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the European Union

IPMorama

**Better integration of varietal resistance into the deployment
landscape is essential for the successful future management of late
blight**

Dan Milbourne

Euroblight Workshop, 19 May 2026, Ourense, Spain

ipmorama.eu



POTATO BLIGHT CONTROL

INTEGRATED PEST MANAGEMENT



DISEASE FORECASTING FOR
TARGETED FUNGICIDES INTERVENTIONS



BLIGHT-
RESISTANT
VARIETIES



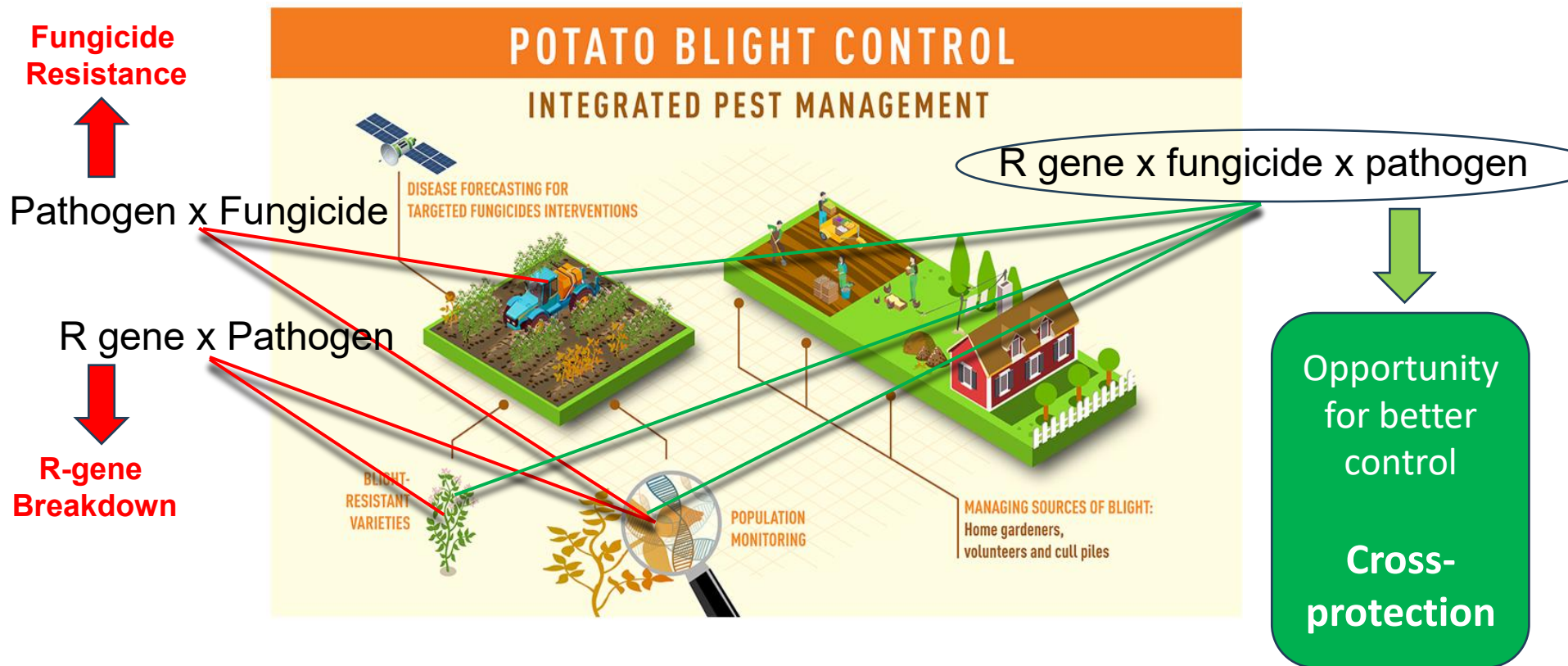
POPULATION
MONITORING



MANAGING SOURCES OF BLIGHT:
Home gardeners,
volunteers and cull piles

What does “integrated” mean in IPM when you include resistant varieties

The challenges and opportunities of interacting components



“It was the best of times, it was the worst of times...”

| | Veredelaar/Handelshuis | Rasnaam * |
|--------------|----------------------------|----------------------------|
| Groep | | |
| A | Agrico | Carolus, Twinner, Twister |
| | Averis | Antora |
| | HZPC | Cayman |
| | Meijer Potato | Sound, Lady Jane |
| B | Agrico | Alouette, Ardeche, Nofy |
| C | Agrico | Levante |
| | Geersing Potato Specialist | Camillo, Cammeo, Esperanto |
| | Plantera | Vitabella |
| D | Agrico | Beyonce, Sevilla |
| | Geersing Potato Specialist | Peter Pan |
| | Meijer Potato | Acoustic |
| E | Agrico | Jacky |
| | Solana Holland | Noia |
| F | Averis | Aveline, Avenger, Avito |
| G | HZPC | Invictus |
| H | Solana Holland | Connect |

* Er zijn alleen rassen opgenomen die commercieel worden geteeld op minimaal 25 hectare.

**BO Akkerbouw
colour group
scheme**

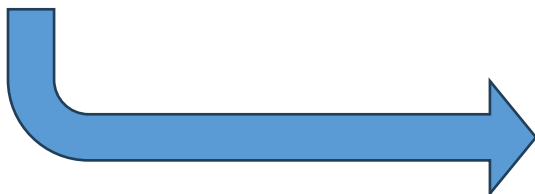
Individual R-genes derived from potato wild relatives

1. R8
2. R9
3. Rpi-blb1
4. Rpi-chc1
5. Rpi-vnt1
6. Rpi-cap1
7. Rpi-blb2





**R-gene
Breakdown**

So we need varieties (that farmers want to grow) with multiple R-genes



In the meantime, we need to develop approaches to integrate resistance into disease management systems to protect single R-genes

Developing Processing Potato Germplasm with Stacked Late Blight Resistance in a Variety-Centric IPM Framework

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IPMorama promotes a variety-centric integrated pest management (IPM) strategy by strengthening the link between resistance breeding, pathogen dynamics, and sustainable crop deployment. A key objective is the development of potato germplasm with well-defined and durable late blight resistance profiles that can be integrated into commercially relevant production systems. Within this framework, a foundation breeding population is being developed to introduce and combine late blight resistance (R) genes into modern potato processing backgrounds.

Goal: genomic + MAS supported recurrent selection for stacking R-genes in processing varieties

Founding population:

- ✓ Single R genes donors
- ✓ French Fry Varieties

→ Intercrossing

Genomic selection + MAS

- ✓ stacking R genes
- ✓ Quality traits

↻

Field trials → **Variety**

Expected outcome

- Advanced processing breeding lines
- 2–4 stacked late blight R genes
- Durable resistance deployment
- Genomic-assisted selection tools

Foundation population for resistance stacking:

- ~5,000 F1 progeny
- Elite processing × resistant donor parents

Year 1 selection

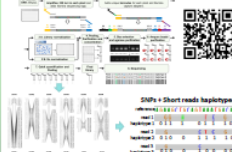
- KASP-based MAS
- Identification of single R genes
- Detection of preliminary resistance stacks

Project start: 59 crosses


1. Crosses between R-donors and processing varieties
2. MAS
3. Genotyping & Quality
4. Crosses cycle 2
5. MAS
6. Genomic selection

Project end: Blight resistant French Fry Varieties within 3-4 years

PotatoMASH: Genome wide genotyping




Characterization for fry colour



Develop Genomic Prediction models






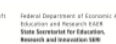
KASP MAS to select ~50% with late blight genes



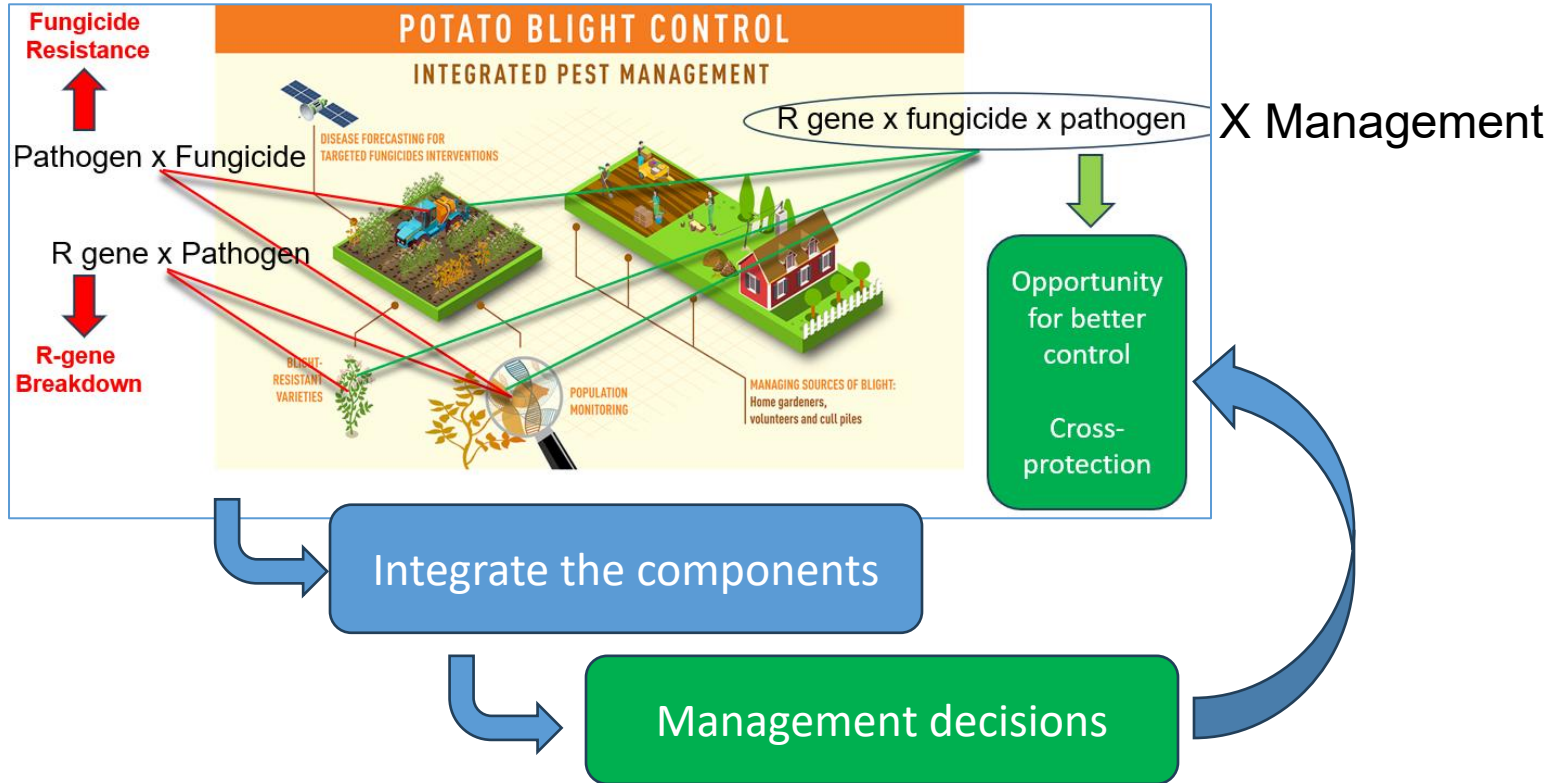
Next steps

- Select progeny advanced for recurrent crossing
- Additional resistance stacking cycles
- Selection for processing quality
- PotatoMASH genotyping
- Genomic prediction for processing traits
- Integrated MAS + genomic selection

Acknowledgements: The project is funded by Horizon Europe Project IPMorama, Grant No. 101135348.

IPMorama core idea: The Vulnerability Landscape



Risk of Infection

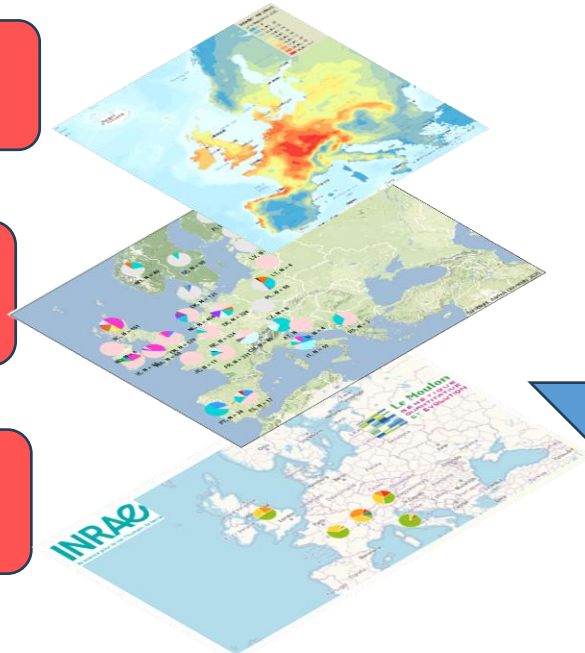
Eg weather

Distribution of Pathogen Virulence

What varieties can a strain overcome?
Emergence of new strains?

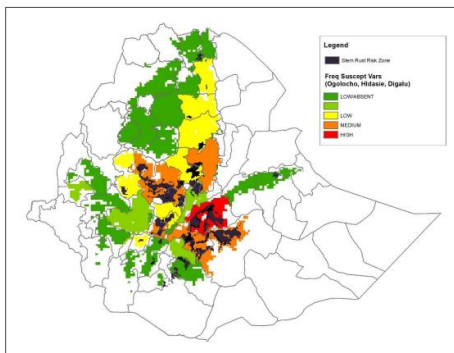
Distribution of R/S Varieties

What R-genes are in the variety?
More than one present?



Multilayered
map to
inform
decisions

Vulnerability Map



Operational and Tactical Level

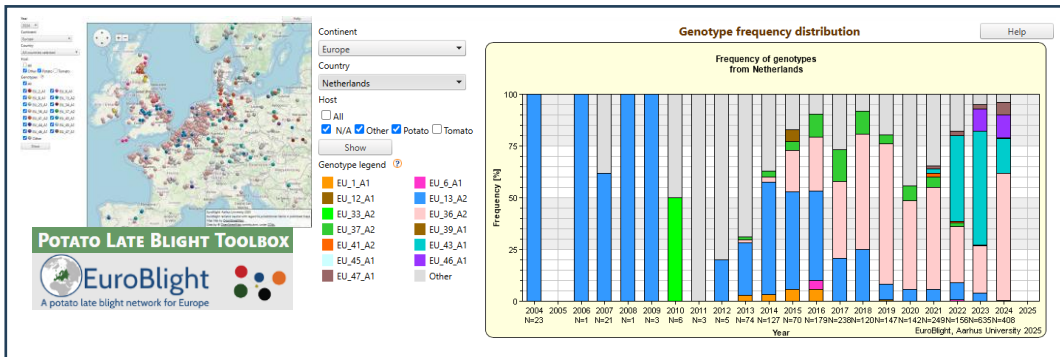
*When to spray
what to grow*

Vulnerability informed DSS

Strategic Level

*Where to grow varieties
When resistances are under threat
Long term deployment planning*

The virulence landscape - fixing the disconnect in current monitoring



| Group | aquired virulence | 2020 | 2021 | 2022 | 2023 | 2024 |
|-------|-------------------|------|--------|------|------------|------------|
| EU36 | ber1 | - | Fl | NH | Fl, Fr | NB, Fl, Fr |
| EU36 | R2 | - | - | - | - | NB |
| EU36 | vnt1 | Fl | Fr, Fl | Fr | - | Fr |
| EU36 | ber1, cap1 | - | - | - | - | Fr |
| EU36 | ber1, blb2 | - | - | - | - | Fr |
| EU36 | ber1, R9a | - | - | - | - | NB |
| EU36 | R9a, blb2 | - | - | - | - | Fl |
| EU43 | R2 | - | NB | NB | NB, Fl, Fr | NB, Fl, Fr |
| EU43 | R2, blb2 | - | - | - | NB | - |
| EU46 | R2 | - | - | - | - | Fr |
| EU47 | R8, R9a | - | - | - | Fr, Fl | Fr, Fl, Ov |



(Lineage and Virulence Emergence) LiVE-Seq

Cost effective genotyping to connect population monitoring to virulence (Amplicon sequencing?)

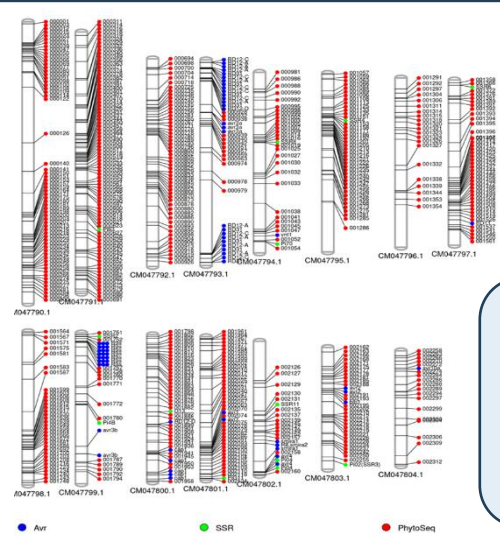
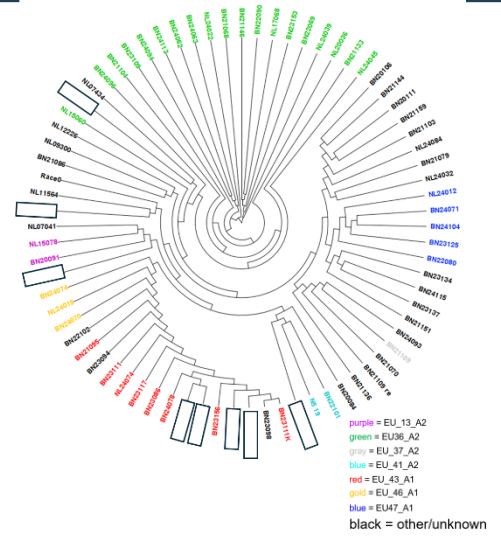
12-plex SSR set for backwards compatibility

P. infestans Avr gene complement

Expand using PenSeq

Phytoseq markers for better phylogeny

Incorporate fungicide targets for resistance detection?



The R-gene landscape: tracking variety deployment over space and time

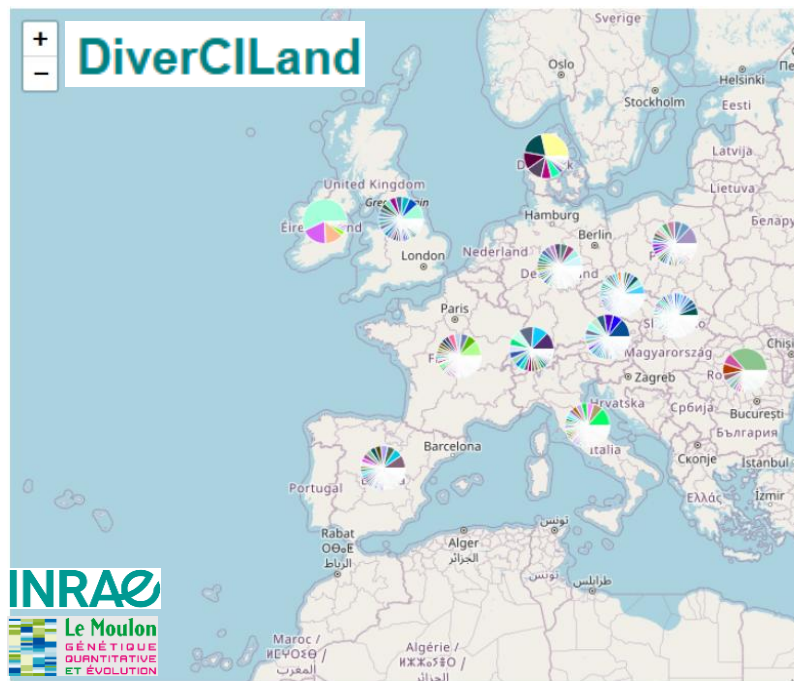
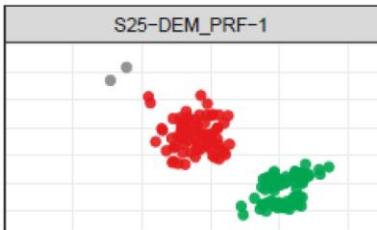
| Countries | Nb Accessions | Data type (Late blight resistance & deployment) | Collected data (period) | Formatted ?Y/N | Insertion DiverciLand | Statut |
|-----------|---------------|--|--------------------------------------|-------------------------------------|-------------------------------------|-------------------|
| DE | 489 | Registration | 2007-2022 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Completed |
| | | Post registration | 2007-2025 (Cultivated) | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | |
| | | Deployment | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | |
| DK | 32 | Registration | 2000-2024 | <input type="checkbox"/> | <input type="checkbox"/> | In progress |
| | | Post registration | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | Deployment | 2024 -2025 (Multiplication) | <input type="checkbox"/> | <input type="checkbox"/> | |
| FR | 196 | Registration | 1935-2025 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Completed |
| | | Post registration | No regular post registration data | <input type="checkbox"/> | <input type="checkbox"/> | No data |
| | | Deployment | 2018-2024 (Multiplication by region) | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Completed |
| IT | ? | Registration | -- | <input type="checkbox"/> | <input type="checkbox"/> | No answer |
| | | Post registration | -- | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | Deployment | -- | <input type="checkbox"/> | <input type="checkbox"/> | |
| NL | ? | Registration | -- | <input type="checkbox"/> | <input type="checkbox"/> | No data available |
| | | Post registration | -- | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | Deployment | 2022-2024 (Multiplication) | <input type="checkbox"/> | <input type="checkbox"/> | |
| SP | ? | Registration | -- | <input type="checkbox"/> | <input type="checkbox"/> | No data |
| | | Post registration | No post registration data | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | Deployment | 2024 | <input type="checkbox"/> | <input type="checkbox"/> | |
| UK | ? | Registration | -- | <input type="checkbox"/> | <input type="checkbox"/> | In progress |
| | | Post registration | 2001-2018 | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | Deployment | 2002-2018 | <input type="checkbox"/> | <input type="checkbox"/> | |
| IE | ? | Registration | -- | <input type="checkbox"/> | <input type="checkbox"/> | No data |
| | | Post registration | -- | <input type="checkbox"/> | <input type="checkbox"/> | |
| | | Deployment | -- | <input type="checkbox"/> | <input type="checkbox"/> | |
| PL | 138 | Registration | 1975-2024 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Completed |
| | | Post registration | No post registration data | <input type="checkbox"/> | <input type="checkbox"/> | No data |
| | | Deployment | 2008-2023 (Multiplication) | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Completed |

Compulsory countries

Complementary countries

| Group | Varietalar / Handbidskjin | Rassam * |
|-------|---------------------------|----------------------------|
| A | Agria | Carolina, Twinner, Twister |
| | Avelis | Antara |
| | H2PC | Cayman |
| | Mejer Potato | Sourd, Lady Jane |
| B | Agria | Aquatic, Antelope, Nady |
| | Agria | Levante |
| C | Geening Potato Specialist | Carallo, Carmeo, Esperanto |
| | Paviers | Vistula |
| D | Agria | Beyone, Sevilla |
| | Geening Potato Specialist | Peter Pan |
| E | Mejer Potato | Acoustic |
| | Agria | Jacky |
| F | Boone Holland | Nada |
| | Avelis | Avelis, Aveliger, Avelo |
| G | H2PC | Inkissa |
| | Boone Holland | Connect |

* Er zijn alleen rassen opgenomen die commercieel worden geteeld op minimaal 10 hectare.



DiverCILand makes possible to store variety descriptions and manage DUS and VCUS data, description data of cultivated landscape and also genetic data on variety characterization.

The R-gene landscape: stakeholder-driven monitoring the crop in real time to support DSS

The BlightTracker APP

The Blight Tracker App is a crowdsourced APP, that needs no login. Open the Link below on your phone, tablet and computer and you are up running

Target users in 2025 are all EuroBlight partners contributing to monitoring of *P. infestans* and *Alternaria spp.* The data will be used for:

- Practice: Early warning and indication of the stability of host resistance

NEW TOOL IN THE FIGHT AGAINST PHYTOPHTHORA: PHYTOALERT

Targeted notifications by resistance group.

One of PhytoAlert's unique features is the ability to filter notifications by resistance group. Growers using varieties with improved Phytophthora resistance can select their variety via a dropdown menu and then only see notifications relevant to their variety type. This also makes the alert system

The R-gene landscape:

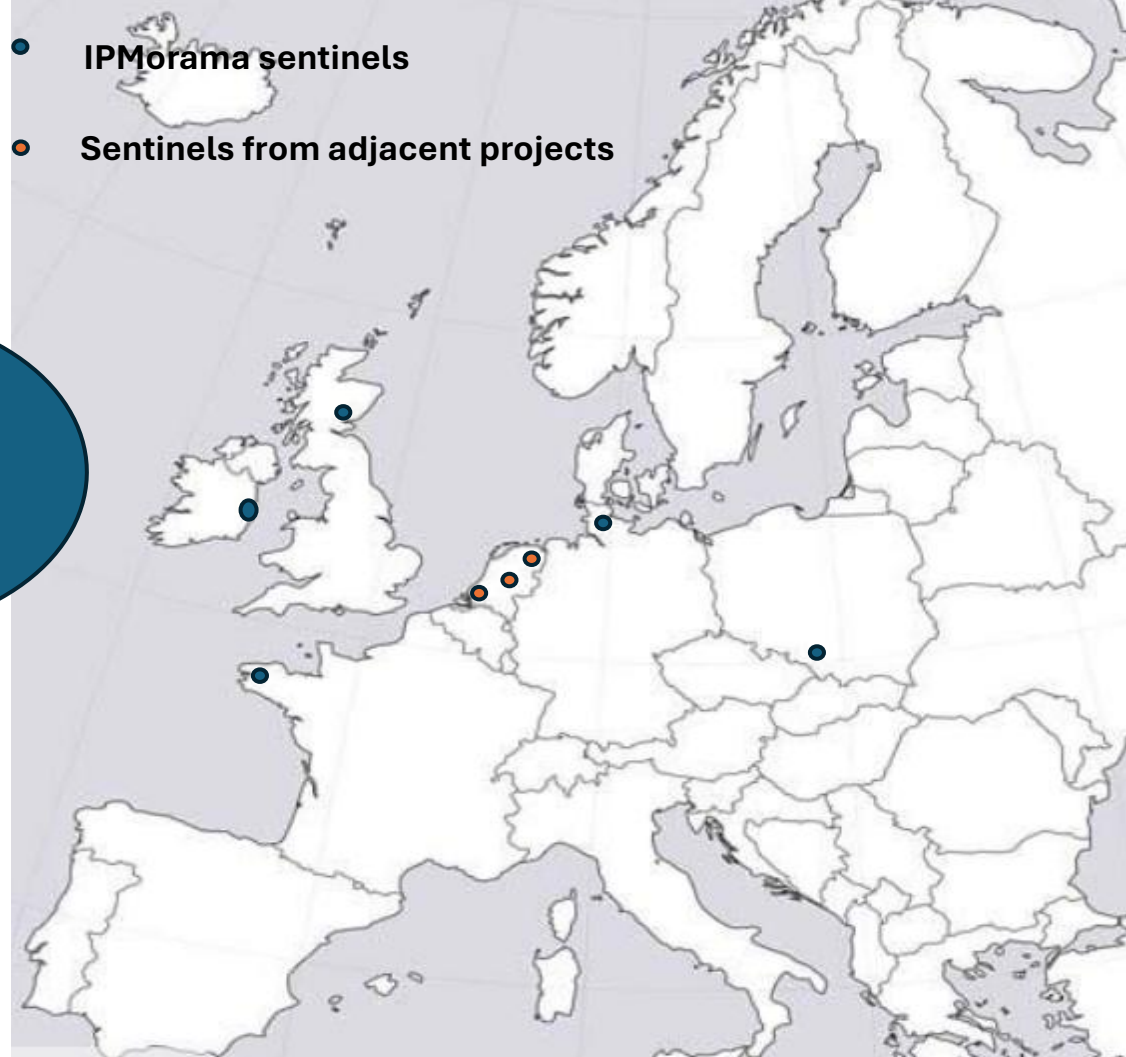
Monitoring using a Sentinel Plot Network



...to be part
of the
IPMorama
sentinel plot
network!

| Country | Region | Project | Year |
|----------------|----------------|----------|------|
| Ireland | Ireland | IPMorama | 2015 |
| | | | 2016 |
| | | | 2017 |
| | | | 2018 |
| United Kingdom | United Kingdom | IPMorama | 2015 |
| | | | 2016 |
| | | | 2017 |
| | | | 2018 |
| France | France | IPMorama | 2015 |
| | | | 2016 |
| | | | 2017 |
| | | | 2018 |
| Spain | Spain | IPMorama | 2015 |
| | | | 2016 |
| | | | 2017 |
| | | | 2018 |
| Italy | Italy | IPMorama | 2015 |
| | | | 2016 |
| | | | 2017 |
| | | | 2018 |

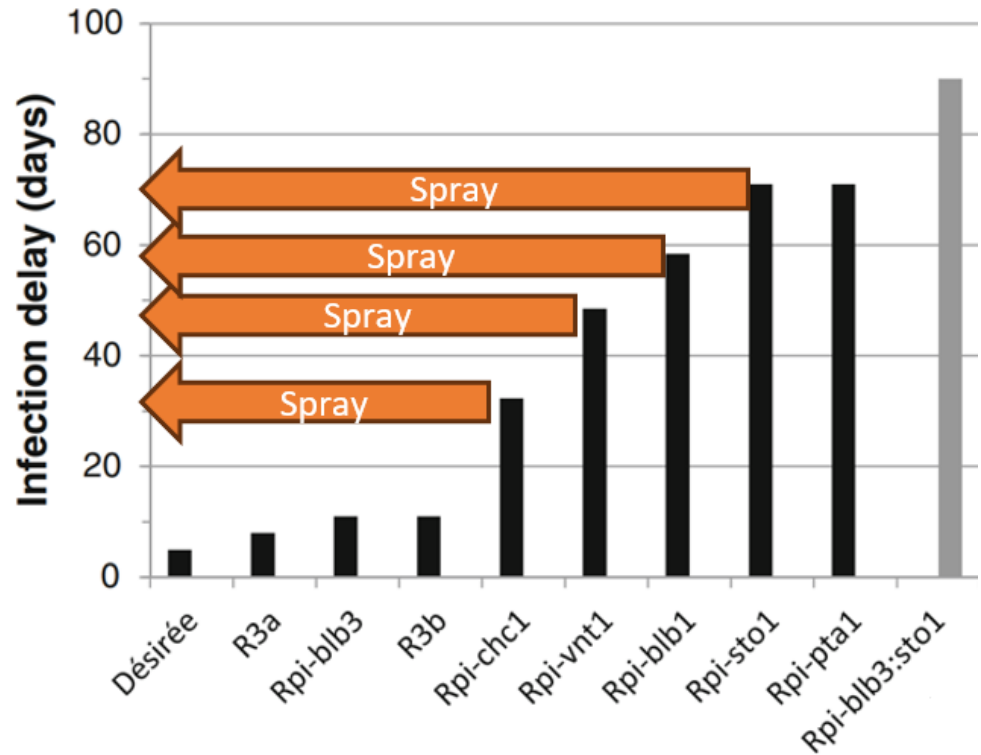
WE WANT YOU!



What would a “variety-integrated” IPM strategy look like?

Delay the 1st Spray!

- Strategy: to **delay first spray** by relying on variety resistance
- Then **spray at full rate**, using best practice (eg rotating fungicides)
- **Preferably before infection/breakdown!**
- Managed using a DSS using variety resistance group as a decision factor
- Each resistance group treated differently according to assumptions of efficacy of resistance (in 2025 trials!)



IPMorama small-scale plot trials 2025

Trials in France, Scotland and Poland

1. Resistance groups A, B, C, D, E, F, I
2. Susceptible (Fontaine)
3. "Sniffer Plots"

Common Practice (Blue)

Vs.

| | | posadzone ziemniaki | | | | | | | | | | | | | | | |
|-----------|-------------|---------------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------|--|--|--|
| | | 3,6 m | 3,6 m | 3,6 m | 3,6 m | 3,6 m | 3,6 m | 3,6 m | 3,6 m | 3,6 m | 3,6 m | 3,6 m | 3,6 m | | | | |
| Innovator | 10 m | Invictus | Invictus | Invictus | Invictus | Invictus | Invictus | Invictus | Invictus | Invictus | Invictus | Invictus | Invictus | | | | |
| | 10 m | Reza | Reza | Reza | Peter Pan | Peter Pan | Peter Pan | Reza | Reza | Reza | Peter Pan | Peter Pan | Peter Pan | | | | |
| | 10 m | Lady Jane | Lady Jane | Lady Jane | Alouette | Alouette | Alouette | Lady Jane | Lady Jane | Lady Jane | Alouette | Alouette | Alouette | | | | |
| | 10 m | Avenger | Avenger | Avenger | Oscar | Oscar | Oscar | Avenger | Avenger | Avenger | Oscar | Oscar | Oscar | | | | |
| | 10 m | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | | | | |
| | 10 m | Oscar | Oscar | Oscar | Avenger | Avenger | Avenger | Oscar | Oscar | Oscar | Avenger | Avenger | Avenger | | | | |
| | 10 m | Alouette | Alouette | Alouette | Lady Jane | Lady Jane | Lady Jane | Alouette | Alouette | Alouette | Lady Jane | Lady Jane | Lady Jane | | | | |
| | 10 m | Peter Pan | Peter Pan | Peter Pan | Fontane | Fontane | Fontane | Peter Pan | Peter Pan | Peter Pan | Fontane | Fontane | Fontane | | | | |
| | 10 m | Fontane | Fontane | Fontane | Reza | Reza | Reza | Fontane | Fontane | Fontane | Reza | Reza | Reza | | | | |
| | border area | | | | | | | | | | | | | | | | |
| | 10 m | Fontane | Fontane | Fontane | Reza | Peter Pan | Reza | Fontane | Fontane | Fontane | Reza | Reza | Reza | | | | |
| | 10 m | Peter Pan | Peter Pan | Peter Pan | Fontane | Fontane | Fontane | Peter Pan | Peter Pan | Peter Pan | Fontane | Fontane | Fontane | | | | |
| | 10 m | Alouette | Alouette | Alouette | Lady Jane | Alouette | Lady Jane | Alouette | Alouette | Alouette | Lady Jane | Lady Jane | Lady Jane | | | | |
| | 10 m | Oscar | Oscar | Oscar | Avenger | Avenger | Avenger | Oscar | Oscar | Oscar | Avenger | Avenger | Avenger | | | | |
| 10 m | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | Cammeo | | | | | |
| 10 m | Avenger | Avenger | Avenger | Oscar | Oscar | Oscar | Avenger | Avenger | Avenger | Oscar | Oscar | Oscar | | | | | |
| 10 m | Lady Jane | Lady Jane | Lady Jane | Alouette | Lady Jane | Alouette | Lady Jane | Lady Jane | Alouette | Alouette | Alouette | Alouette | | | | | |
| 10 m | Reza | Reza | Reza | Peter Pan | Reza | Peter Pan | Reza | Reza | Peter Pan | Peter Pan | Peter Pan | Peter Pan | | | | | |
| 10 m | Invictus | Invictus | Invictus | Invictus | Invictus | Invictus | Invictus | Invictus | Invictus | Invictus | Invictus | Invictus | | | | | |
| | | 1 block | | | | 2 block | | | | 3 block | | | | 4 block | | | |
| | | pole - wjazd | | | | | | | | | | | | | | | |
| | | Sniffer S | Sniffer R2 | Sniffer A | Sniffer B | Sniffer C | Sniffer D | Sniffer E | Sniffer F | Sniffer G | Sniffer I | | | | | | |



"IPMorama approach" - DSS supporting R-variety input



Late Blight Foliage Resistance

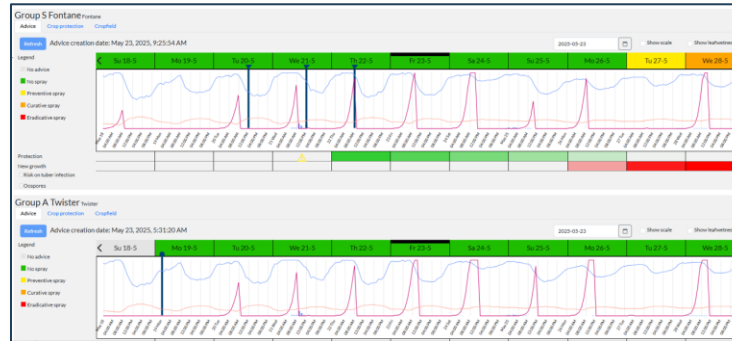
Delay first spray application based on cultivar resistance level

When was late blight first found in the area (5 km radius)?

Late Blight Foliage Resistance

Delay first spray application based on cultivar resistance level

When was late blight first found in the area (5 km radius)?



IPMorama variety-centric IPM trials (Scotland, Poland, France)

| Cultivar resistance group | Disease pressure: Treatment | HIGH | Normal | Low |
|---------------------------|-----------------------------|------------|------------|-------------|
| | | France | Poland | Scotland |
| | | Ploudaniel | Bobrowniki | Invergowrie |
| All | Common practice | 9 | 13 | 12 |
| Group S | ICM | 6 | 13 | 11 |
| Group R2 | ICM | 5 | | 1 |
| Group G | ICM | | 7 | |
| Group A | ICM | 5 | 8 | 0 |
| Group B | ICM | 5 | 1 | 0 |
| Group C | ICM | 5 | 1 | 0 |
| Group D | ICM | | 1 | 0 |
| Group E | ICM | | 1 | 0 |
| Group F | ICM | | 1 | |
| Group I | ICM | | 1 | |

One important conclusion: using assumptions about resistance gene “strength” in DSS doesn’t work well, supports the need for monitoring and vulnerability mapping to support DSS.

Notes:

- Not all resistance groups at all sites
- Some different group representatives and different sites
- French trial was burned off after ~65 days
- Almost no blight observed in Scottish trial, some blight in Polish trial and more in French trial

Table 1. Cultivar resistance groups and the number of fungicide applications necessary to keep a healthy crop in three locations in 2025. More information on cultivar resistance groups can be found [here](#).

Next Steps:

- Progress towards developing and validating LiVeseq and R-gene deployment maps
- Development of a Vulnerability Mapping Tool (VMT) that will feed decisions in multiple spatio-temporal contexts
- Small scale plot trials repeated in 2026 (spray decisions based on monitoring and eventually input from VMT)
- Farm-scale, farmer-led trials of single and dual resistant varieties using IPMorama best practice in 2027, including economic analysis – is it usable and affordable, will growers trust it.
- Collaboration, collaboration, collaboration – across the scientific community and entire potato value chain

IPMorama Breeding:

Vanessa Prigge, Lars Boge, Friedrich Kauder, Albert Schulthess, Julien Bruckmueller (SaKa/Solana), Charlotte Prodhomme, Sylvie Marhadour, Clementine Borrelli (inov3PT), Lea Vexler, Dan Milbourne, Denis Griffin (Teagasc)

IPMorama Potato IPM

Trials:

Geert Kessel, (WUR)
James Lynott, Alison Lees (JHI), Jeanne Simon (inov3PT), (Delphy)

IPMorama Vulnerability Landscape:

Jens Hansen, Isaac Abuley (AU), David Cooke, Ingo Hein, Amanpreet Kaur (JHI) Jack Vossen (WUR), Valerie Cadot, Soukaina Amazdo (GEVES), Alban Fesquet, Yannick De Olivera, Jerome Enjalbert (INRAe)

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