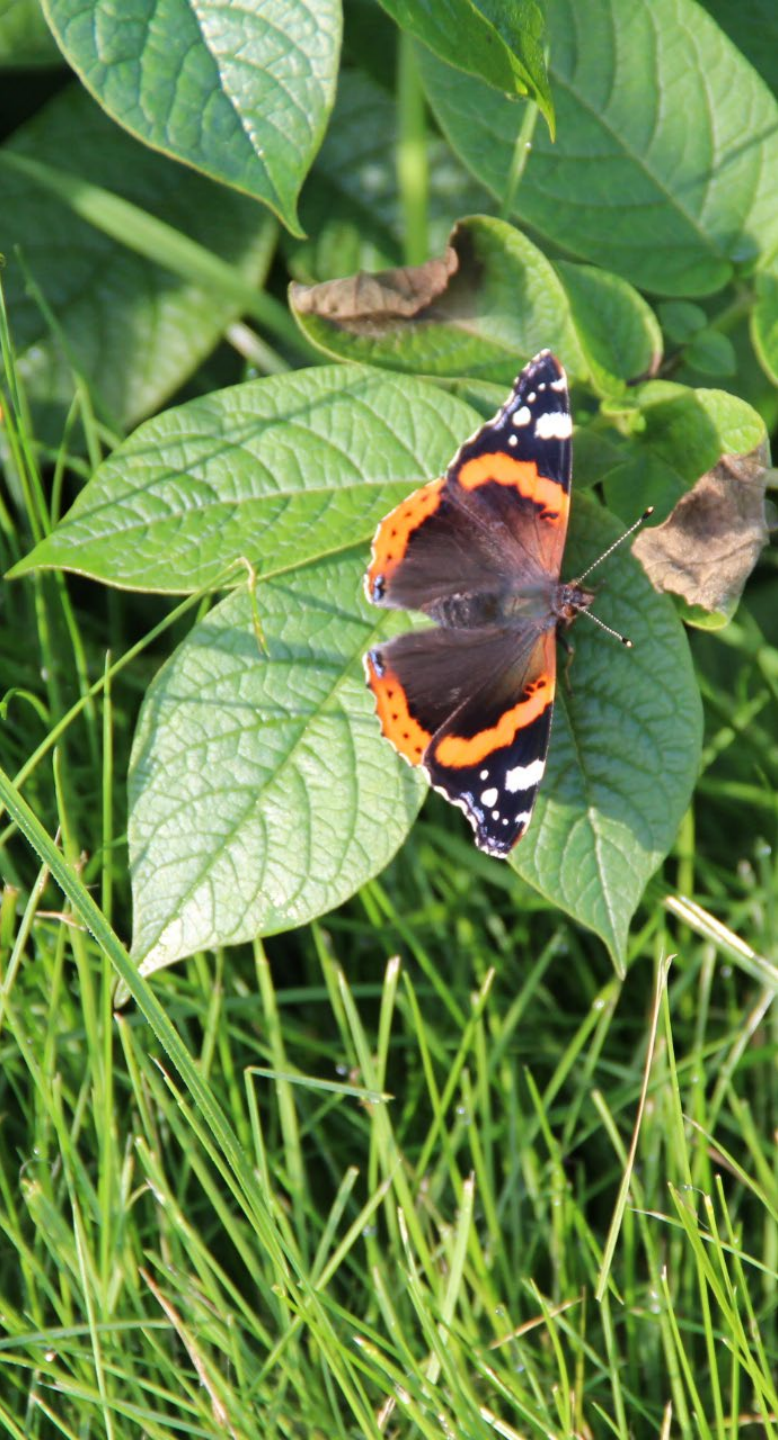


Kartoffelskimmel i DK og Europa – hvad er status

Jens G. Hansen & Isaac K. Abuley, Aarhus Universitet

Outline

- EU43 resistance against mandipropamid – sounding the alarm
- Key results on the Danish *P. infestans* population
- The evolution and spread of EU43 in Europe, 2017-2023 – focus on DK and NL
- Discussion

Store Kartoffeldag 2024, 25 January, 2024

PLANTER | 30-08-2022 08:35:45 |

Risiko for resistens mod Revus

I flere forsøg ses der nu en vigende effekt af Revus mod skimmel i kartofler. Derfor anbefaler landskonsulent, at midlet indtil videre ikke anvendes, hvor der er udbredt skimmel.

Forsøgsmæssigt er der anvendt ren Revus i forsøgmarken i Arnborg. Den vigende effekt giver mistanke om resistensudvikling. Arkivfoto

SEGES sounding the alarm

News from SEGES, 30 August 2022

Risk for resistance against Revus
(a.i. = mandipropamid). Obs from trials and commercial fields

Only EU ☑

Product (Dose rate [litre or kg/ha])	Leaf blight	Tuber blight	New growth	Stem blight	Protec-tant	Curative	Anti sporulant	Rain-fastness	Mobility	Year
cymoxanil + fluazinam									Unknown + Unknown	0
copper				●	●◖	0	0	●	C	
cyazofamid (0.5)	3.8	3.8	●●	●	●●●	0	0	●●●	C	2001
fluazinam (0.4)	2.9			●	●●●	0	0	●●◖	C	1992
fluazinam + azoxystrobin (0.5)	3.6								C + C	2016
mandipropamid (0.6)	4.0		●●	●◖	●●●	●[6]	●◖	●●●	C/T	2005
mandipropamid + difenoconazole (0.6)	4.0		●●	●◖	●●●	●[6]	●◖	●●●	C/T + C	2005
benthiavalicarb (0.5)	4.2								T	2018
cymoxanil + metiram				●◖	●●	●●	●	●●	T + C	1976
cymoxanil + copper				●◖	●●	●●	●	●●	T + C	1976
dimethomorph + fluazinam (1.0)	3.7	3.3	●	●	●●◖	●	●●	●●◖	T + C	2012
(zoxamide + cymoxanil) + fluazinam (0.45+0.4)	4.0								C/T + C	2013
(zoxamide + dimethomorph) + fluazinam (1.0+0.4)	4.2								C/T + C	2015
mandipropamid + cymoxanil (0.6)	4.4		●●	●◖	●●●	●●	●◖	●●●	C/T + T	2013
(pyraclostrobin + dimethomorph) + adjuvant (2.5+1.0)	4.0[7]								C/T + T	2012
metalaxyl-M + fluazinam[2]			●●	●●	●●◖	●●◖	●●◖	●●●	S + C	
propamocarb + cymoxanil + cyazofamid ((2.0)+0.5)		4.6							S + T + C	2012
propamocarb + cymoxanil (2.0)					●◖	●●◖[9]	●●◖		S + T	2011
propamocarb-HCl + fluopicolide (1.6)	3.8	3.9	●●	●●	●●●	●●	●●◖	●●◖	S + C/T	2006
oxathiapiprolin (0.15)			●●◖	●●◖	●●●	●●	●●◖	●●●	S	2017
oxathiapiprolin + amisulbrom (0.15+0.3)	4.9								S + C	2018
oxathiapiprolin + amisulbrom (0.25)	4.9	3.9	●●◖	●●◖	●●●	●●	●●◖	●●●	S + C	2022
oxathiapiprolin + benthiavalicarb (0.4)	4.9	3.4	●●◖	●●◖	●●●	●●	●●◖	●●●	S + T	2019

[1] *Includes maneb, mancozeb, propineb and metiram.* [2] *See proceedings for comments on phenylamide resistance.* [3] *Based on EuroBlight field test in 2006-2015.* [4] *Based on EuroBlight field trials 2009-2012.* [5] *Based on limited data.* [6] *In some trials there were indications that the rating was 1½.* [7] *A provisional rating based on 5 EuroBlight experiments.* [8] *Observations from several trials indicated that both New growth and Stem blight were ++.* [9] *In some trials the curative activity was +++.*

EuroBlight
A potato late blight network for Europe

Available products against late blight in Denmark, 2023

Ranman is banned in DK

Shirlan / Zignal / Banjo forte

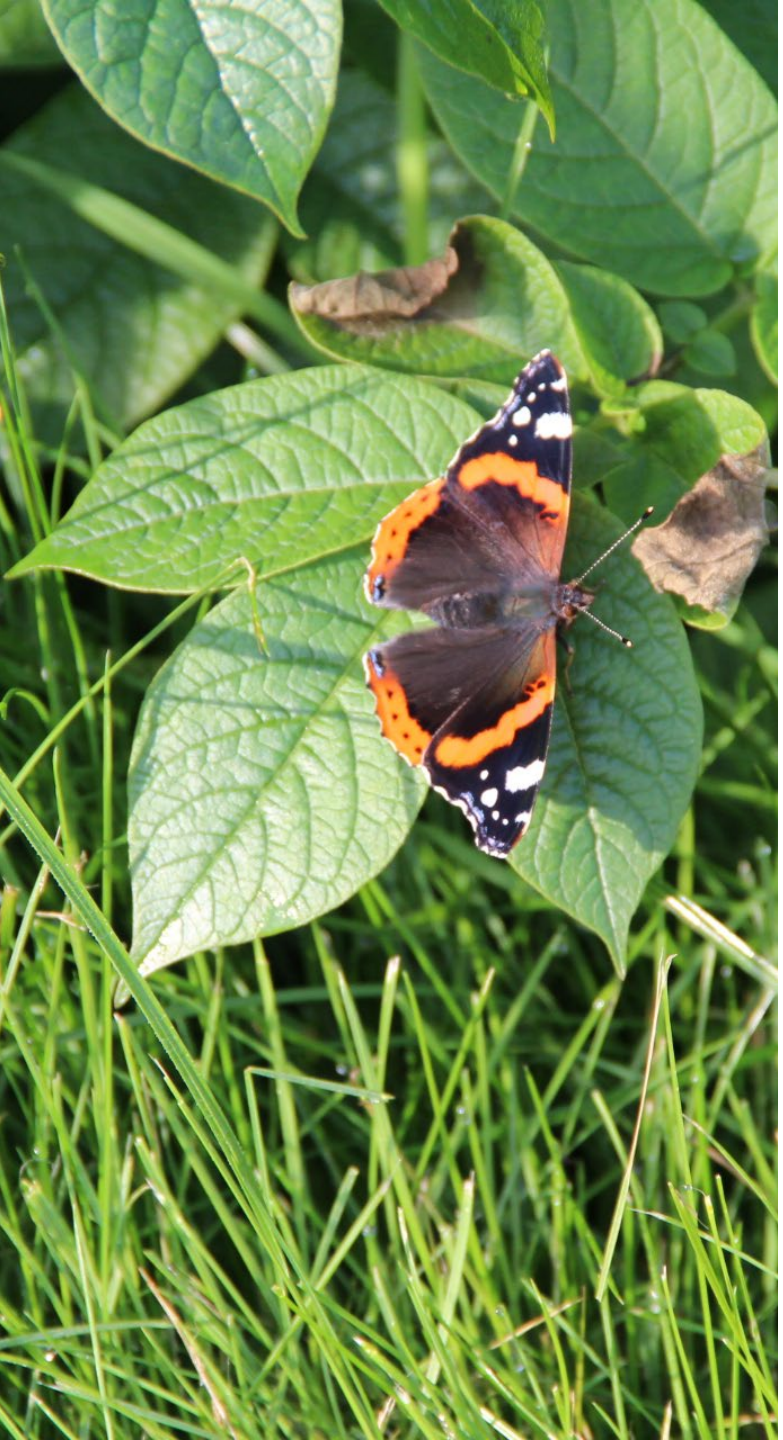
Limited use of Revus in DK (2023: two times in starch potatoes and 0 (zero times in ware potatoes)

Cymbal (cymoxanil alone)

Proxanil

Infinito not allowed in DK

Zorvec is used together with fluazinam to reduce the risk of fungicide resistance



Key questions:

- ❑ Basic biology behind what we see in the fields and trials?
- ❑ Why is the frequency of EU43 dramatically increasing ?
- ❑ How to monitor this new variant fast and reliable?
- ❑ Develop fungicide resistance avoidance strategies?

15 August, 2022: Task-Force to combat new aggressive late blight (6 meetings)

- Aarhus University
- SEGES
- Syngenta
- Belchim (Nordisk alkali)

Topics for discussion

- Methodologies in the field and in the lab
- Coordinated sampling
- Fungicide Resistance Avoidance Strategies
- Communication and dissemination strategy

- DLBR+ Meetings every Monday during the season – Kartoffelnyt and other newsletters

Resistance to mandipropamid in EU_43_A1 reported

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Department of Agroecology › Current news › News › show

A new variant of the late blight pathogen Phytophthora infestans is threatening the potato production

The results of a study on late blight show 100% resistance to one of the most important fungicides in potato production. Researchers find the development of the new variant of late blight worrying in relation to future control in Danish fields.

Resistance has been found in late blight to one of the most widely used pesticides. This raises concerns among researchers from Aarhus University.

Photo: Jens G. Hansen

6 January 2023 by Camilla Brodam Galacho

Press release by Aarhus University, 6 Jan 2023

5 isolates tested – all resistant to mandipropamid

https://agro.au.dk/en/current-news/news/show/artikel/kartoffelproduktionen-trues-af-stigende-resistens-hos-kartoffelskimmel-mod-kemiske-bekaempelsesmidler

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

28 April 2023

ORIGINAL ARTICLE | Open Access

The EU43 genotype of *Phytophthora infestans* displays resistance to mandipropamid

Isaac K. Abuley, James S. Lynott, Jens G. Hansen, David E. L. Cooke, Alison K. Lees

First published: 28 April 2023 | https://doi.org/10.1111/ppa.13737

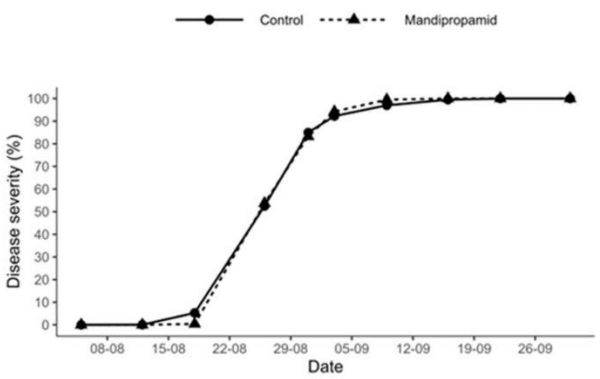
Abstract

Mandipropamid is an active ingredient in the carboxylic acid amide group of fungicides and plays a key role in current potato late blight (*Phytophthora infestans*) management programmes. However, reports from Danish potato growers in 2022 suggested that mandipropamid had lost its efficacy. A study was therefore conducted to investigate the sensitivity of isolates collected from fields in which mandipropamid had been reported to be ineffective. Seventy-two isolates of *P. infestans* collected from potato fields in Denmark were genotyped using microsatellite markers, revealing a dominance of the clonal lineage EU43 and fewer isolates of EU41 and 'other' genetically distinct genotypes. Isolates belonging to the EU43 and EU41 lineages were selected, in addition to representative isolates of clones EU36 and EU37 from Scotland, and tested for sensitivity to mandipropamid at five concentrations ranging from 0.1 to 10 µg/mL on potato leaf discs (cultivar Maris Piper). The EU43 genotype infected leaf discs at all tested concentrations, and therefore no dose–response curve could be calculated. A dose response was observed for isolates of genotypes EU36, EU37 and EU41 with EC_{50} values ranging from 0.35 to 0.75 µg/mL. Field experiments confirmed resistance of tested isolates of genotype EU43 to mandipropamid, with no significant difference in the area under the disease curve between the untreated and mandipropamid treatments. Analysis of the Danish population of *P. infestans* showed that EU43 was widely distributed across the country. To our best knowledge, this is the first report of resistance to mandipropamid in *P. infestans*.

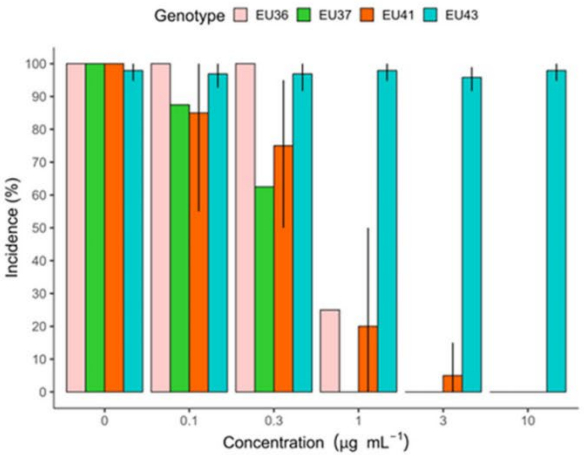
***Phytophthora infestans* was isolated from late blight lesions**

Isolates were tested for their sensitivity to mandipropamid

Field experiment with EU43

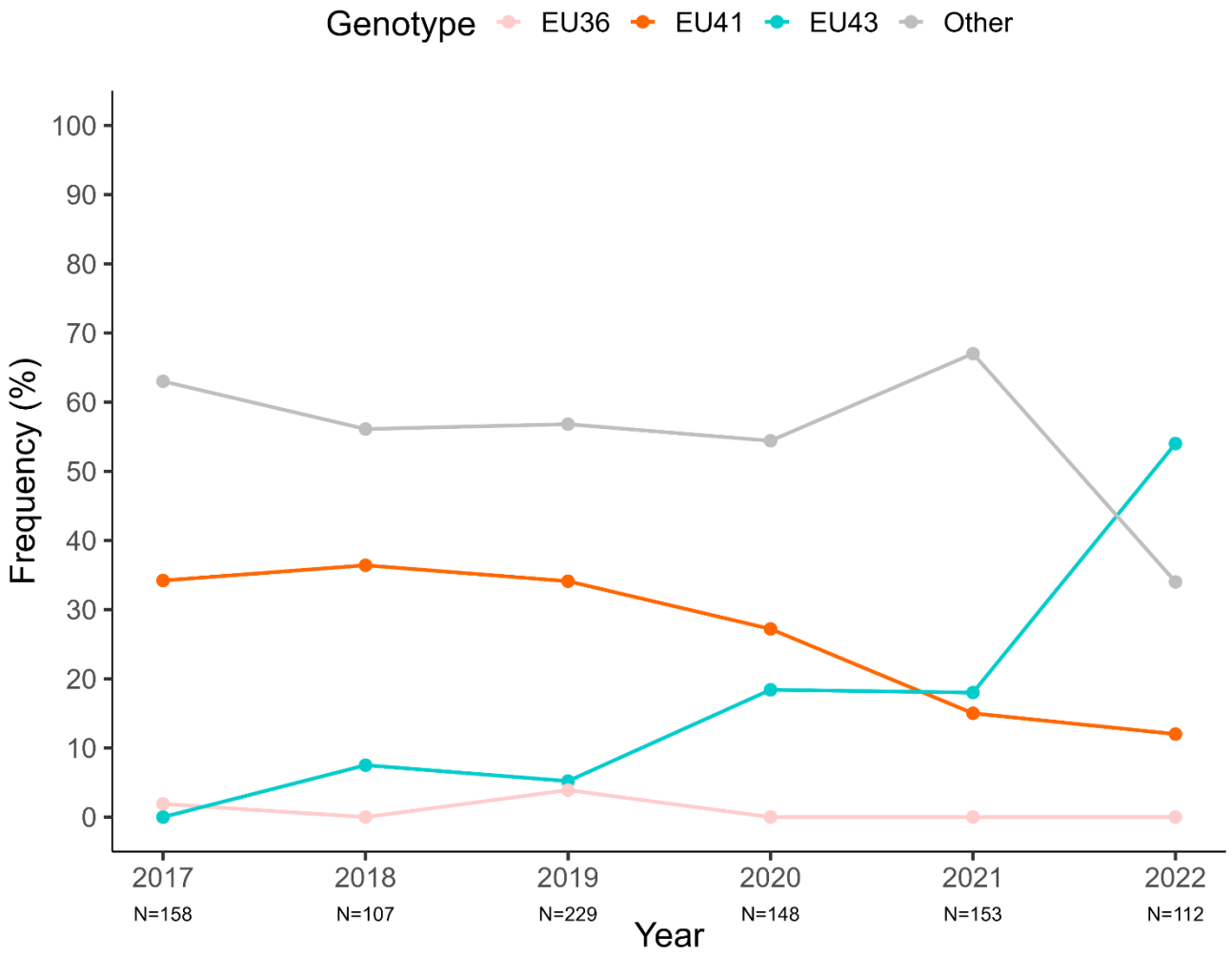


Disease development in the untreated control and mandipropamid treated plots



EU43 infected leaf discs at all concentrations of mandipropamid

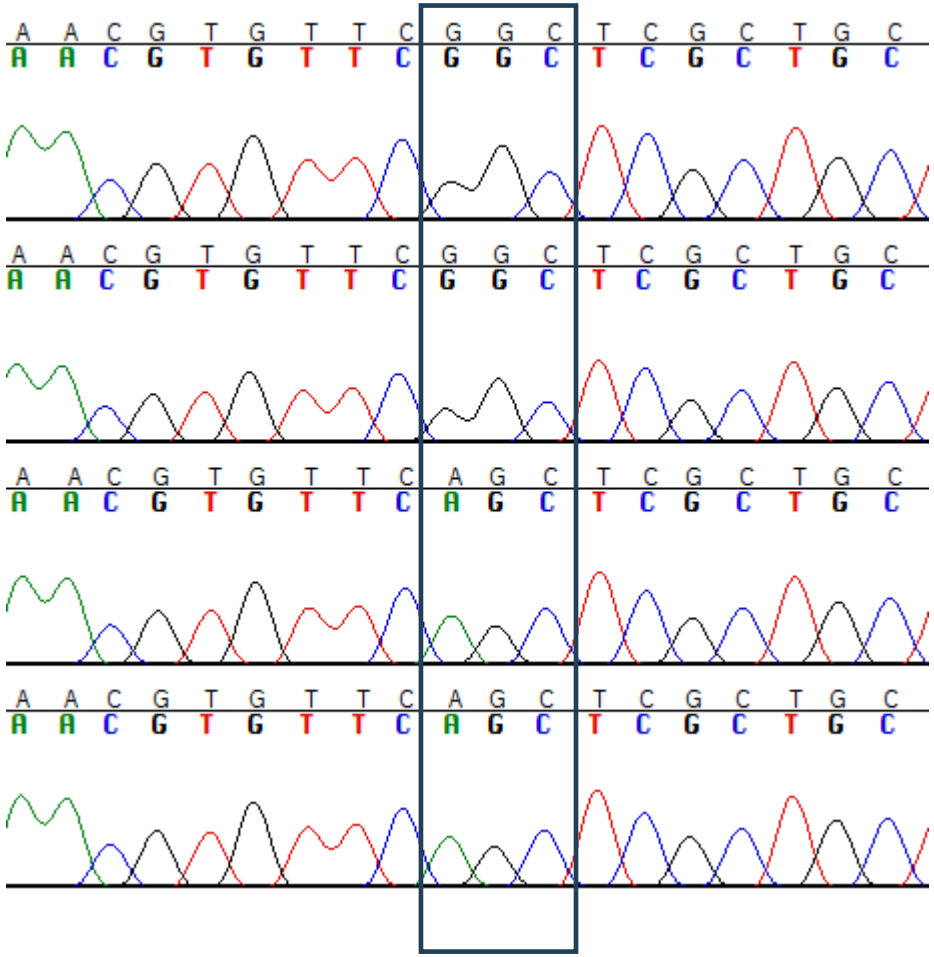
The spatial and temporal distribution of EU43 in Denmark



15/02/2022

What else do we know about EU43 – and the other genotypes we have in DK

Mutation confirmed



Sensitive

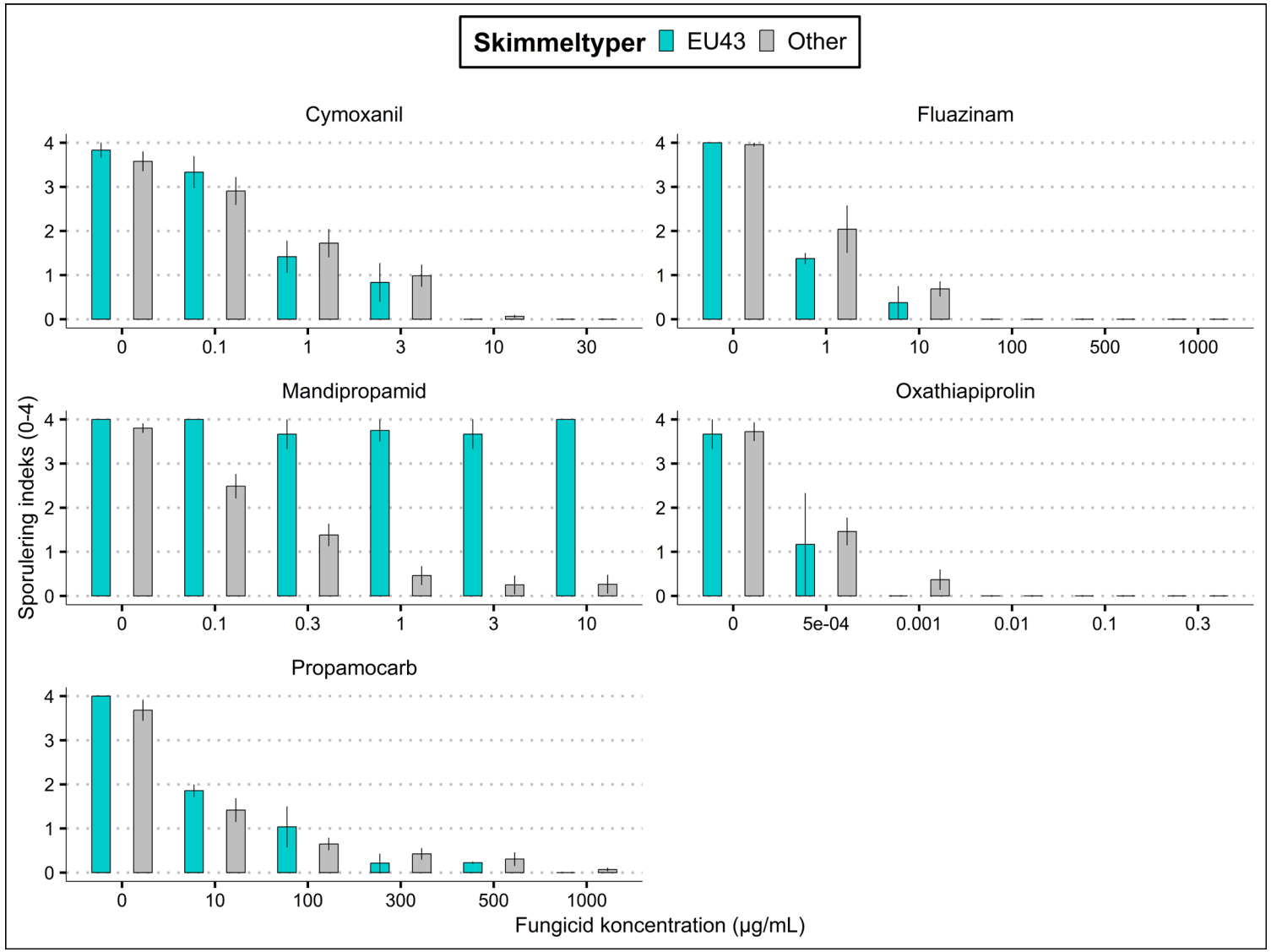
Sensitive

Resistant

Resistant

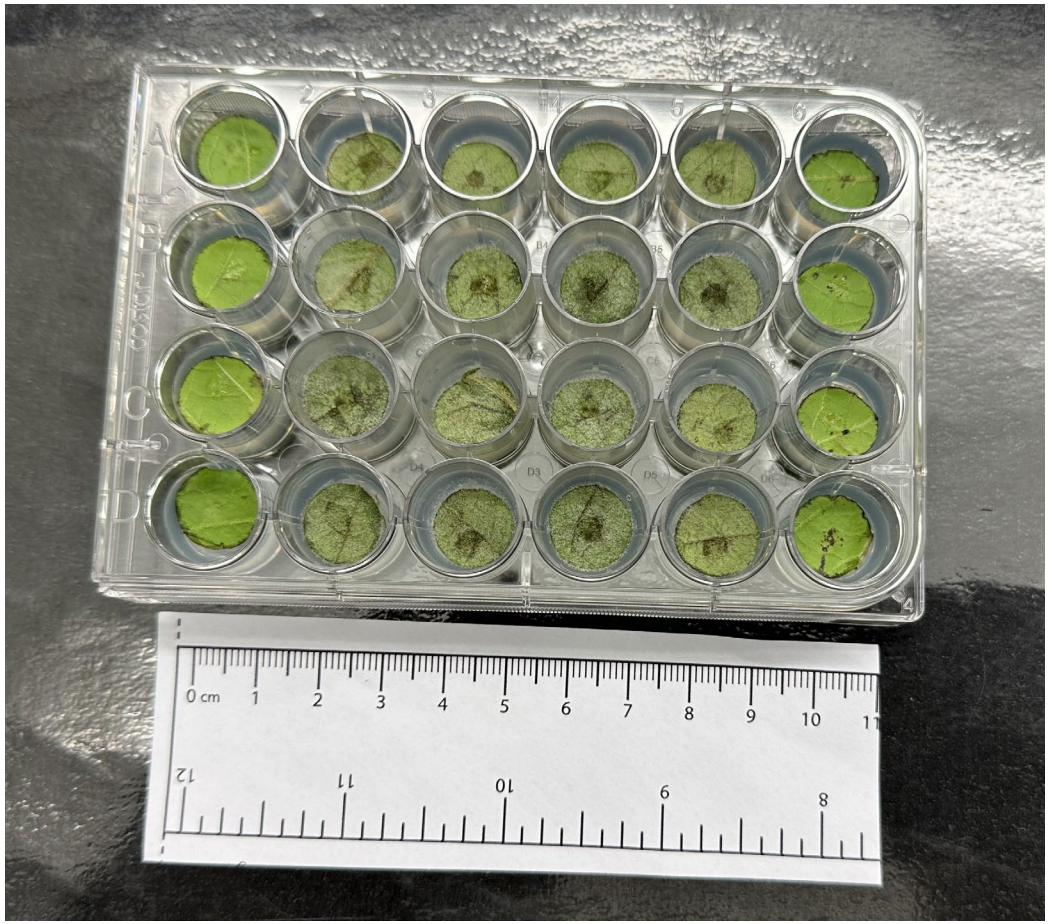
- Syngenta indicated mutation at end of *PiCesA3* gene
- G1105S conserved Glycine to Serine *cf* Blum *et al* Valine or Alanine
- Simple PCR assay at Hutton confirmed same SNP in 10 isolates of EU_43_A1
- Homozygous recessive
- No other SNPs identified across 950bp screened gene
- SNP not found in any other sample to date

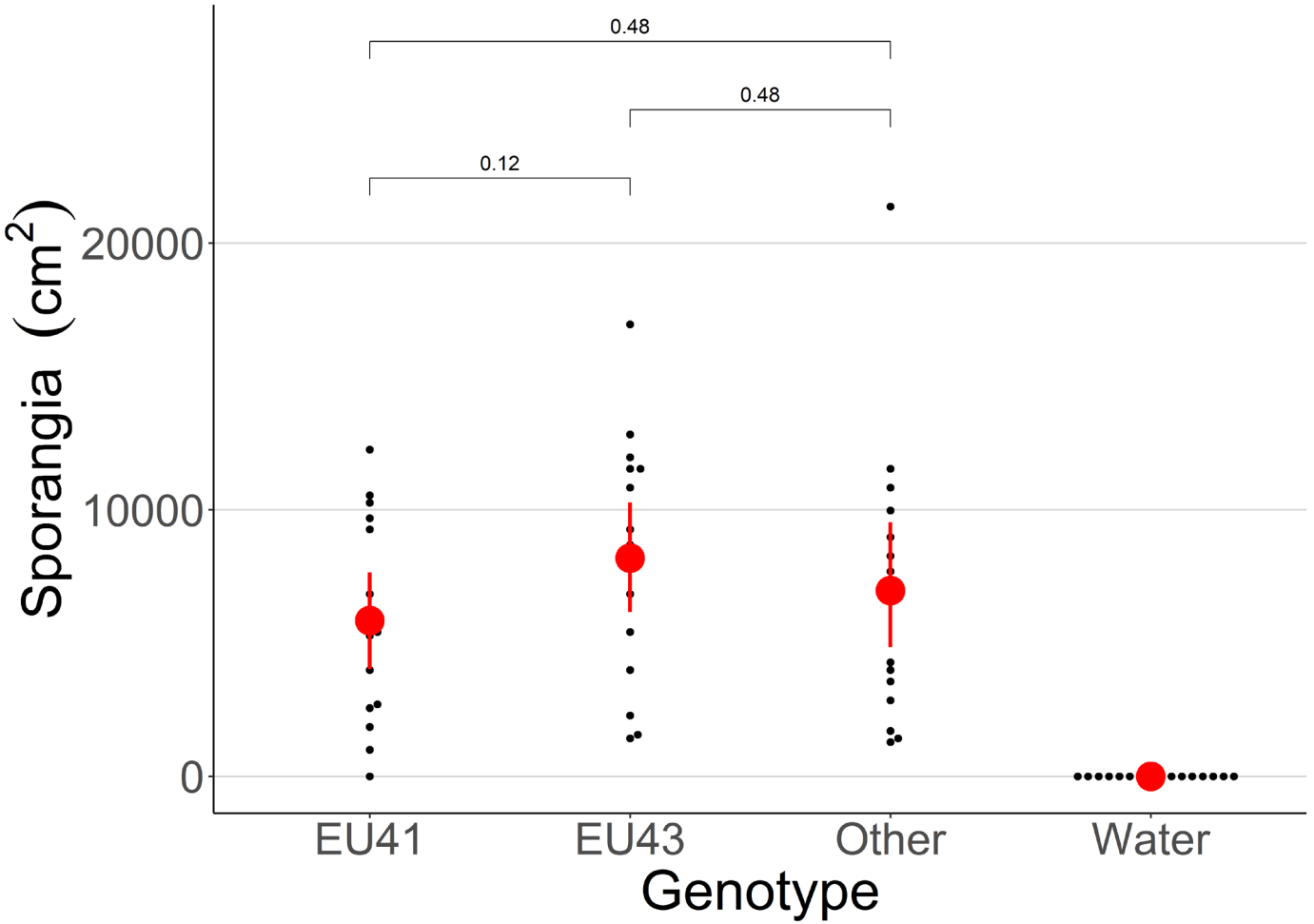
Except EU43 and mandipropamid, all tested isolates were sensitive to the fungicides tested



Number of isolates tested so far:
EU43 = 3
Other = 27

Sporangia production of EU43, EU41, and other genotypes





15/02/2022

Tabel 1. General strategies for Starch potatoes

Nr.	1	2	3	4	5	6	7	8	9	10	11	12	13	Antal behand.	Mængde, l/ha	Pris, kr./kg-l	Omkostninger, kr./ha
Uge	25	26	27	28	29	30	31	32	33	34	35	36	37				
Dato	12-jun	19-jun	26-jun	03-jul	13-jul	13-jul	24-jul	31-jul	07-aug	14-aug	21-aug	28-aug	04-sep	Number Treat-ments	Amount l/ha	Cost / Kg - l	Total Cost / ha
Ranman Top/ Azuleo																	
Revus							0,6			0,6				2	1,2	325	390
Shirlan/Zignal/ Banjo	0,4	0,4	0,4	0,4	0,4			0,4	0,4		0,4	0,4	0,4	10	4	528	2.112
Zorvec				0,15	0,15									2	0,3	1.457	437
Proxanil		2					2			2				3	6	239	1.434
Cymbal/Option	0,25		0,25					0,25	0,25		0,25	0,25		6	1,5	280	420
Amistar							0,5							1	0,5	235	118
														24			**4.911** **~ 660 €**
	Indledende blok			Zorvec blok			Proxanilblok				Afsluttende blok						

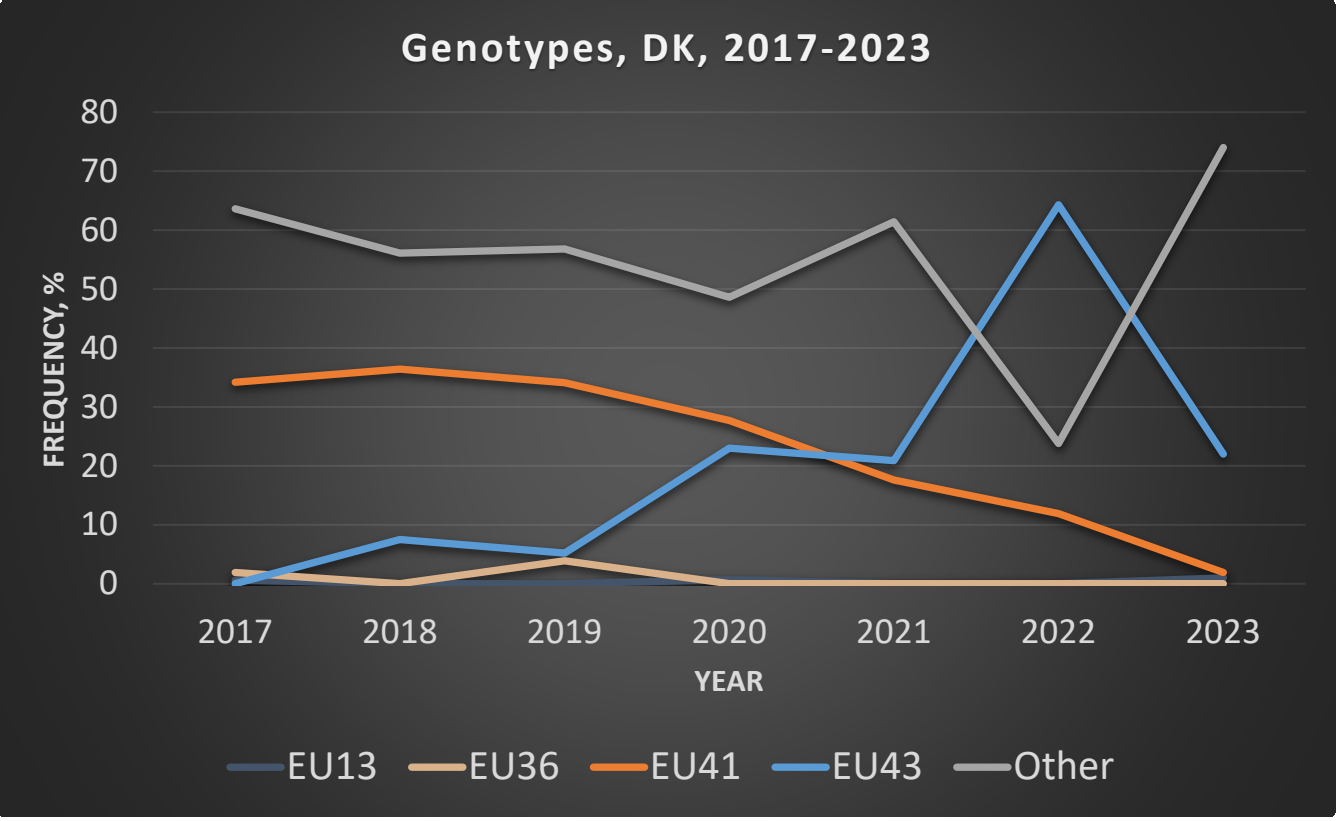
Key issues

Revus:
Starch: 2 times, late season
Ware: 0 times

Shirlan:
Starch: 10 times
Ware: 7 times

Danger! It puts pressure on other active ingredients, especially fluazinam

Gradual loss in sensitivity found earlier for EU33 and EU37 (not on/off)

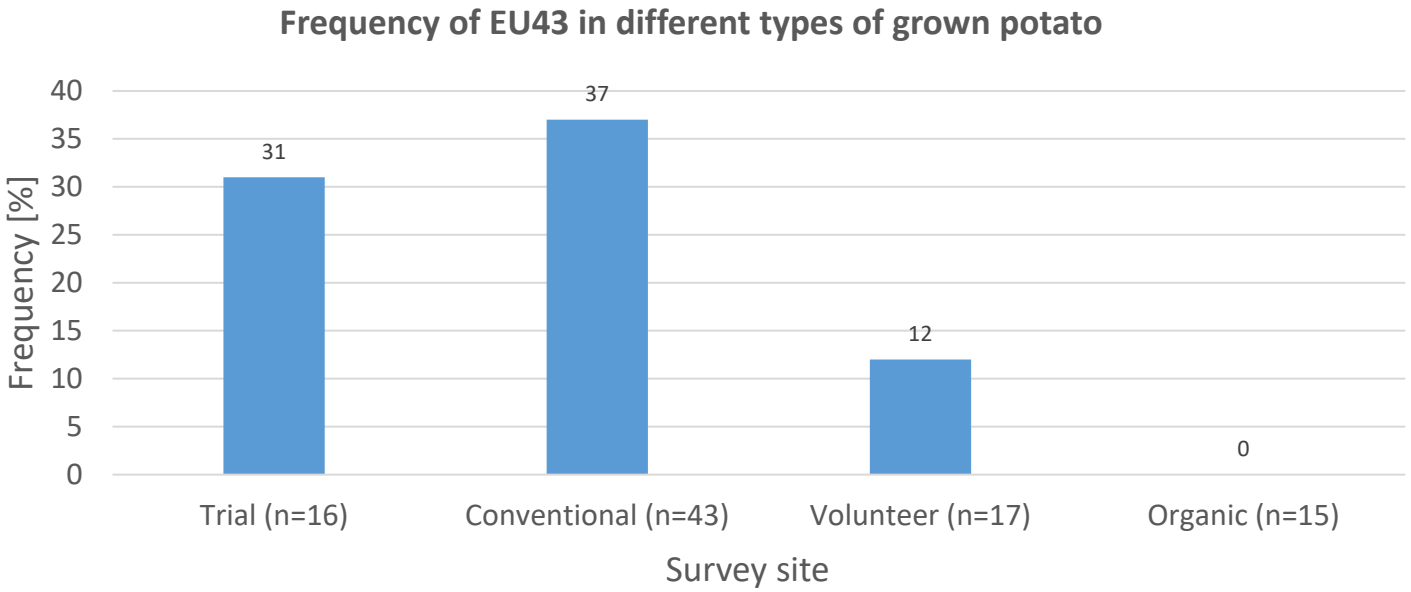


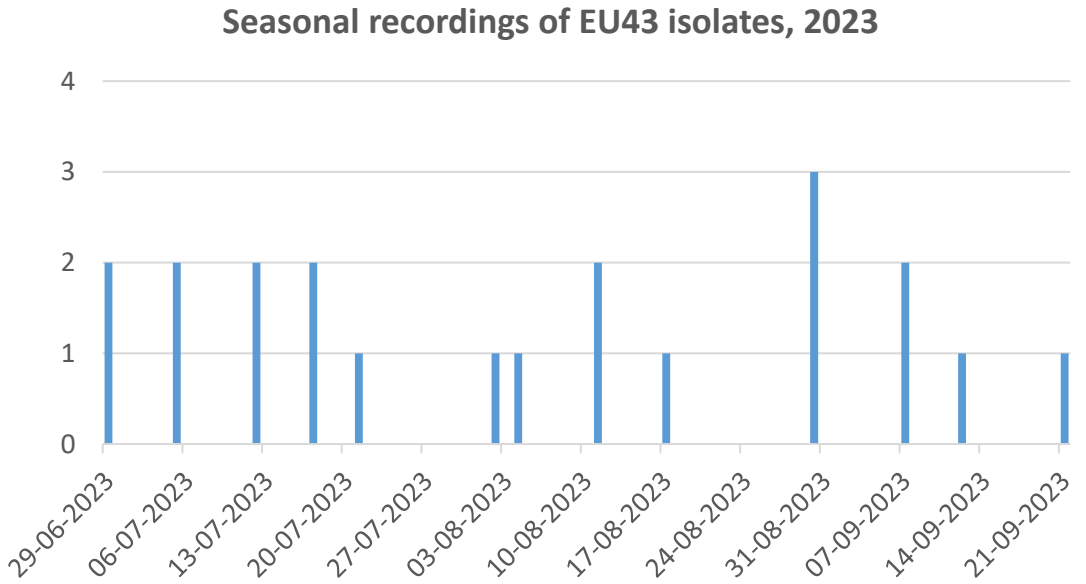
Status 2023

EU43: from 64% in 2022 to 24% in 2023.

EU41: from 12 to 1% and

Others: from 24% to 73%





Most of you followed the advise from the Task-force, SEGES and your local advisors, newsletters

A few did their own strategy. This worked most probably fine because the blight pressure was low

Please follow the guidance from your advisor in 2024

This a game of Chess and **we won the first match against phytophthra**. But the game is best out of 5 matches!

Europe

Potato late blight

EuroBlight

A potato late blight network for Europe

Genotype Map

Year: 2022

Continent: Europe

Country: All countries selected

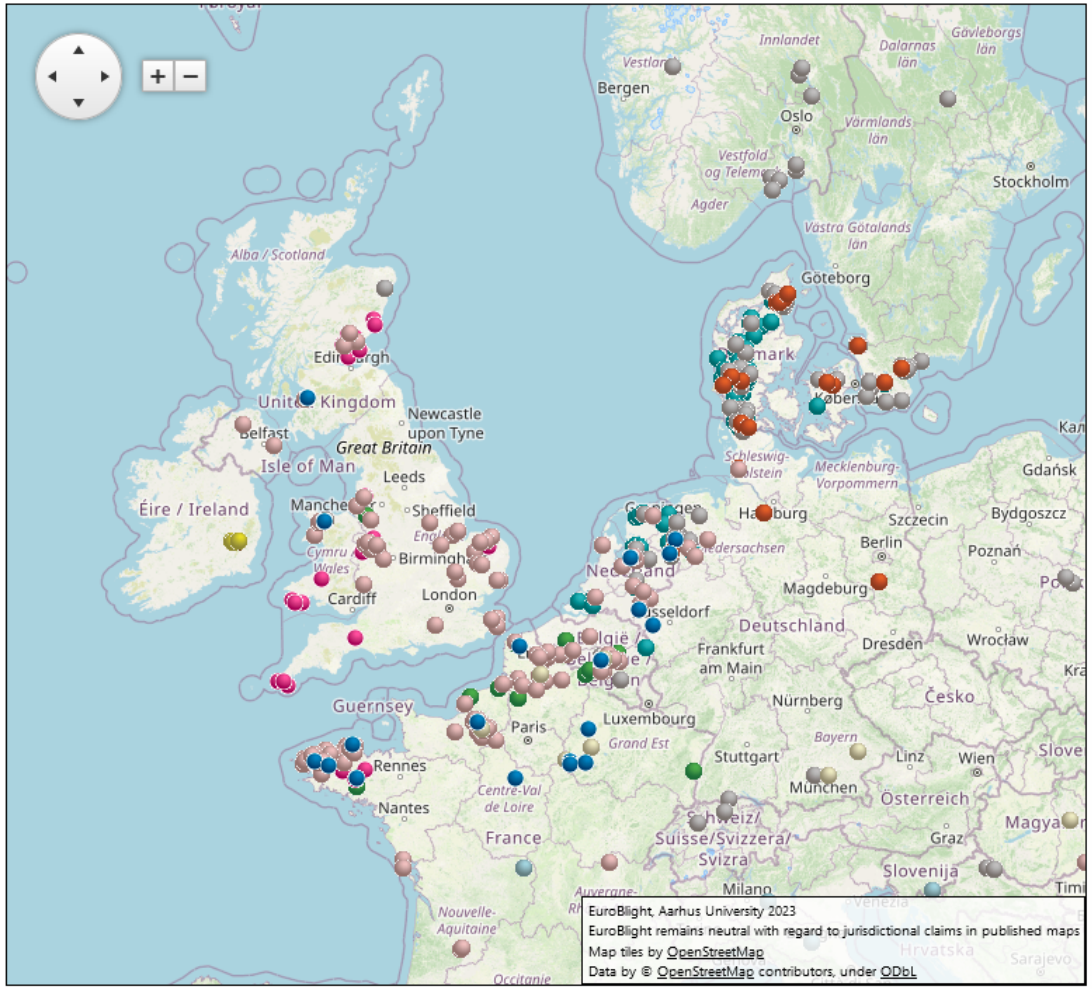
Host: All; Potato; Tomato

Genotypes: All

EU_6_A1; EU_8_A1; EU_12_A1; EU_13_A2; EU_23_A1; EU_36_A2; EU_37_A2; EU_39_A1; EU_41_A2; EU_43_A1; EU_44_A1; EU_45_A1; Other

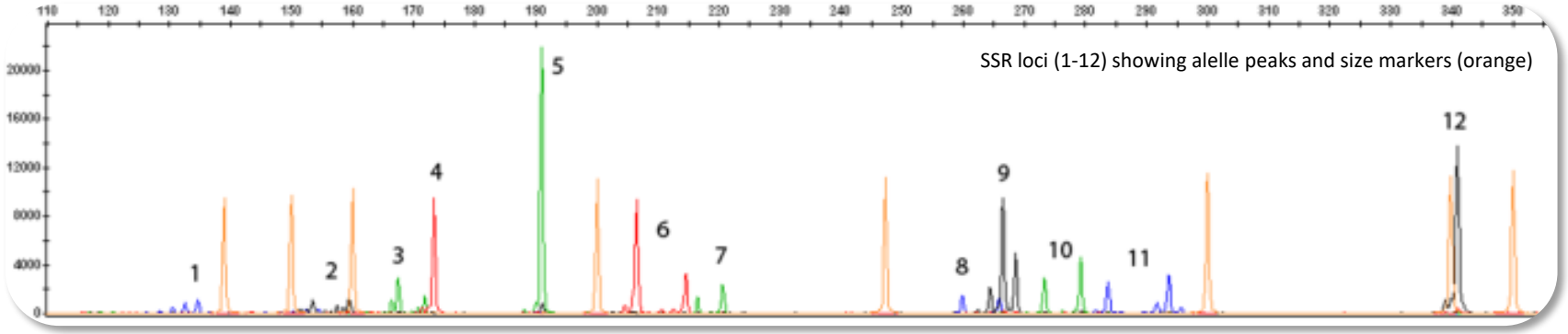
Show

Help

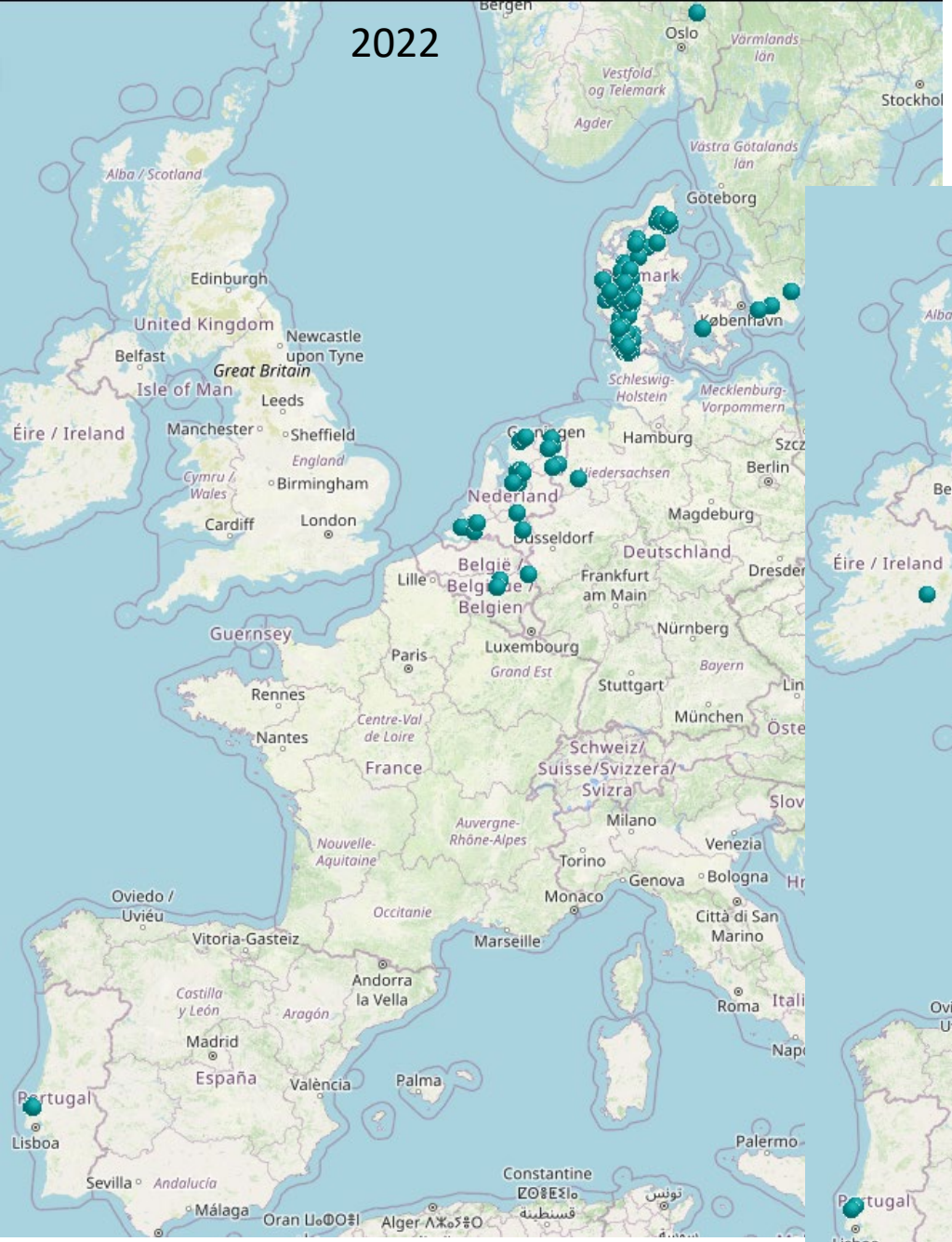


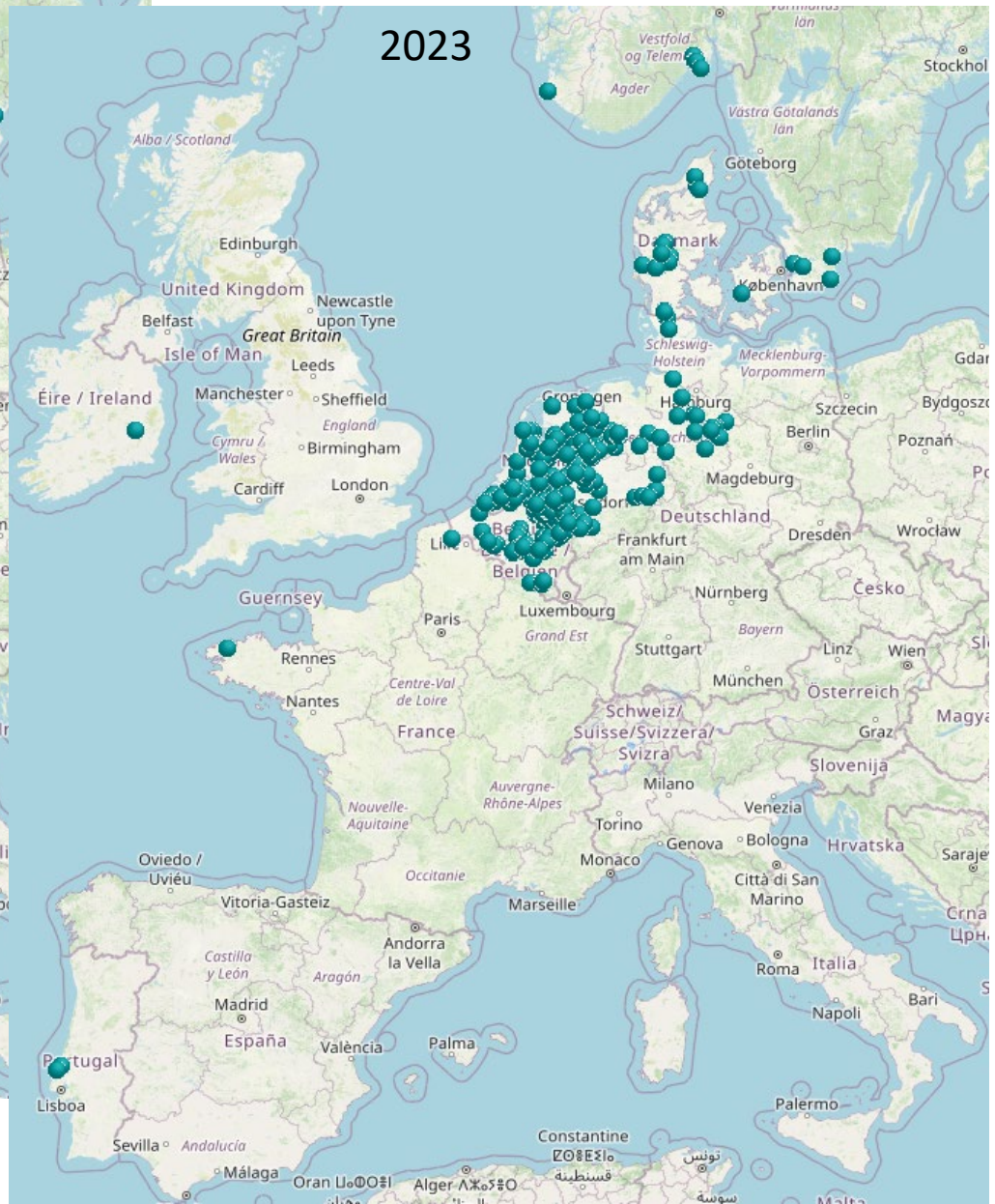
Monitoring methods

- Scouts issued with sample forms and FTA cards (GB & FR live cultures collected)
- Outbreak data (e.g. location, crop type, cultivar) recorded
- Lesions pressed onto FTA cards to capture pathogen DNA
- DNA fingerprinted using 12-plex SSRs (Li *et al.* 2013)
  - Louise Sullivan at Hutton, UK
  - Romain Mabon & Michele Guibert at INRAE, FR
  - Dr Marta Janiszewska at IHAR, PL
- Genotypes defined & data stored in EuroBlight database
- Data publicly mapped on www.euroblight.net



EU43 distribution in Europe



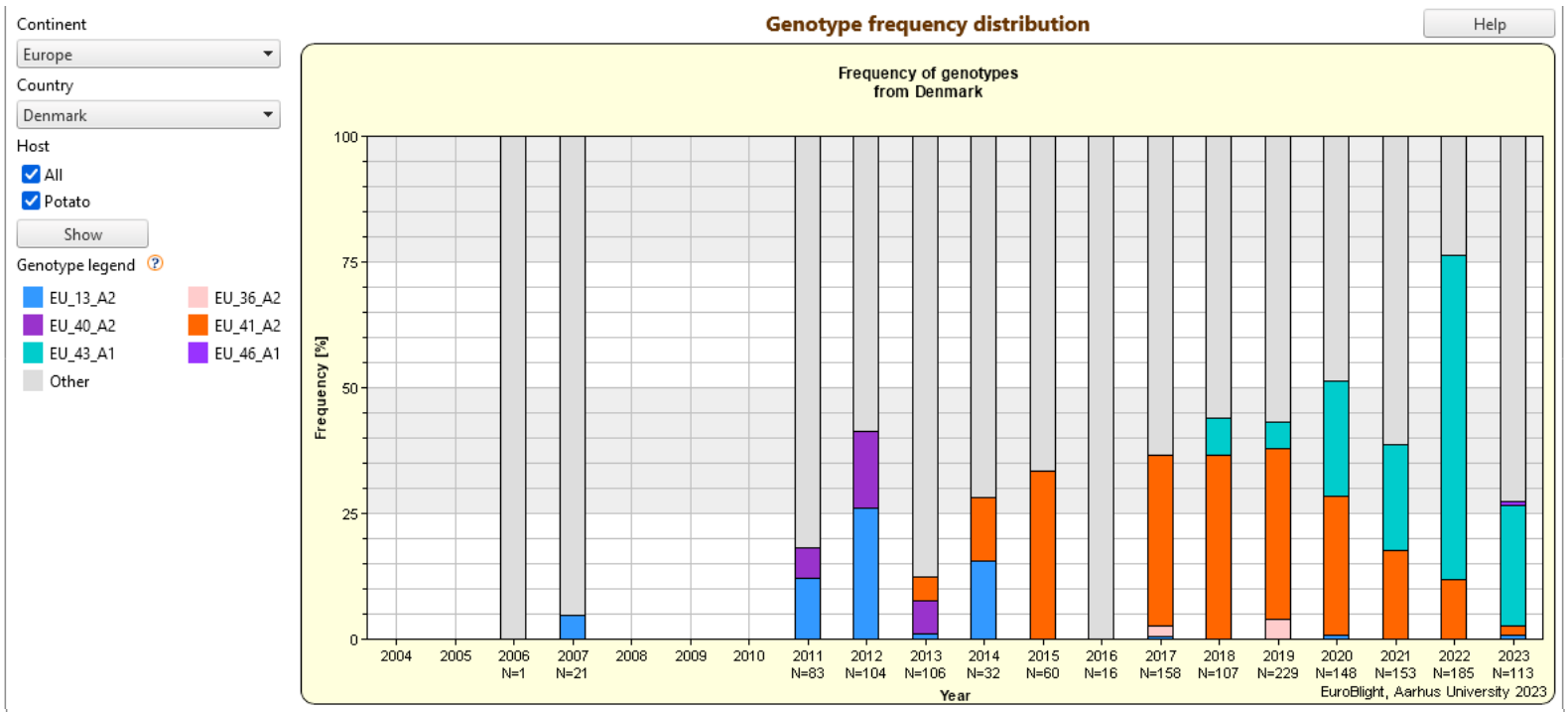


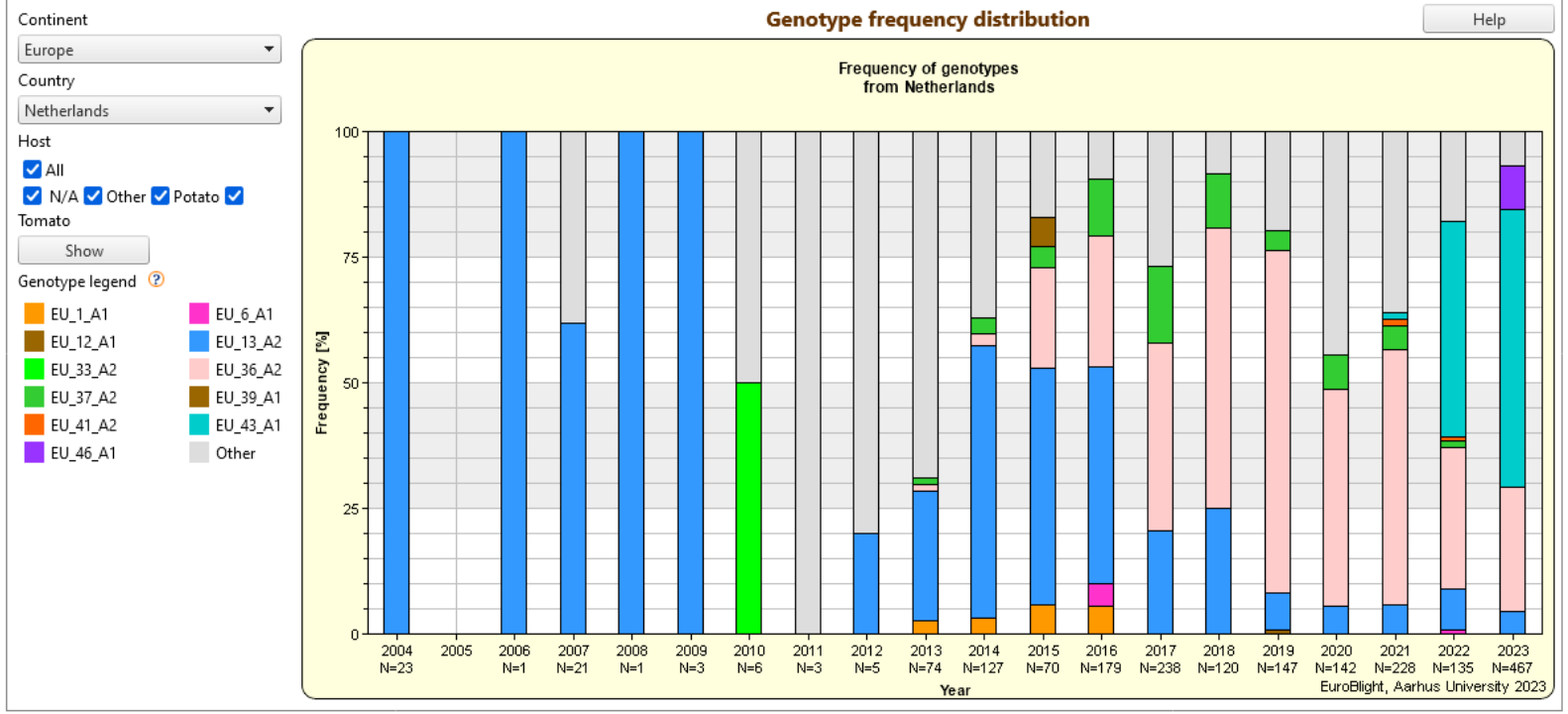
EU43 frequency shift from 2022 to 2023

- DK: from 64 to 24%
- NL: from 43 to 55%
- DE: from 7 to 52%

EU43 first time found in France and Ireland

This is the same MLG as found in Denmark

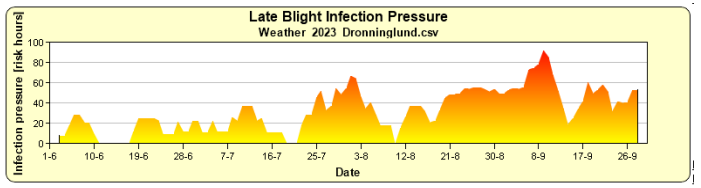




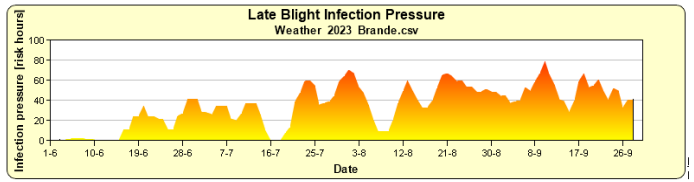
Infection pressure

Denmark

Other



EU46



EU43

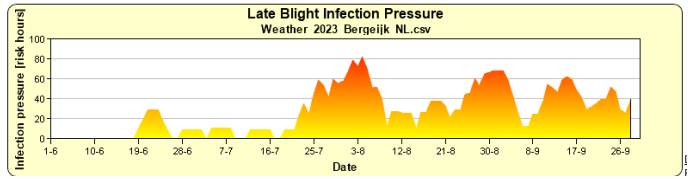
EU41 & EU13

1. Similar weather-based blight risk
2. But different late blight management strategy

The Netherlands

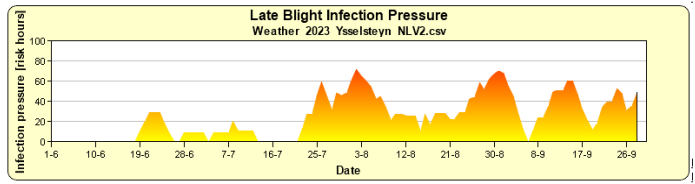
EU46

EU43



EU36

EU13



GENOTYPE

Genotype map | Genotype frequency map | Genotype frequency chart | Frequency rank | World map | World appearance

Continent

Europe

Year

All
2023 2022
2021 2020
2019 2018
2017 2016
2015 2014
2013 2012
2011 2010
2009 2008
2007 2006
2005 2004

Host

All
N/A Other
Potato Tomato

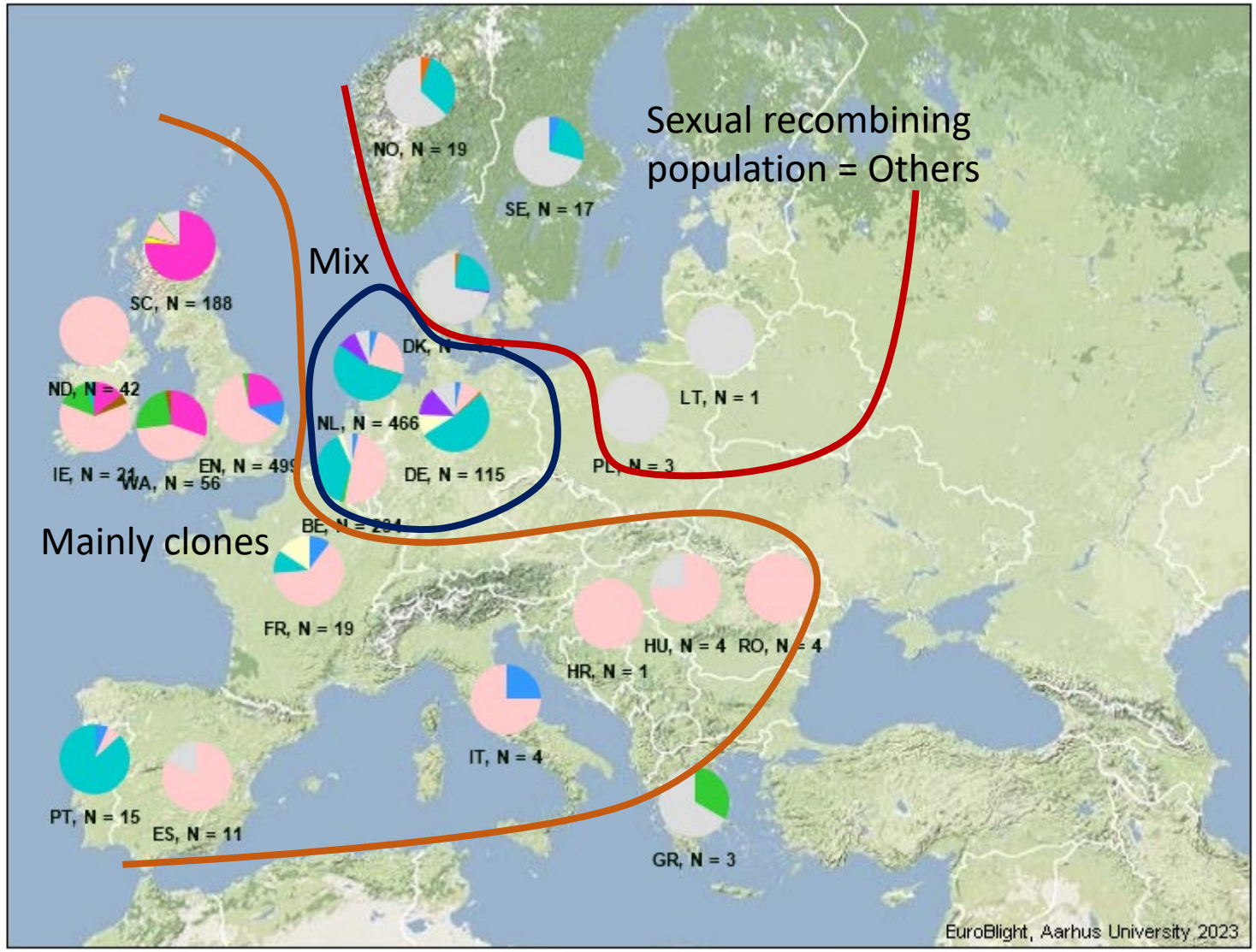
Show

Genotype legend

EU_6_A1
EU_8_A1
EU_12_A1
EU_13_A2
EU_36_A2
EU_37_A2
EU_39_A1
EU_41_A2
EU_43_A1
EU_45_A1
EU_46_A1
Other

Genotype frequency distribution

Help



Thank you for your attention

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EuroBlight
A potato late blight network for Europe

Thanks to many partners and colleagues for contributing