

EuroBlight workshop

18-21 May 2026, Ourense, Spain

The Syngenta logo is positioned on a dark green horizontal bar. It consists of the word "syngenta" in a white, lowercase, sans-serif font. A large, light gray, stylized leaf graphic is partially visible on the right side of the slide, overlapping the green bar and extending upwards.

syngenta

The Emergence and Management of CAA and OSBPI Fungicide Resistance in *Phytophthora infestans*: A Five-Year European Surveillance Study

Lorenzo Borghi, Tommaso Moles, Ursin Stirnemann, Luca Cornetti,
and the whole Fungicide Resistance Monitoring and Diagnostic team

Syngenta Crop Protection, Switzerland

The story up to 2023 ...

The emergence of resistance to CAAs and OSBPis in *P. infestans*



Plant Pathology An International Journal edited by the British Society for Plant Pathology

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New Mechanisms of Resistance to CAA and OSBPI Fungicides in *Phytophthora infestans*

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First published: 16 November 2025 | <https://doi.org/10.1111/ppa.70086> | VIEW METRICS



2021: outbreak of resistance to CAAs in Denmark: **discovery of the fully cross-resistant mechanism by Syngenta**

2022: Spread of resistance to CAAs: **field trials to test new strategies (mixtures and alternations), first shared with DK**

2023: **Syngenta communicates new recommendations for CAA resistance management together with FRAC**



In regions with reported cases of resistance:

- CAA fungicides must be used in mixtures, with not more than 2 consecutive applications
- In case mixtures cannot be applied for regulatory reasons, apply CAA fungicide in strict alternation

<https://www.frac.info/frac-teams/working-groups/caa-fungicides/>

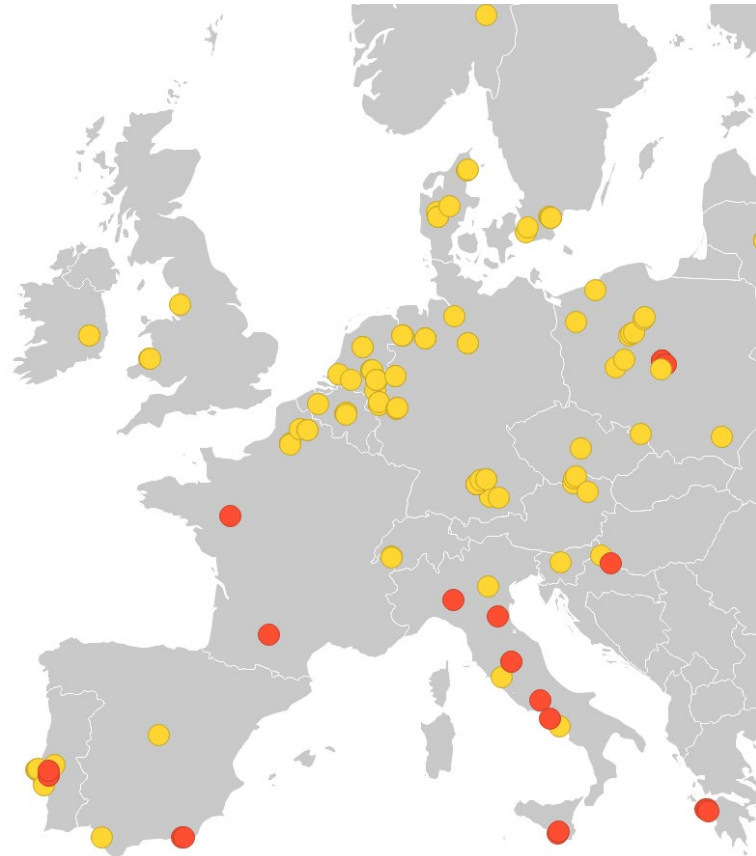


Efficacy?



Phytophthora infestans field monitoring 2024-25

Monitoring 2024-25 includes 358 leaf isolates and 683 FTA cards / dried leaf

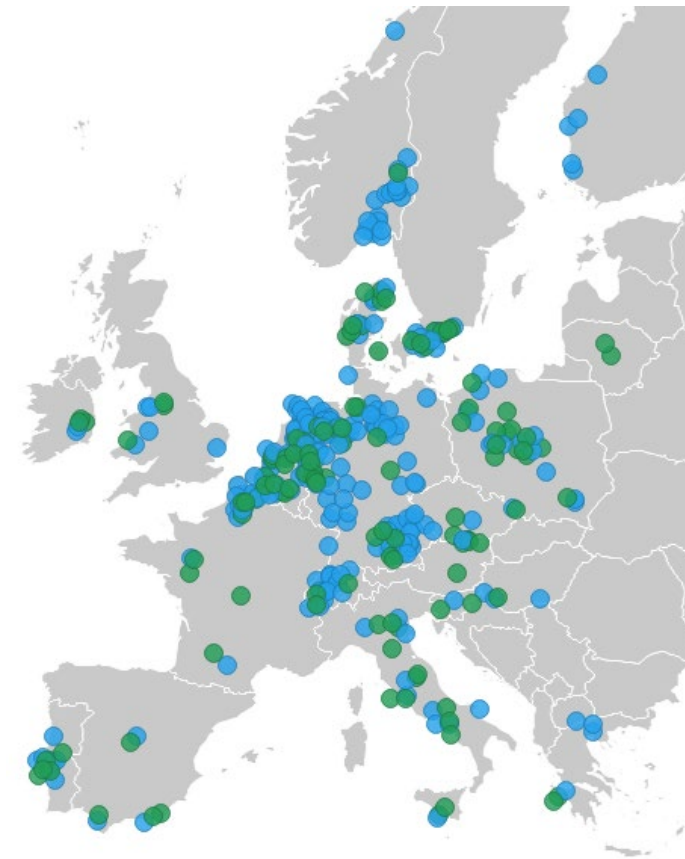


Samples for bioassay

- potato
- tomato

isolates

Austria	21
Belgium	18
Croatia	8
Czech Republic	2
Denmark	36
France	23
Germany	86
Greece	7
Ireland	4
Italy	34
Lithuania	6
Netherlands	23
Norway	2
Poland	44
Portugal	25
Slovenia	2
Spain	16
Sweden	23
Switzerland	23
United Kingdom	8



Samples for molecular analyses

- FTA
- leaf

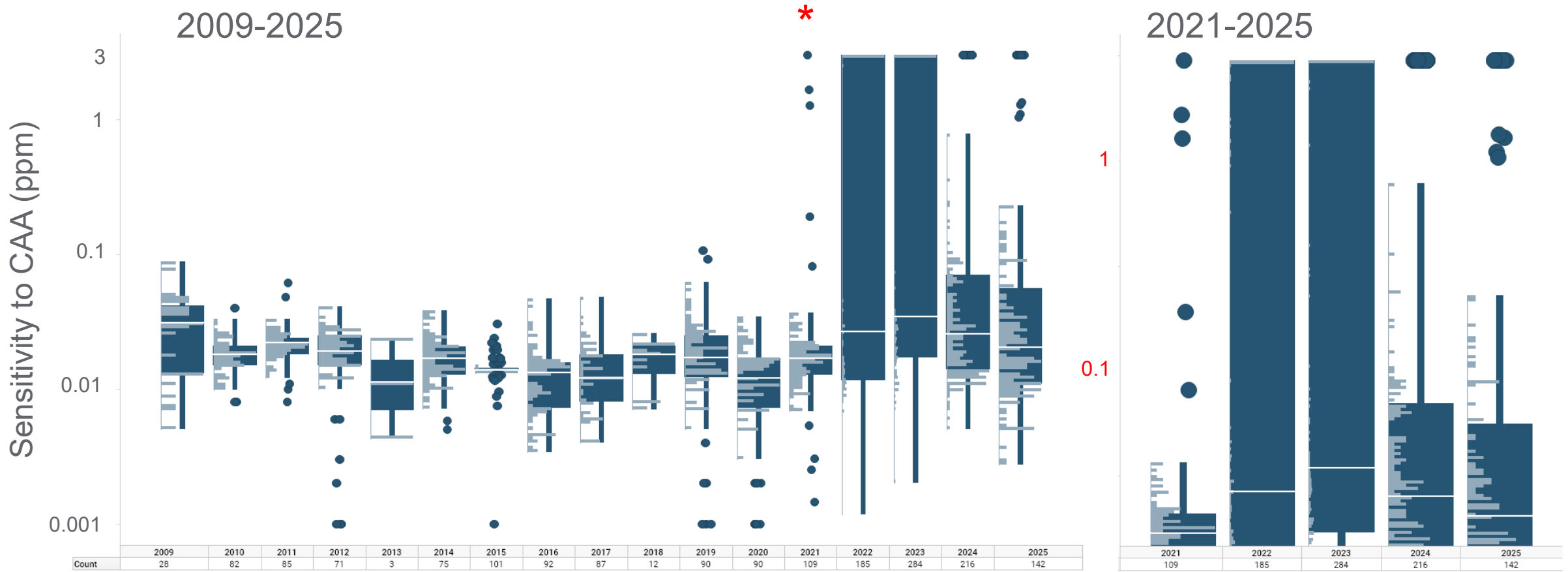
isolates

Austria	20
Belgium	76
Canada	6
Croatia	12
Czech Republic	3
Denmark	107
Finland	14
France	86
Germany	264
Greece	7
Hungary	0
Ireland	19
Italy	28
Lithuania	7
Netherlands	124
Norway	14
Poland	105
Portugal	56
Slovenia	4
Spain	15
Sweden	90
Switzerland	34
United Kingdom	39

- In 2025 we sampled 62% of the symptoms collected in 2024 (low pathogen pressure)
- 65% of 2024-25 samples were collected from field trials and 35% from commercial fields.

Evolution of *P. infestans* sensitivity to CAAs since 2009 (n=2013)

All samples (isolates) tested up to 2020 showed complete sensitivity to CAAs

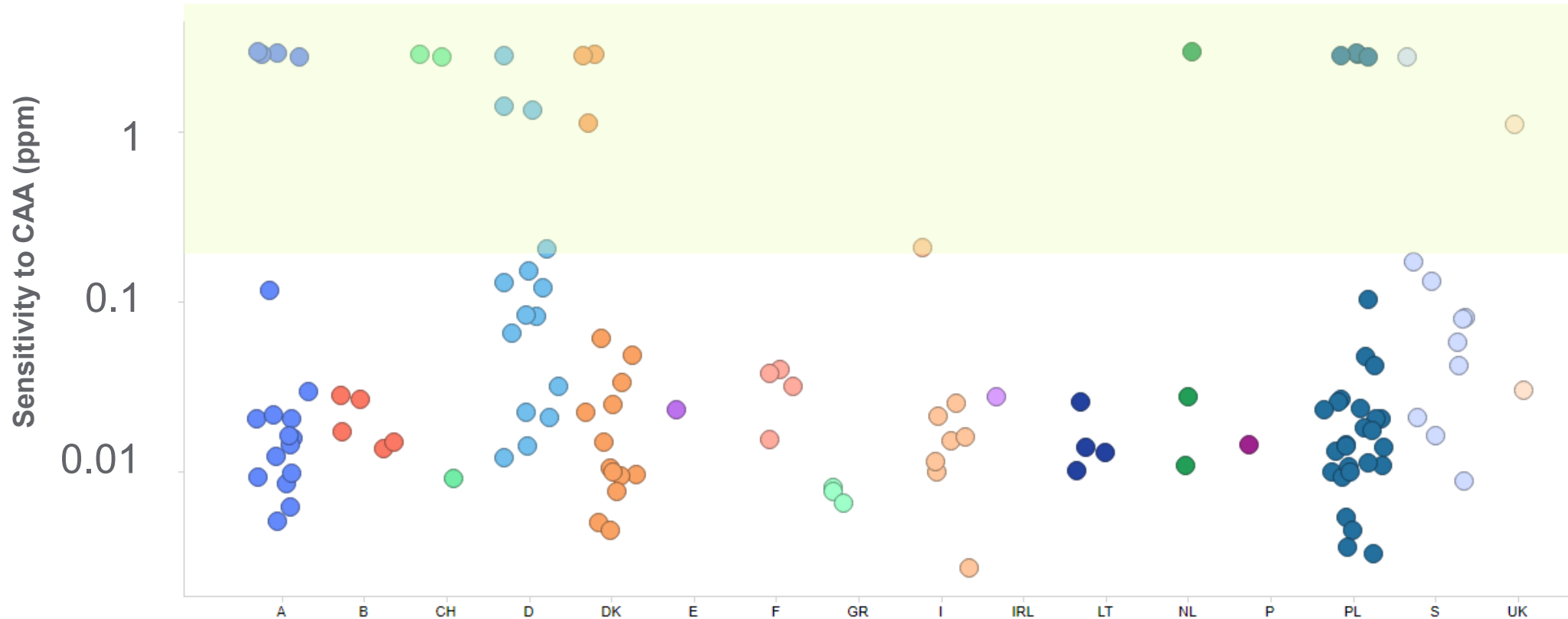


- In 2024-2025 we observed a reduction of resistance to CAAs compared to 2022-2023, both as median and population composition (MPD 0, 0.001, 0.01, 0.03, 0.1, 0.3, 1, 3 ppm)
- Outliers and resistant samples are still present in 2024-2025, but a shift is clearly visible compared to 2022-2023

Geographic distribution of sensitivity to CAAs in 2025 (n=142)

P. infestans resistance to CAAs is present in several European countries

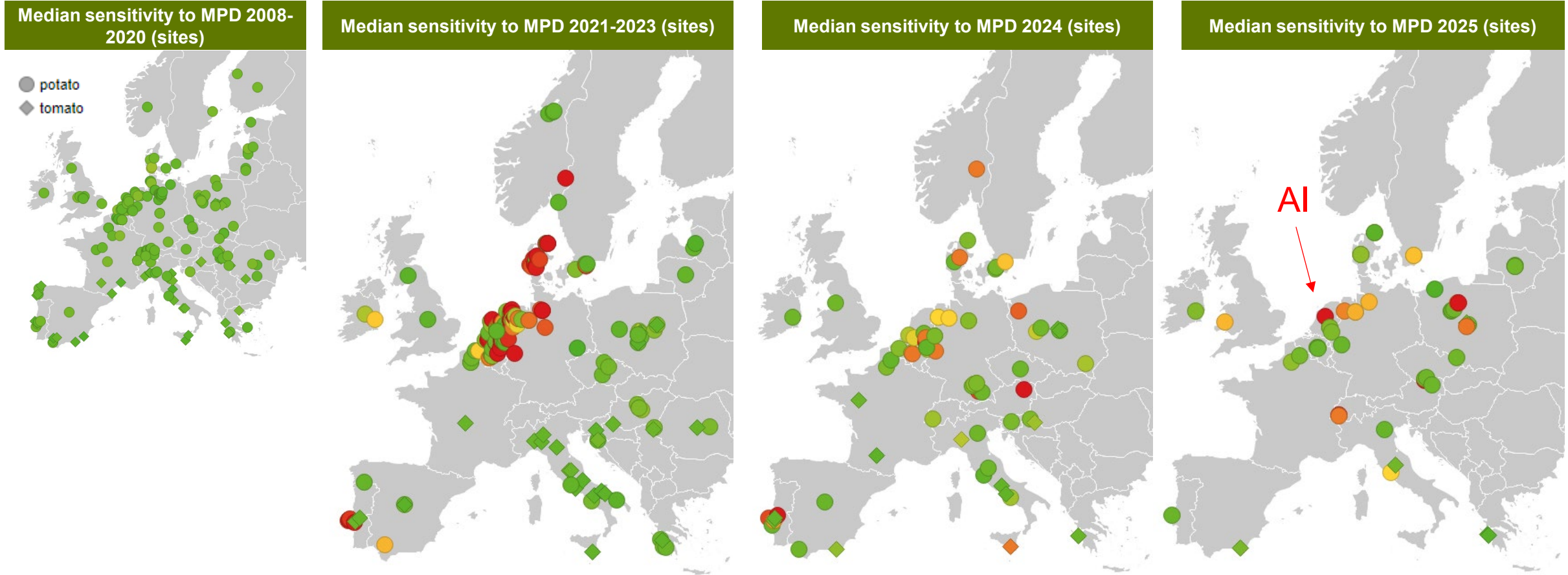
*



- **No resistant phenotype** was detected in Belgium, France, Greece, Ireland, Lithuania, Portugal, and Spain (in potato or tomato)
- **Strains collected from potato and showing resistance to CAAs were monitored in Austria, Switzerland, Germany, Denmark, (Italy) **, Netherlands, Poland, Sweden, and UK**

All samples monitored between 2008 and 2020 were sensitive to CAAs

A total of 2023 *P. infestans* strains collected from 25 European countries were tested

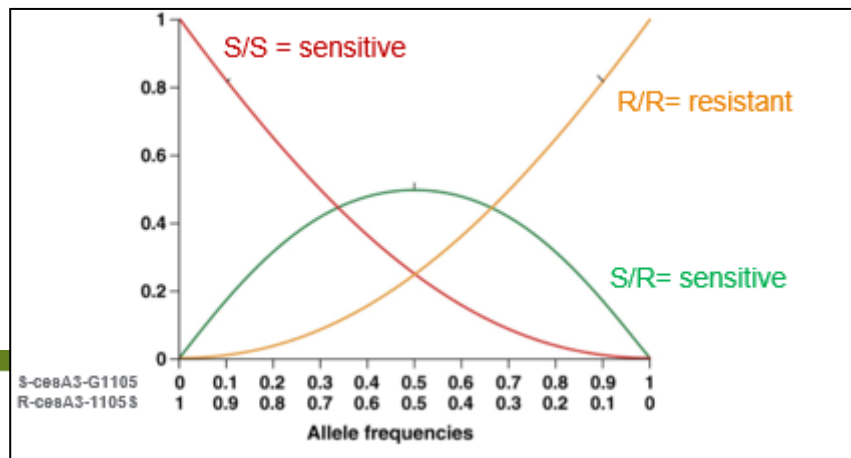


- Up to 2020 no resistance to CAAs detected in potato/tomato
- From 2021 to 2023 resistance to CAAs detected in Portugal, Benelux, Germany, Spain, Denmark, Ireland and Norway
- In 2024 Austria, Sweden and Poland as new entries
- In 2025 Switzerland, UK (and Italy) as new entries

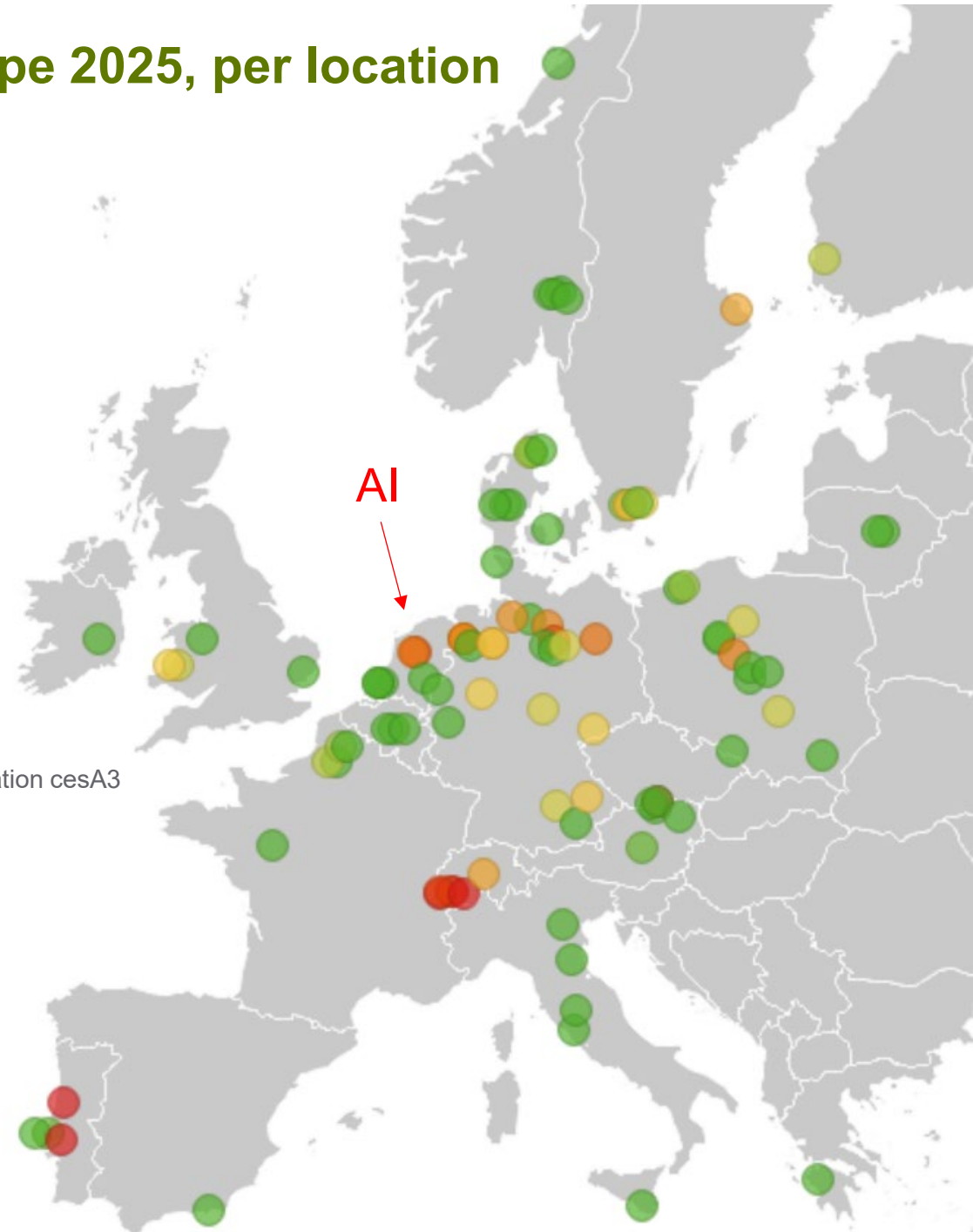
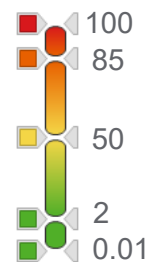
Detection Quantification of cesA3_1105S, Europe 2025, per location

Molecular quantification from FTA cards and leaves

- The mutation cesA3_1105S likely to follow **recessive inheritance mechanisms**
- High frequency of cesA3_1105S was detected in Portugal, and Switzerland
- Moderate to high frequency of cesA3_1105S was detected in Netherlands (**AI with EU43**) and Germany
- Low to moderate frequency of cesA3_1105S in North France, UK, Finland, Poland, Denmark, Austria and Sweden
- Full sensitivity to CAA (no cesA3_1105S) in Belgium, Spain, Ireland, Greece, Italy, Lithuania and Norway

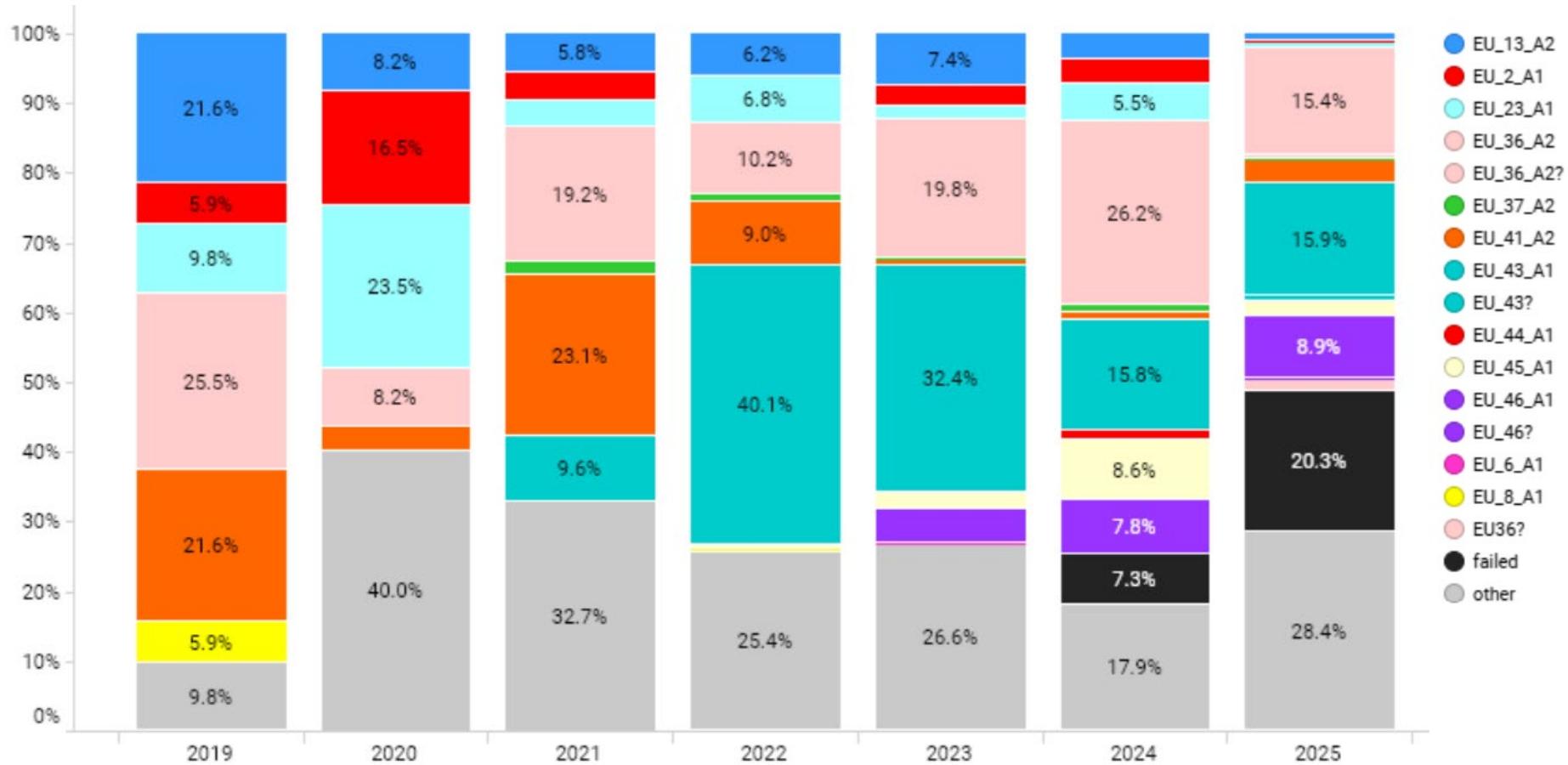


Frequency of mutation cesA3



Historical development of SSR types, EU, (Syngenta data)

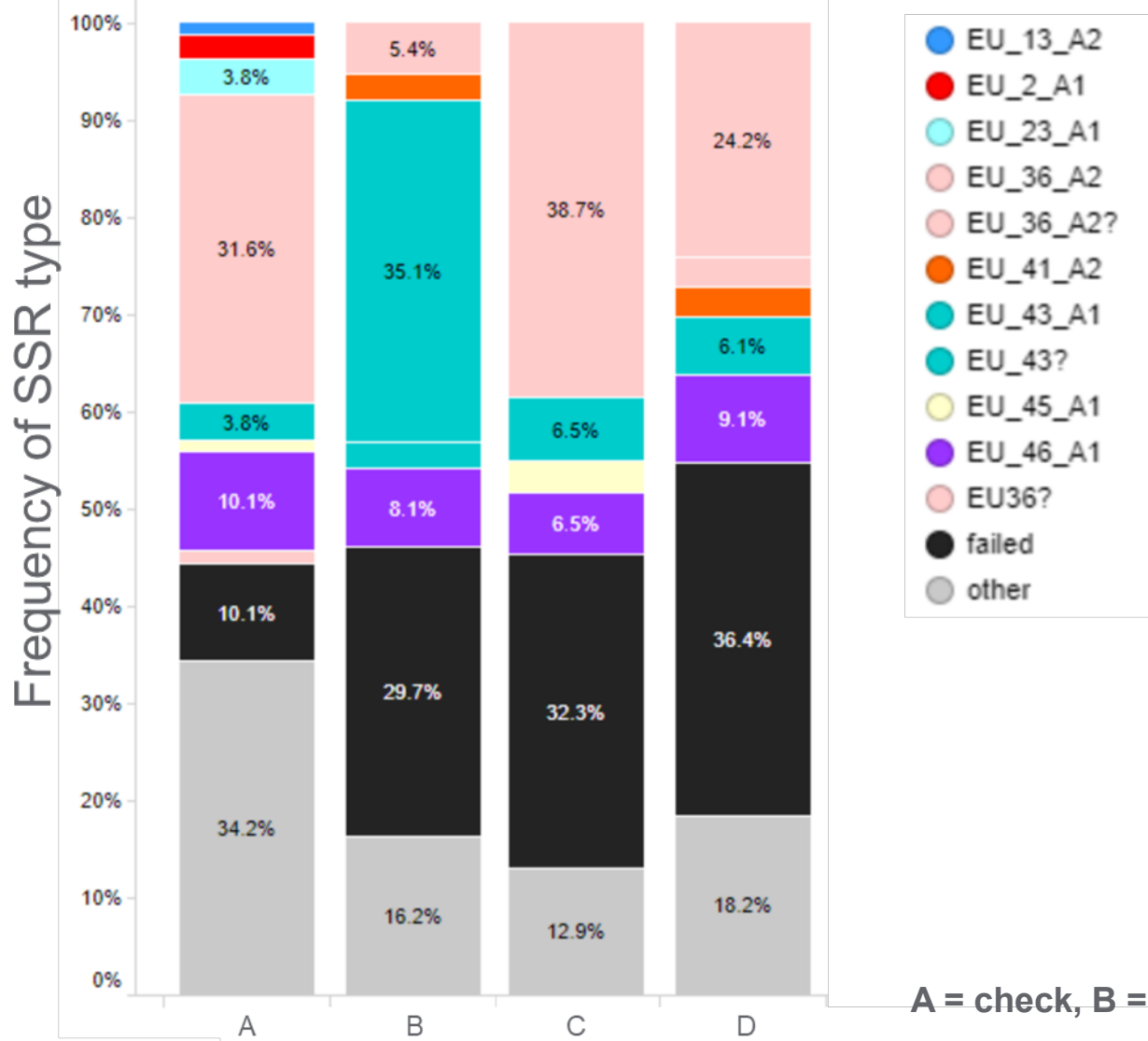
There is no genetic correlation between SSR types, “SSR probes” and resistance markers



- In the last two years, the frequency of EU43 has been reduced and stabilized compared to 2022-2023
- EU46 frequency in 2025 is similar to 2024
- What is behind this reduction / stabilization?

Effects of CAA mixtures / strategies on selection of SSR types, EU

Quantification from FTA cards. field trials

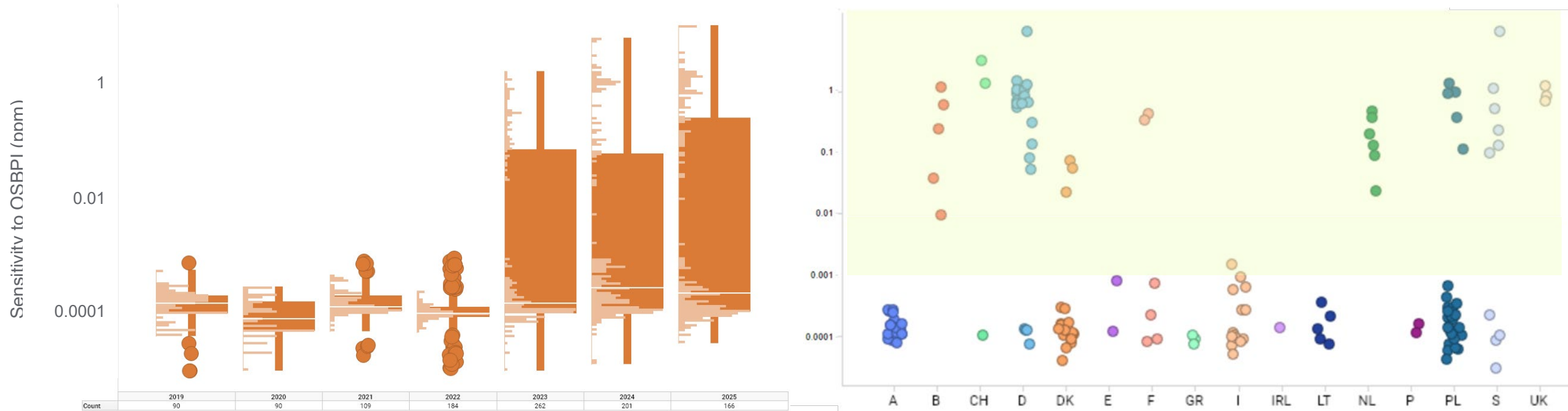


- Consecutive CAA solo (B) increases the presence of EU43 but not of EU46
 - **EU46 is not under selection of CAA, is the slight increase reported by Euroblight 2026 possibly caused by selection via OSBPI?**
- **C and D keep control on EU43 and EU46 despite the presence of CAA and other MoAs**
- Additional contributors to the management of CAA resistance:
 - recessive inheritance of cesA3_1105S?
 - fitness cost given by the mutation?

A = check, B = 6x CAA, C = CAA containing mixture, D = CAA containing strategy

Evolution of *P. infestans* sensitivity to OSBPIs since 2009 (n=1102)

2025



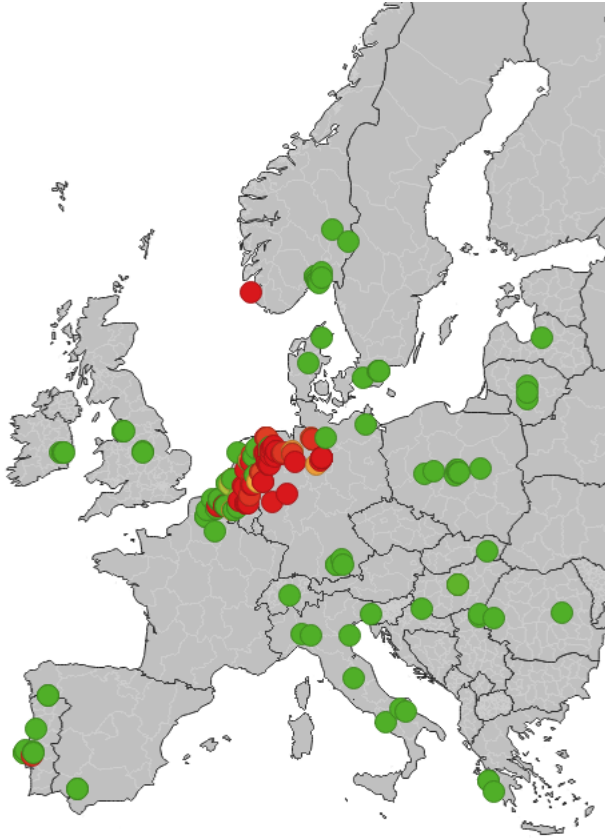
- **First resistance to OSBPIs in *P. infestans* from potato was detected in 2023 (OXTP 0, 0.00001, 0.0001, 0.001, 0.01, 0.03, 0.1, 0.3 ppm)**
- In 2025, full sensitivity to OSBPIs is monitored in Austria, Spain, Greece, Ireland, Lithuania, and Portugal
- **In 2025, resistance to OSBPI in *P. infestans* is detected in Belgium, (Italy)*, Netherlands, Germany, France, Switzerland, UK, Denmark, Sweden and Poland.**

* not supported by molecular analyses

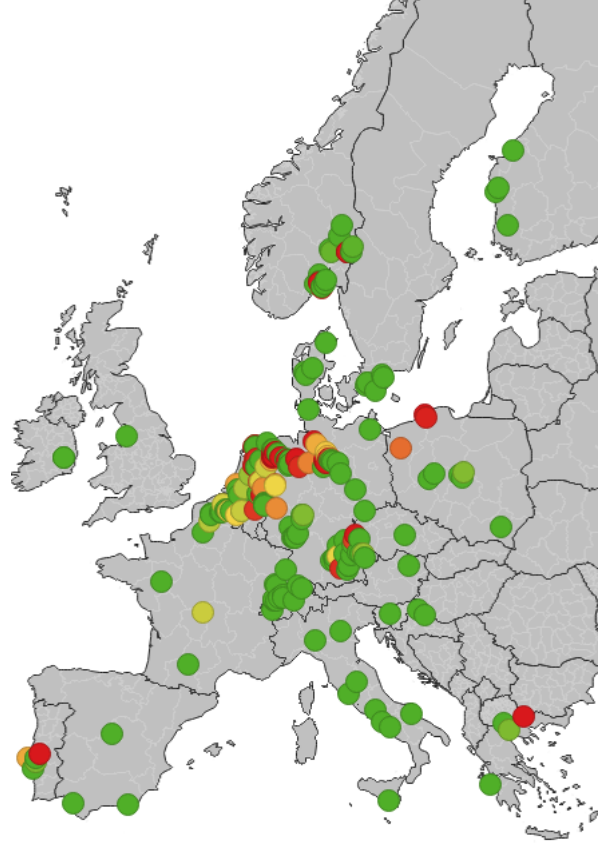
Geographic distribution of sensitivity to OXTP in 2023-2025

Cumulative frequency of *osbp_770V + osbp_837F/I*

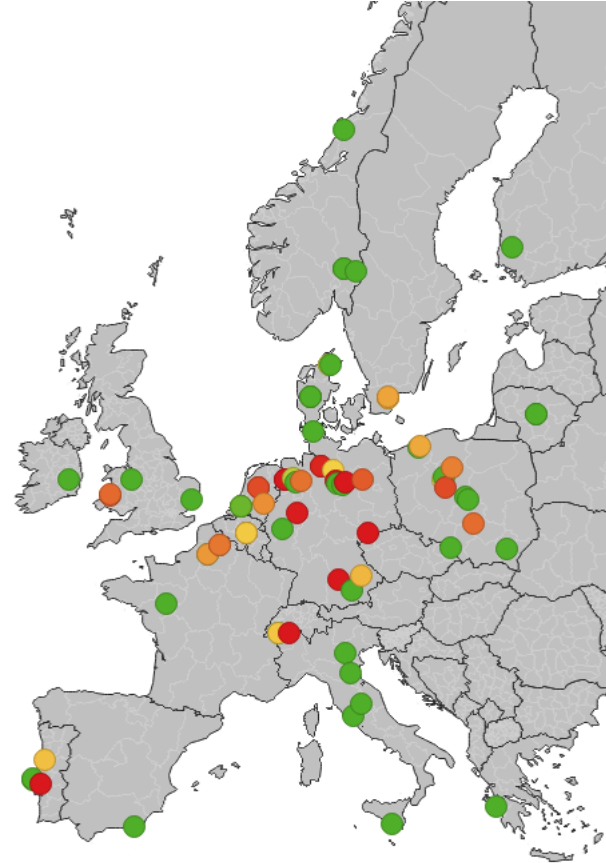
P. infestans *osbp_cum* – sites 2023



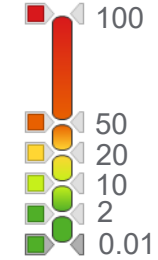
P. infestans *osbp_cum* – sites 2024



P. infestans *osbp_cum* – sites 2025



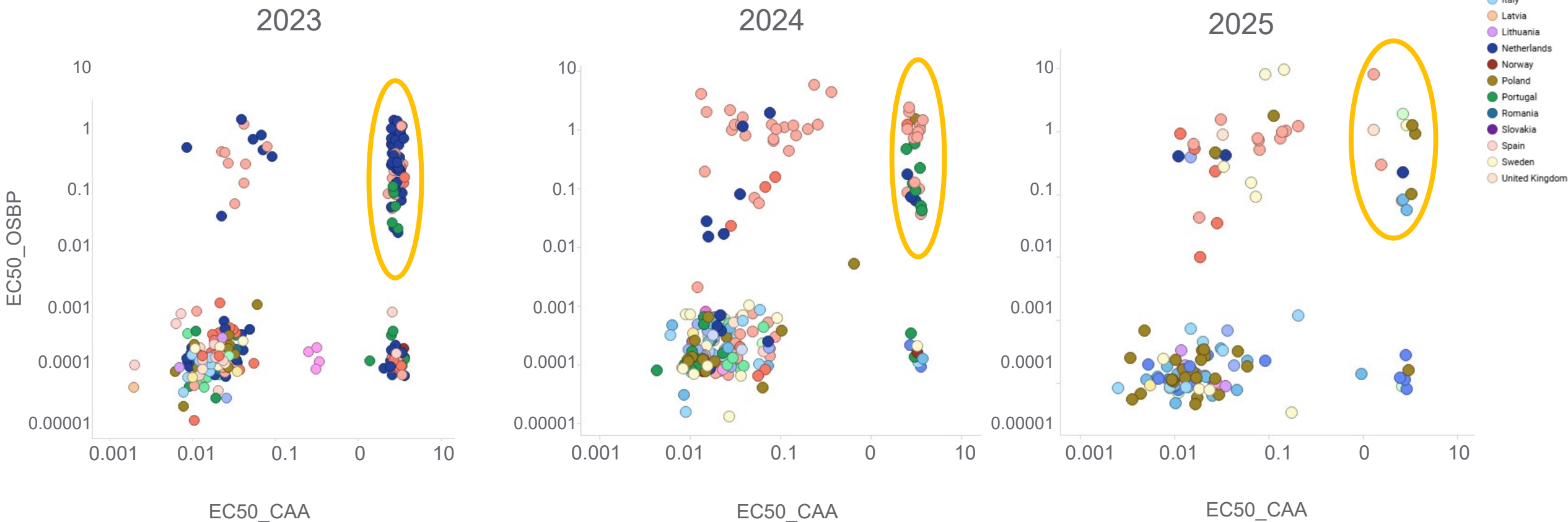
Frequency of mutations in *osbp*



- In 2023, resistance to OSBPI emerged
- In 2024 it spread across Europe
- In 2025, regional variations of sensitivity to OSBPIs are still present
- **Mutations in *osbp* loci 770 and 837 are dominant**

CAA, OSBPI double mutants, evolution 2023-2025 (isolates)

Correlation CAAR and OSBPIR (phenotyping)



Phenotyping suggests a decrease in double mutants CAA, OSBPI (in the orange circle) from 2023 to 2025

CAA, OSBPI double mutants, evolution 2023-2025

CAAR decreased in the last 2 years, OSBPIR increased, double mutants decreased (phenotyping)

	2023	2024	2025
sensitive	55.02%	67.14%	62.60%
OSBPIR	5.80%	15.19%	21.95%
CAAR,OSBPIR	23.12%	12.44%	9.76%
CAAR	15.89%	4.48%	5.79%

- The sensitive population to both CAAs and OSBPIs in 2025 is higher than 2023 (62% compared to 55%)
- Resistance to OSBPI increased from 5.80% to 21.95%
- Resistance to CAA decreased from 15.89% to 5.79%
- **Double mutants CAA,OSBPI decreased from 2023 to 2025 from 23.12% to 9.76%**

Where do we go from here?

- In the last two years, mixtures and alternations with different MoAs and strategies based on country-specific, available products reduced the levels of resistance to CAA compared to 2022-2023

2.2. CAA – *Phytophthora infestans* – Late blight

Disease incidence

In 2024, disease pressure was very high in the main potato growing areas of Europe.

Monitoring results

(Certis-Belchim, K-I Chemical and Syngenta)

In 2024 samples were taken from potatoes and tomatoes from Austria, Belgium, Croatia, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Portugal, Slovenia, Spain, Switzerland, Sweden, UK. As in 2023, analysis was done with sensitivity tests using isolates or populations from leaf samples and/or with genetic analysis from these samples. Complementary studies were conducted to quantify target-site mutation G1105S.

Potatoes: In countries where CAA resistance was detected in the last years, the frequency of CAA resistance stabilized or even decreased. This indicates that resistance management strategies are effective.

However, an expansion to other countries has been detected (Austria, Poland, France). A full sensitive situation was observed in UK, Ireland, Italy, Latvia, Lithuania, Spain, Greece, Switzerland, Czech Republic, Croatia, Slovenia, Finland.

2.2. CAA – *Phytophthora infestans* – Late blight

Disease incidence

In 2025, disease pressure was low in the main potato growing areas of Europe.

Monitoring results

(Certis Belchim and Syngenta)

Europe

In 2025, samples were taken from potatoes and tomatoes from Austria, Belgium, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Portugal, Spain, Switzerland, Sweden, and United Kingdom. As in the previous years, analysis was done with sensitivity tests using isolates or populations from leaf samples and/or with genetic analysis from these samples. Complementary studies were conducted to quantify target-site mutation G1105S.

Potatoes: In countries where CAA resistance was detected in the last years, the frequency of CAA resistance stabilized or even decreased. This indicates that resistance management strategies are effective.

An expansion to other countries has been detected (Switzerland and United Kingdom). In 2025, resistance has been detected in Austria, Denmark, France, Germany, Poland, Portugal, Sweden, Switzerland, the Netherlands, and United Kingdom.

- How to **stop resistance spread via seed potatoes?** The case of Portugal 2022
- How to **keep the toolbox as large as possible** to stabilize or even decrease resistance?
 - Old new chemistry? New resistant potato varieties? IPM / ICM (ctrl on potato culls, interval timing ...)

