
    - IPM based Decision Support Systems
    - Fungicides (low input, targeted strategy)
    - Resistance genes protect active ingredients
    - Active ingredients protect resistance genes

MOLECULAR PLANT PATHOLOGY (2008) **9**(3), 385–402 DOI: 10.1111/J.1364-3703.2007.00465.X

Review

Plant diseases that changed the world

Phytophthora infestans: the plant (and *R* gene) destroyer

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SUMMARY

Phytophthora infestans remains a problem to production agriculture. Historically there have been many controversies concerning its biology and pathogenicity, some of which remain today. Advances in molecular biology and genomics promise to reveal fascinating insight into its pathogenicity and biology. However, the plasticity of its genome as revealed in population diversity and in the abundance of putative effectors means that this oomycete remains a formidable foe.

Scholar identified 13 400 articles, with 4450 since 2002—and this search did not find all of the contributions. There are many books (e.g. Dowley *et al.*, 1995; Ingram and Williams, 1991; Lucas *et al.*, 1991), thousands of research articles and thousands of popular reports, and many historical treatments (e.g. Turner, 2005). The 'romance' occurs because many, many scientists have had high hopes that their investigations would lead to control of this dangerous pathogen. The 'controversies' (some continuing to today) develop from differences in method/interpretation—aided by ego. The vast literature creates a special challenge in writing a short overview of this organism and mandates that it be highly selective.

	2021	2022	2023
EU36 .ber1		NH	NH, Fl, Fr
EU43 .R2		NB	NB, Fl, Fr
EU43 .R2.blb2			NB
Other .R8		Fr	Fr, Fl

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Example change spraying strategies over years

voorbeeld blokkenschema zoals tot en met 2023 gebruikt werd

T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14
●	●	●	●	▲	▲	▲	■	■	★	★	★	★	★

van blok bespuiting naar afwisselen

From block spraying to alternating

voorbeeldschema waarbij producten worden afgewisseld

T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14
●	★	●	▲	★	▲	★	▲	■	★	■	★	■	★

naast afwisselen óók combineren

Change & combinations of fungicides

voorbeeldschema afwisselen én combineren producten

T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14
●	★	●	▲	★	▲	★	▲	■	★	■	★	■	★
△	□	△	☆	□	☆	□	☆	○	□	○	□	○	□

Figuur 1: Ieder symbool correspondeert met een product naar keuze uit figuur 2.

Symbols correspont with a product in the next table

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Fungicide adaptation

Mode of action
Product name

FRAC groepcode			Groep 11	Groep 21	Groep 27	Groep 28	Groep 29	Groep 40	Groep 43	Groep 45	Groep 49	Groep P 07
Werkingsmechanisme			QoI	QiI	c.a.-oxamine	carbamates	--	CAA	benzamides	QoSI	OSBPI	Phosphonates
Middelnaam												
Amphore Flex	C	M			cymoxanil			mandipropamid				
Azuleo	C			cyazofamide								
Banjo	F						fluazinam					
Banjo Forte	F	D					fluazinam	dimethomorf				
Canvas	A			amisulbrom								
Carial Star [1]	M							mandipropamid				
Curzate Partner	C				cymoxanil							
Cymbal	C				cymoxanil							
Edipro	P					propamocarb						
Enervin SC	A									ametoctradin		
Evitto	A			amisulbrom								
Exacto	F						fluazinam					
Fluzam	F						fluazinam					
Gachinko	A			amisulbrom								
Gadarock	F	K					fluazinam					kaliumfosfonaten
Grecale	C	F			cymoxanil		fluazinam					
Infinito	P	F				propamocarb			fluopicolide			

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Conclusions

- Current crop protection strategy in potatoes not durable:
    - Strategies based on fungicides alone not durable (pathogens adapt)
    - Strategies based on host resistance alone not durable(pathogens adapt)
- Fully integrated approach to pest & disease control urgently needed
    - Genetic component in IPM extremely valuable (but need protection)
        - Number of –R-genes limited, fungus highly adaptive
        - For many pests no resistant varieties available yet
        - Role of modern breeding technolgy?
    - Active ingredients (fungicides) needed to protect the host resistance genes and v.v.
- Fully integrated approach, incl sanitation, host resistance and low input fungicides most duarble option for future
    - Significant reduction of pesticide input possible
- Complex issue for farmers, good extension service is crucial
- Support & acceptance in the value chain necessary

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THANK YOU!

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