

Fungicide Positioning — Post Restrictions.
What to Consider when Making a Plan – **European Perspective**

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Resistance Management Considerations

The European Situation

- In Europe Late Blight is the major disease in potato crops.
 - Early Blight is a secondary / minor disease (increasing in some countries in recent years).
 - All foliar strategies are based on a Late Blight control program and additional / top up treatments are considered for Early Blight.
 - Some newer varieties and recent weather patterns are seeing a shift into more consideration to Early Blight programs.
 - Controlling the diseases and resistance management strategies are the major focus points.

Resistance Management Considerations - *Programs*

- “We have anti-resistance strategies in place, but we need to be honest and ask, ‘how widely-used are they?’”
 - Block application vs alternating sequence application ?
 - Build up the fungicide on leaf with block of 3-4 sprays
 - Careful choices need to be made with block type application approach to ensure high-end products are used otherwise the crop is at risk for 3-4 weeks if the wrong product is used!
- OR
- Alternating moa by switching to different mode of action every spray to maximize methods of control

Resistance Management Considerations - *Programs*

- Overuse of a product with a single mode of action can increase risk of resistance.
- Tank-mix high-risk fungicide with another mode of action
- Alternate modes of action for resistance management
- Keep to target spray intervals, if applications are stretched have a back up plan.

EU Late Blight Fungicides Position

Proxanil (propamocarb + cymoxanil)

Acrobat WG (dimethomorph + mz)

Curzate (cymoxanil) – only curative (tank-mix in high pressure)

Infinito (propamocarb + fluopicolide)

Allegro (fluazinam)

Valbon (benthiavalicarb + mz)

Revus (mandipropamid)

Dithane DG

Ranman

Electis / Gavel

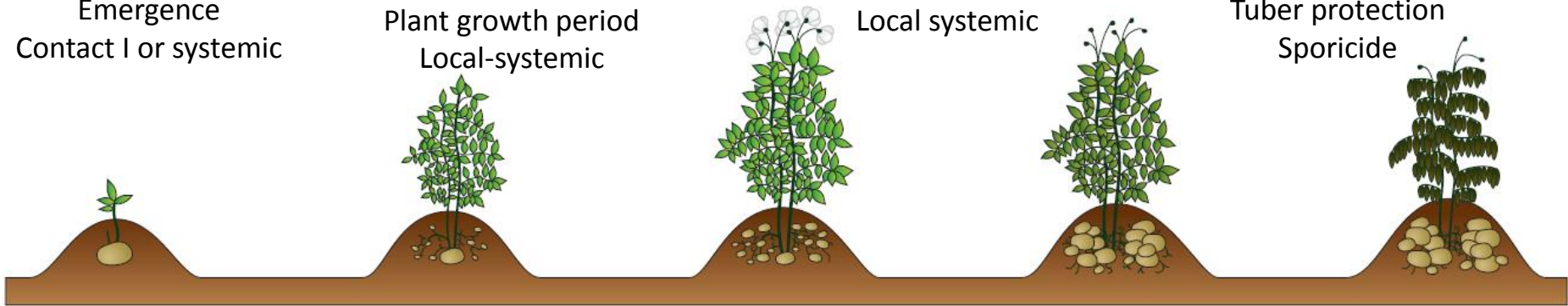
Ranman (cyazofamid)

Emergence
Contact I or systemic

Early season
Plant growth period
Local-systemic

Full canopy / Contact II or
Local systemic

Tuber protection
Sporicide



Leading Potato Late Blight Fungicides - changes

- **10 years ago**
 - Curzate Mz *
 - Acrobat Mz *
 - Shirlan / Allegro
 - Ranman
 - Valbon *
 - Dithane *
- **5 years ago**
 - Revus
 - Ranman
 - Shirlan / Allegro
 - Curzate
 - Curzate Mz *
- **2018**
 - Revus
 - Infinito
 - Ranman
 - Curzate
 - Curzate Mz *

* Contain mancozeb

Chlorothalonil is not used in Europe – supermarkets negative list / regulatory issues, approval will not be renewed

Resistance Management Considerations - *Programs*

- Several active ingredients all fall into similar mode of action groups.
 - CAA chemistry (FRAC Group 5) now restricted to max 3-5 sprays in the EU (country dependant).
 - The CAA fungicides covers several high-end active ingredients in Europe.
 - Dimethomorph / Mandipropamid / Bentiavalicarb.
 - **Alternating products is NOT always alternating modes of action.**
 - **Alternating modes of action is not always alternating sites of action within the cell.**

EU Registered Potato Late Blight Fungicides: *Mode of Action / Site of Action*

Target Site of Blight Fungicides

Mitosis
Beta tubulin assembly (B3)
Zoxamide

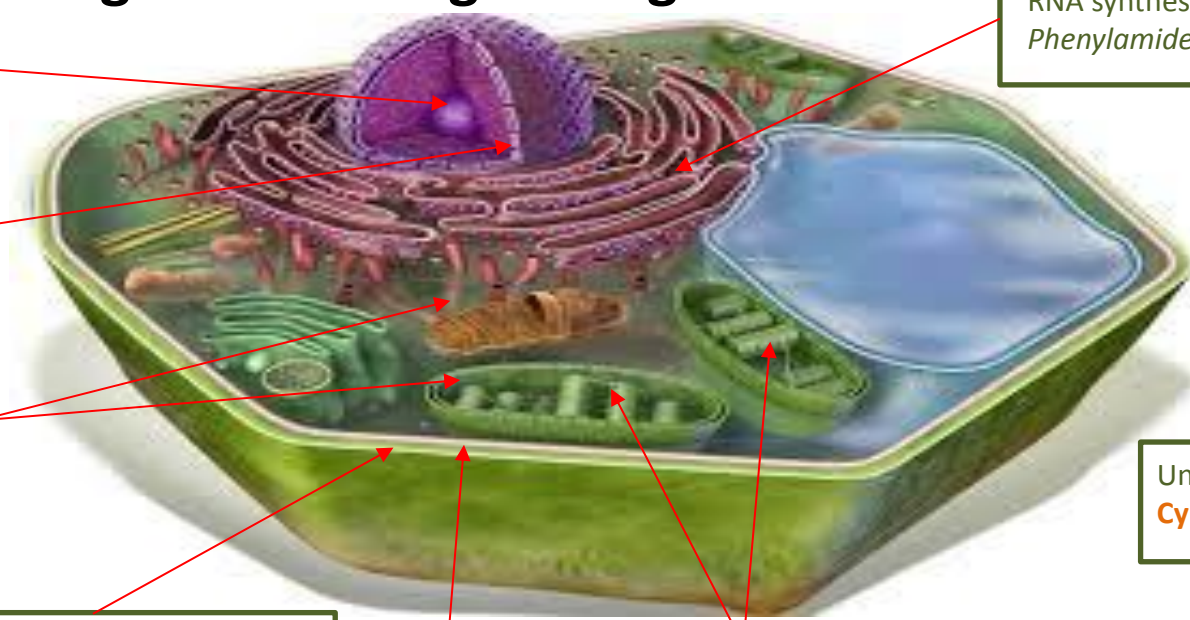
Cell wall Proteins
Spectrin like proteins (B5)
Fluopicolide

Multi-Site
Thiol inhibitor, 6 pathways
Mancozeb (M3)
Copper (M1)
Chlorothalonil (M5)

Cellulose Synthase (H5)
CAA (Carboxylic acid adimes)
Dimethomorph, Benthiavalicarb, Mandipropamid

Lipid & membrane synthesis
Cell membrane permeability/fatty acids (F4) Carbamates, **Propamocarb**
Lipid homeostasis and transfer/storage (F9) **Oxathiapiprolin**

RNA synthesis (A1)
Phenylamides: **Metalaxyl**



Unknown MOA
Cymoxanil

Respiration
Qoi (complex III, cytochrome bc1) (C3)
Famoxadone, Fenamidone
Qii (complex III, cytochrome bc1) (C4)
Cyazofamid, Amisulbrom
Uncouplers of Oxidative Phosphorylation (C5) **Fluazinam**
Qosi (complex III, cytochrome bc 1) (C8) **Ametoctradin**

Key Country Commercial Programs

- France
 - Historically a “block type” series of applications for the first 4-5 applications based on multiple applications of mancozeb alone and the second half of the season is based on high-end products like Revus / Curzate / Ranman / fluopicolide + propamocarb (Presidio + Tattoo) / Allegro (? tax) end season for tuber blight control.
 - Mainly official advisory driven who are now changing to more tank-mixes and resistance management considerations.
 - **Government driven major change is the “pesticide tax” for some products this has doubled their price (mancozeb!) so usage dropped considerably in 2018 onwards.**

EU Potato – Late Blight and Alternaria

– *France pesticide tax*

- In January 2017 the French Government launched a “green tax” on pesticides with the objective of reducing the amount of active ingredients applied to crops.
 - It targets the amount of active ingredient applied.
- Mancozeb cost to farmer almost doubled overnight due to the tax of € 6.75 /kg of active ingredient (**\$ 10 CAD / kg of active ingredient**).
- A big reduction in mancozeb use (to be replaced by fluazinam / Allegro) in 2019 but now worries over the Netherlands sensitivity issue with fluazinam.
 - This all due to political pressure.

Key Country Commercial Programs

- United Kingdom
 - Very much strategies with alternating multiple modes of action and tank-mixes, in high risk conditions mancozeb still used strategically as a multi-site partner with the high risk single site mode of action fungicides.
 - Usual is to start with 2-3 sprays of Infinito (fluopicolide + propamocarb (Presidio +Tattoo) and then follow with applications based around the high-end fungicides – Revus / Ranman / Curzate / Curzate Mz / oxathiapiprolin (Orondis) / Gavel.
 - Mancozeb could be added in high risk conditions where single-site fungicides are used or on varieties where Early Blight maybe an issue.

Key Country Commercial Programmes

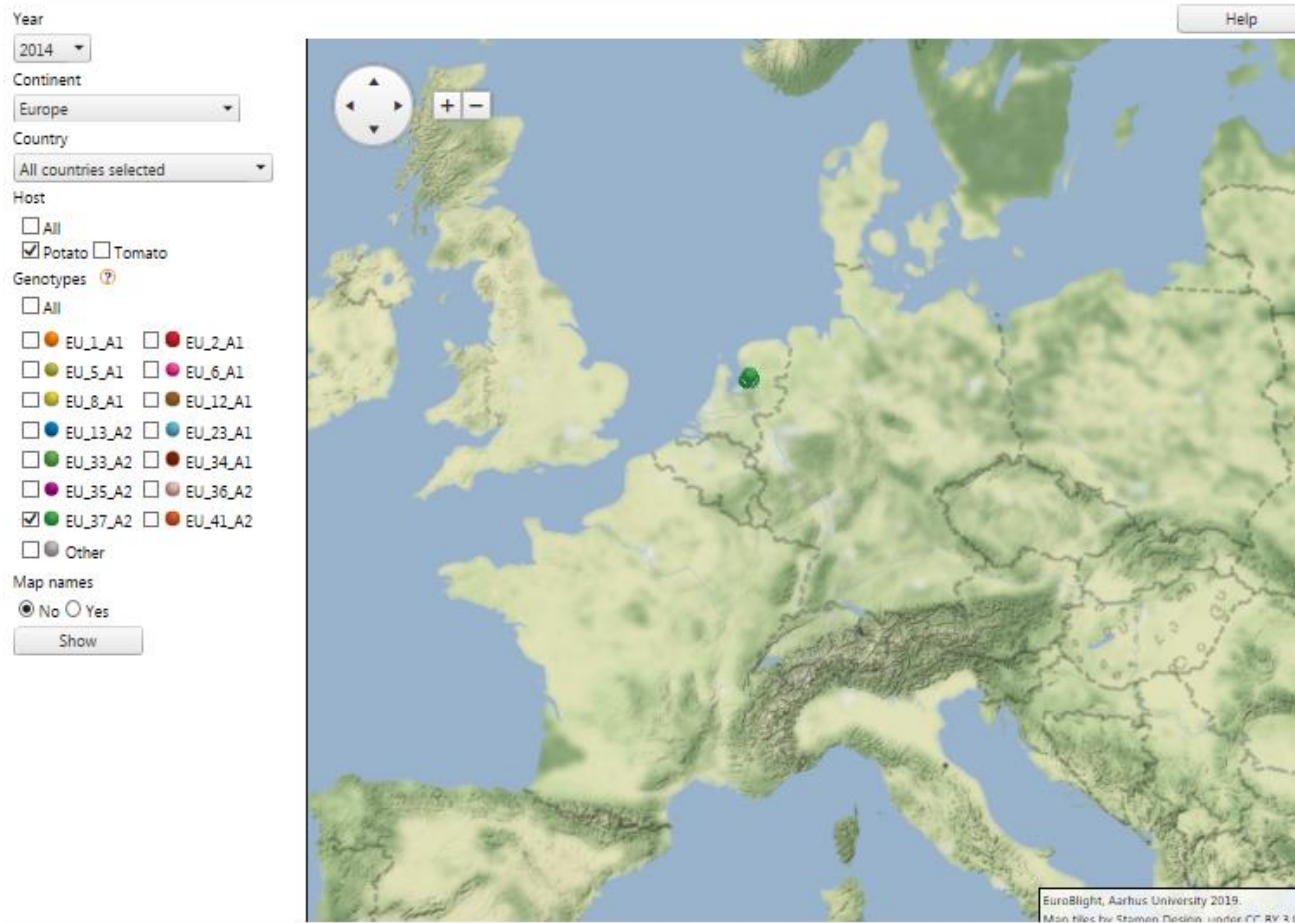
- The Netherlands
 - Historically a season long series of applications based around mancozeb and mancozeb containing products in “block type” applications.
 - Allegro was launched and mancozeb use almost disappeared
 - Low use rate compared to mancozeb / tuber blight activity.
 - The “block type” series of applications usually based around multiple applications of Allegro and Ranman (suddenly Early Blight is a problem, mancozeb had been controlling Early Blight).
 - Recent issues with Allegro and launch of Revus has focused more on Revus / fluopicolide + propamocarb (Presidio + Tattoo) / Ranman strategy with addition of Curzate in high risk conditions still based on “blocks” of 4 sprays.

Case History – The Netherlands

- Historically for many years, standard commercial grower strategy was Product A x3 sprays / Product B x3 sprays / Product A or C x3 sprays / Product B x3 sprays.
- 20 years ago Mancozeb dominated the Dutch potato blight market
 - Allegro was launched (low use rate / tuber blight activity) and Mancozeb disappeared.
 - A new Late Blight genotype Dark Green 37_A2 first detected in a single location in 2013, showed a significant reduction in sensitivity to fluazinam in 2016 which lead to a significant drop in usage in 2018.

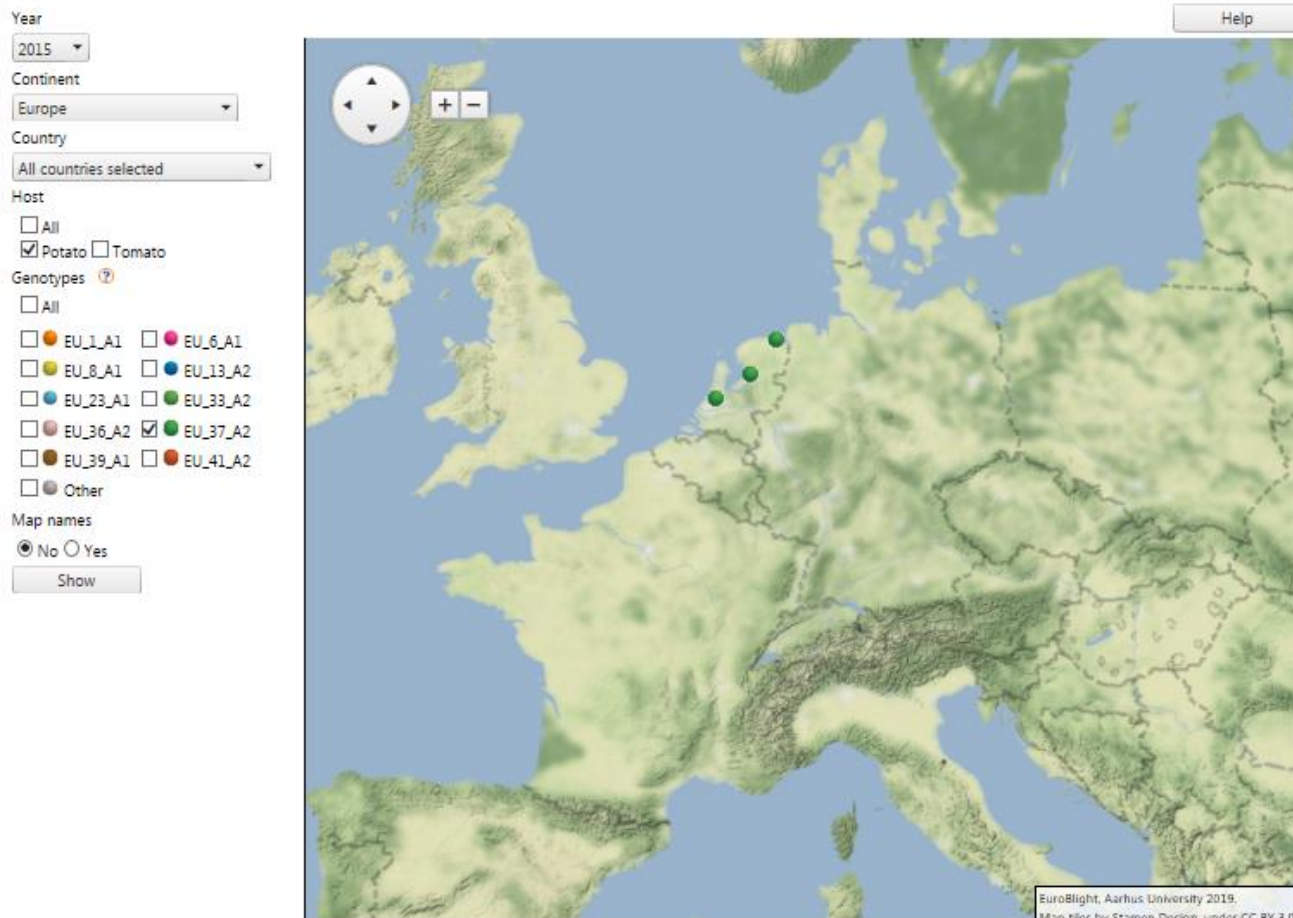
Case History – The Netherlands - Dark Green 37_A2

Genotype Map



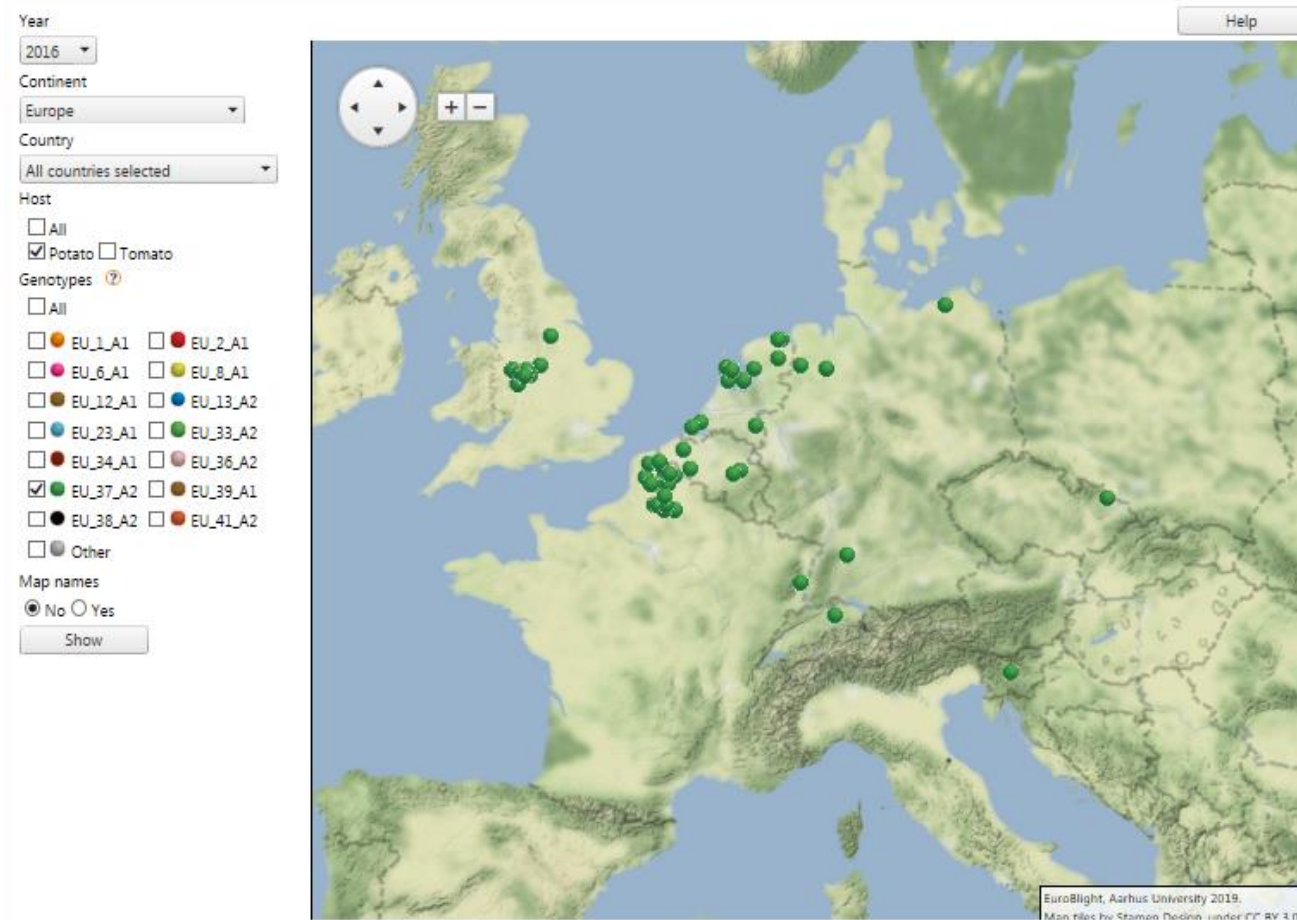
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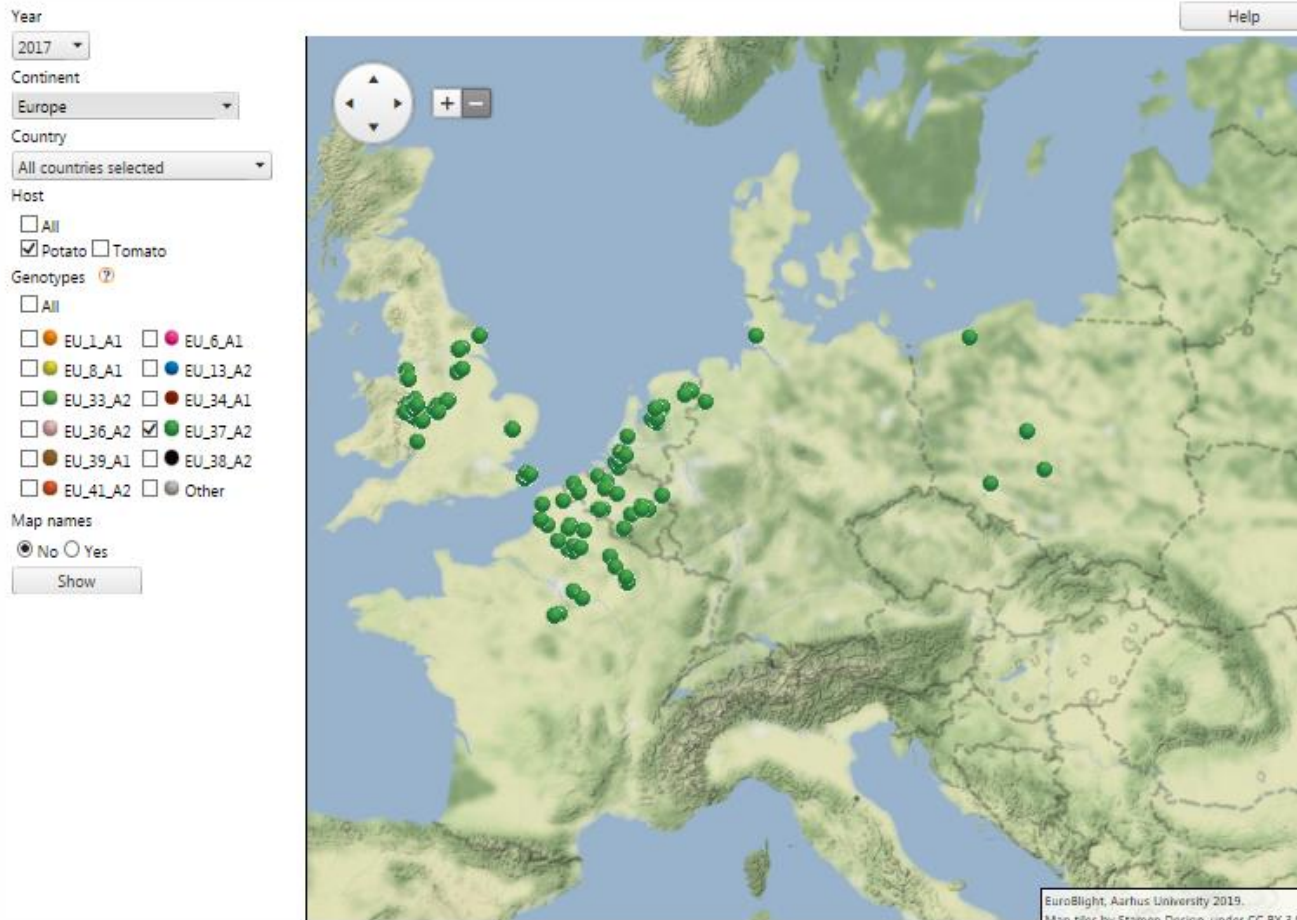
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Genotype Map



Case History – The Netherlands - Dark Green 37_A2

Genotype Map



EU Potato – Late Blight and Early Blight – *could we live with a reduction in mancozeb applications ?*

- In some countries (The Netherlands / Scandinavia), mancozeb is rarely used (*) in Late Blight programs.
 - Lower use rate products preferred (Allegro).
- A reduction in mancozeb would not be so important in these countries...
- Key issue would be the impact on Early Blight programs in certain countries.

- * with the recent fluazinam (Allegro) reduced sensitivity issues, mancozeb is again being used for Late Blight control.

EU Potato – Late Blight and Early Blight / Alternaria – *could we live with a reduction in mancozeb applications ?*

- In most potato growing countries (excluding The Netherlands), mancozeb is still a partner in some existing older pre-mix products and also as an additional tank-mix partner to key single-site fungicides for a resistance management strategy but also in certain varieties for control of Early Blight / Alternaria.
- Recent new products have seen a shift away from having mancozeb as a partner.
 - Uncertainty over the future of mancozeb.
 - Regulatory issues / reduced number of sprays in a season could be by product limit or total amount of kgs active ingredient applied.

EU Potato – Late Blight and Alternaria – *could we live with a reduction in mancozeb applications ?*

- A reduction in mancozeb applications would be very serious in these countries where Early Blight / Alternaria is becoming a more serious problem in recent years (new varieties / warmer summers etc) ...
 - Very limited options of other chemistry.
- A reduction in overall total number of applications is inevitable and already happening as products go through the re-registration process..

EU Potato – Late Blight and Alternaria – *could we live with a reduction in mancozeb applications ?*

- The shift away from mancozeb is already happening in the newer late blight products but we are also losing some of the older active ingredients due to regulatory issues or lack of support from the manufacturer due to costs of re-registration.
- Over the next few years the available choices will get smaller and there is more risk of over-use of single site modes of action and possible risk of resistance.

EU Potato – Late Blight and Alternaria

– could we live with a reduction in mancozeb applications ?

- Late blight strategies are already working with less mancozeb but the key issue will be the impact on Early Blight strategies where mancozeb plus high risk specific Early Blight products will have to rely on less mancozeb and even higher risk of resistance to the Early Blight specific products.
- **The available choices for Early Blight control are limited and there is more risk of over-use of single site modes of action and possible risk of resistance to the limited number of these fungicides if there is reduction in mancozeb applications.**

EU Potato – Late Blight and Alternaria / Early Blight – *could we live with a reduction in mancozeb applications ?*

- “We have anti-resistance strategies in place, but we need to be honest and ask, ‘how widely-used are they?’”
 - Probably better than we think for Late Blight but the key is continued research work and monitoring of the situation and passing on new information.
- Do we have a strategy for controlling Early Blight with reduced applications of mancozeb ?
 - Better monitoring of the crop / targeted applications of mancozeb and Early Blight specific products and using resistance management plans to ensure we keep what we currently have in the armoury.

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Thank You