



Emerging fungicide resistance: the case Denmark

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Phytophthora Under the Lens. 1. July 2025

STØTTET AF
Kartoffelafgiftsfonden

SEGES
INNOVATION

Treatments against late blight in Denmark

1944

1-2 treatments



Foto: Frederiksen, T

Bordeaux mixture
Non-specific

1962

2 treatments



Foto: Møller Eriksen, N

Dithane (mancozeb)
Non-specific

2023

12-14 treatments
(two MoA, double dosage)



Foto: Klemmensen, P

Mandipropamid
Fluazinam
Oxathiapiprolin
Specific

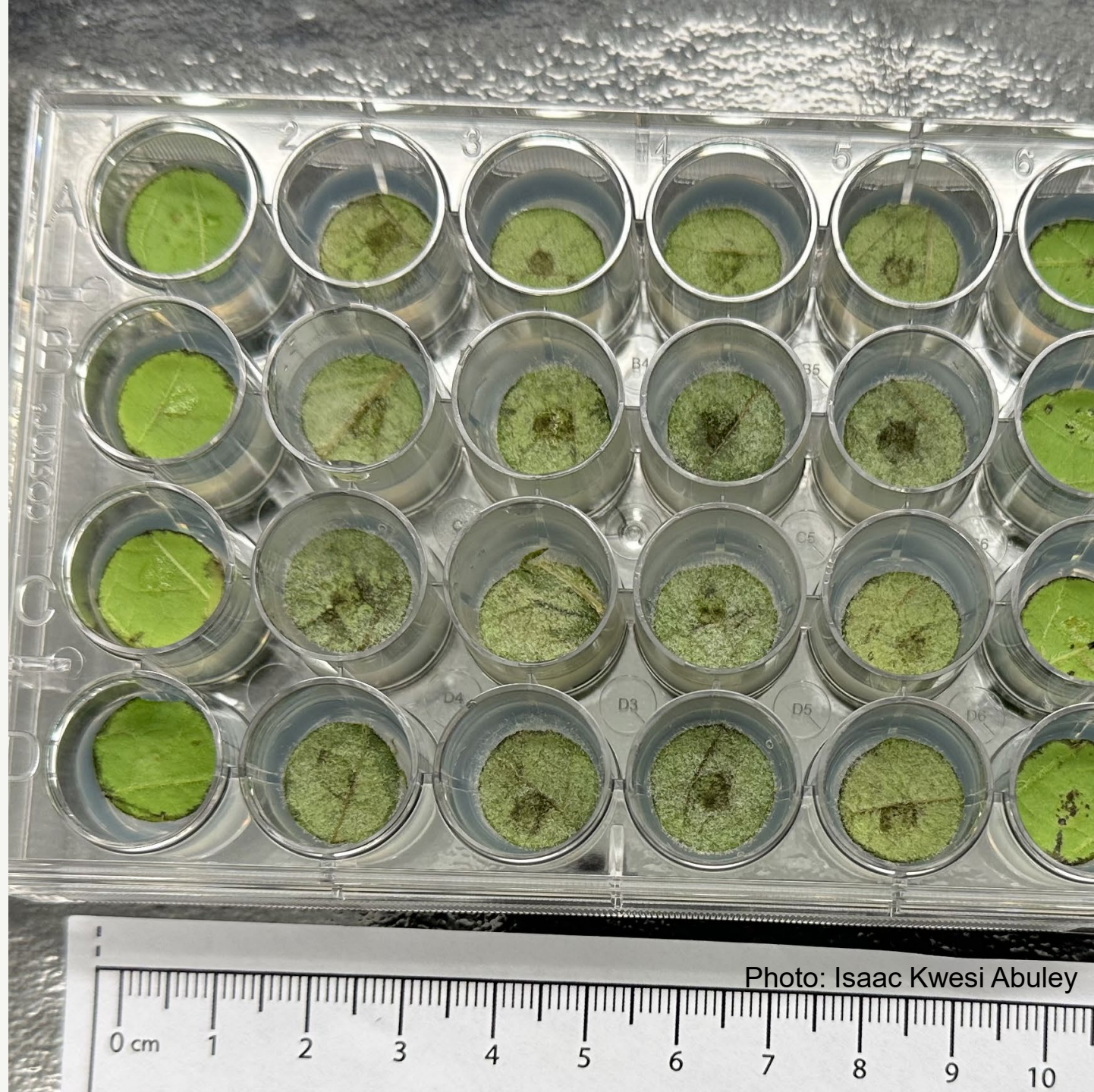
Symptoms of oospores from the end of the 1990s



Fungicide resistance

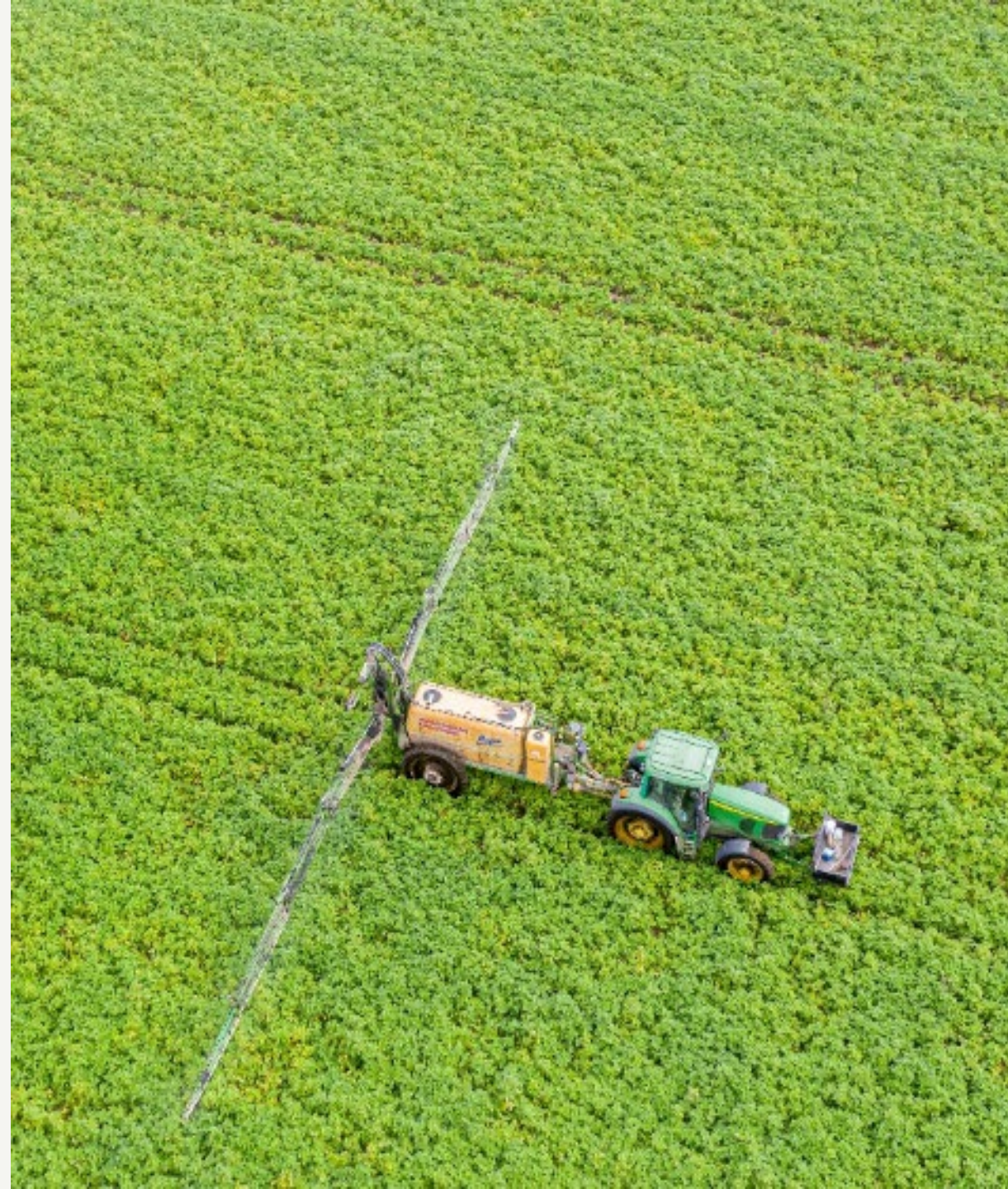
Specific fungicides

- Metalaxyl 2004
- Fluazinam 2006, 2011, 2017
- Mandipropamid 2022
- Oxathiapiprolin 2023



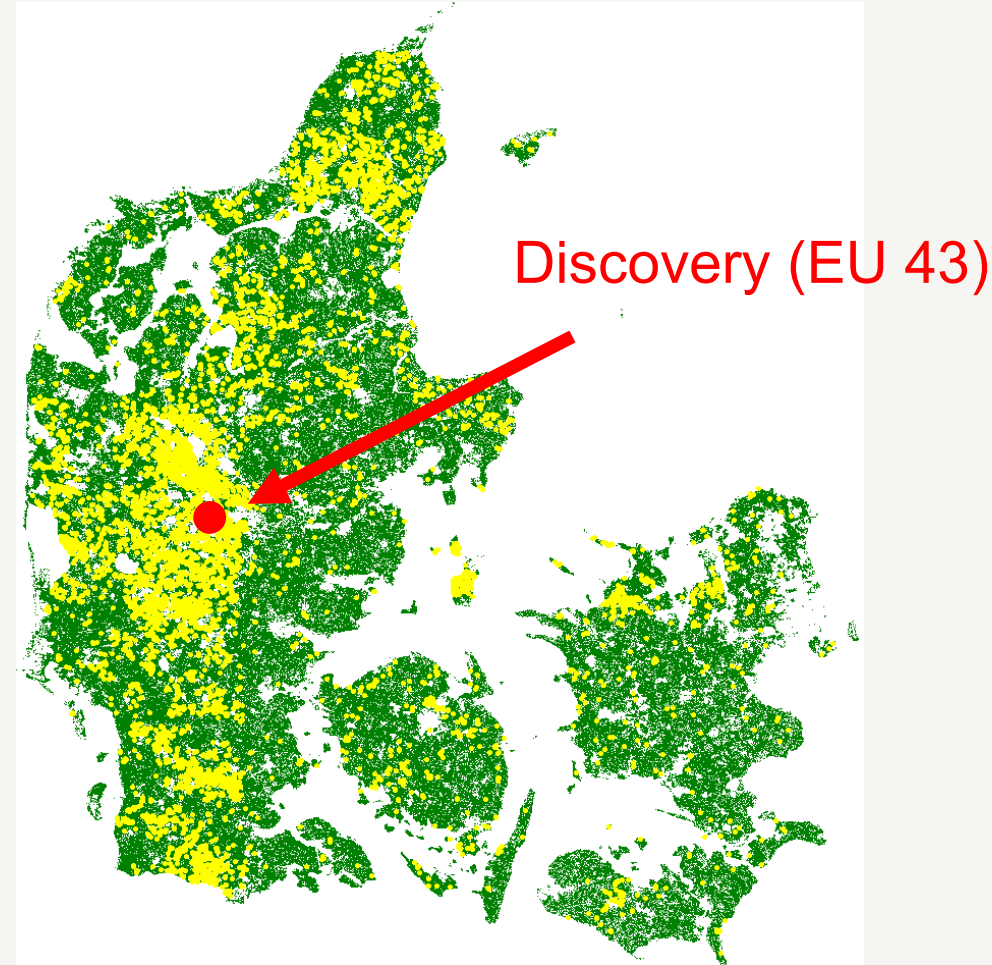
Available fungicides i 2023 - 2025

- **Preventive**
 - Fluazinam
 - Oxathiapiprolin
 - Mandipropamid
 - (Azoxystrobin)
- **Curative (mixing partners)**
 - Cymoxanil
 - Propamocarb



Wake up call 2022

8.500 potato fields in Danmark (60.000 ha)



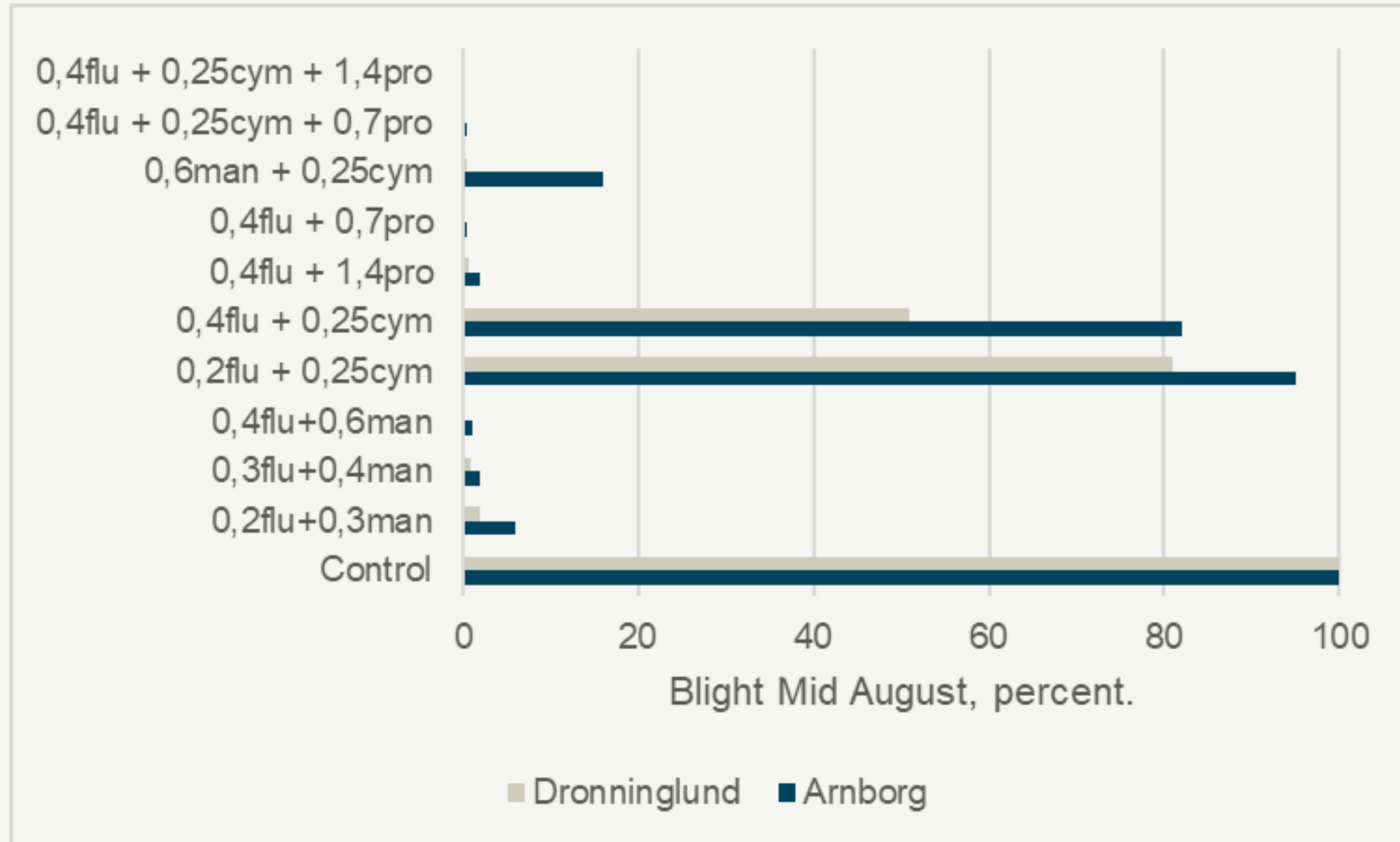
Development of control strategy

- **Danish Potato Workshop december 2022**
 - 75 - 90 participants; researchers (Aarhus University), advisers (potato industry, private and independent) farm supply companies, agro chemical companies (Syngenta, Certis Belchim) - Status on situation – what did we know?
- **On-line workshop spring – Control Strategy**
 - Monday online-meeting. 10-20 participants; responsible for newsletters
 - Ad hoc online-update meetings ('60-70 participants)

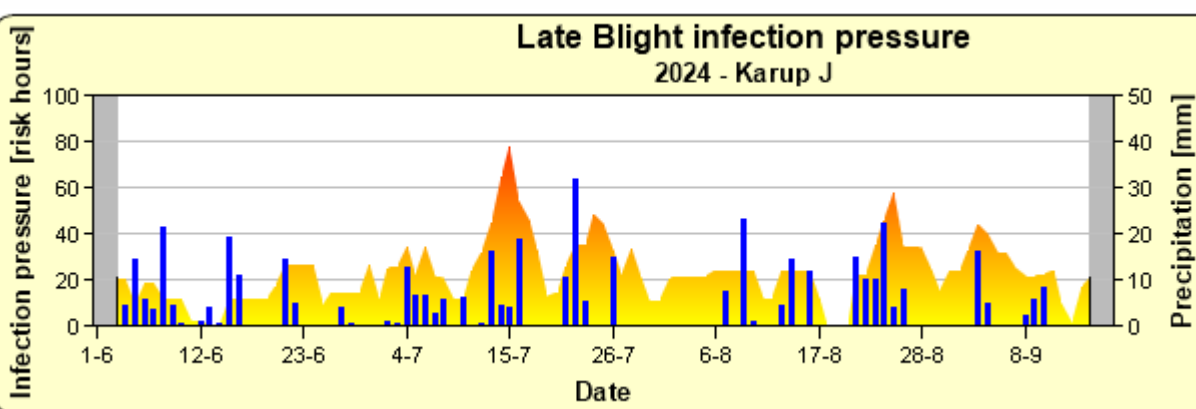
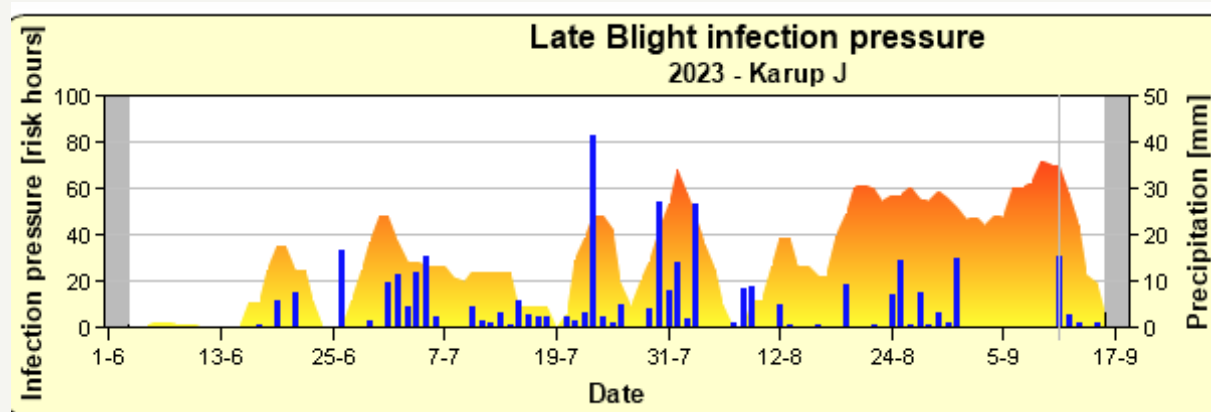
Control strategy for 2023-2025

No.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	No.
Date	05-jun	12-jun	19-jun	26-jun	03-jul	10-jul	17-jul	24-jul	31-jul	07-aug	14-aug	21-aug	28-aug	04-sep	11-sep	treat.
Mandipropamid		0,45						0,45		0,45		0,6		0,6		5
Fluazinam		0,4	0,4		0,4		0,4		0,4		0,4		0,4	0,4	0,4	9
Oxathiapiprolin				0,15		0,15										2
Propamocarb			1,0	1,4		1,4		1,0		1,0						5
Cymoxanil					0,25				0,25		0,25	0,25	0,25		0,25	6
Azoxystrobin							0,5					0,5				2
		Start block		Zorvec block				Middle block				Final block				29

Adjustment of strategy middle of season 2023

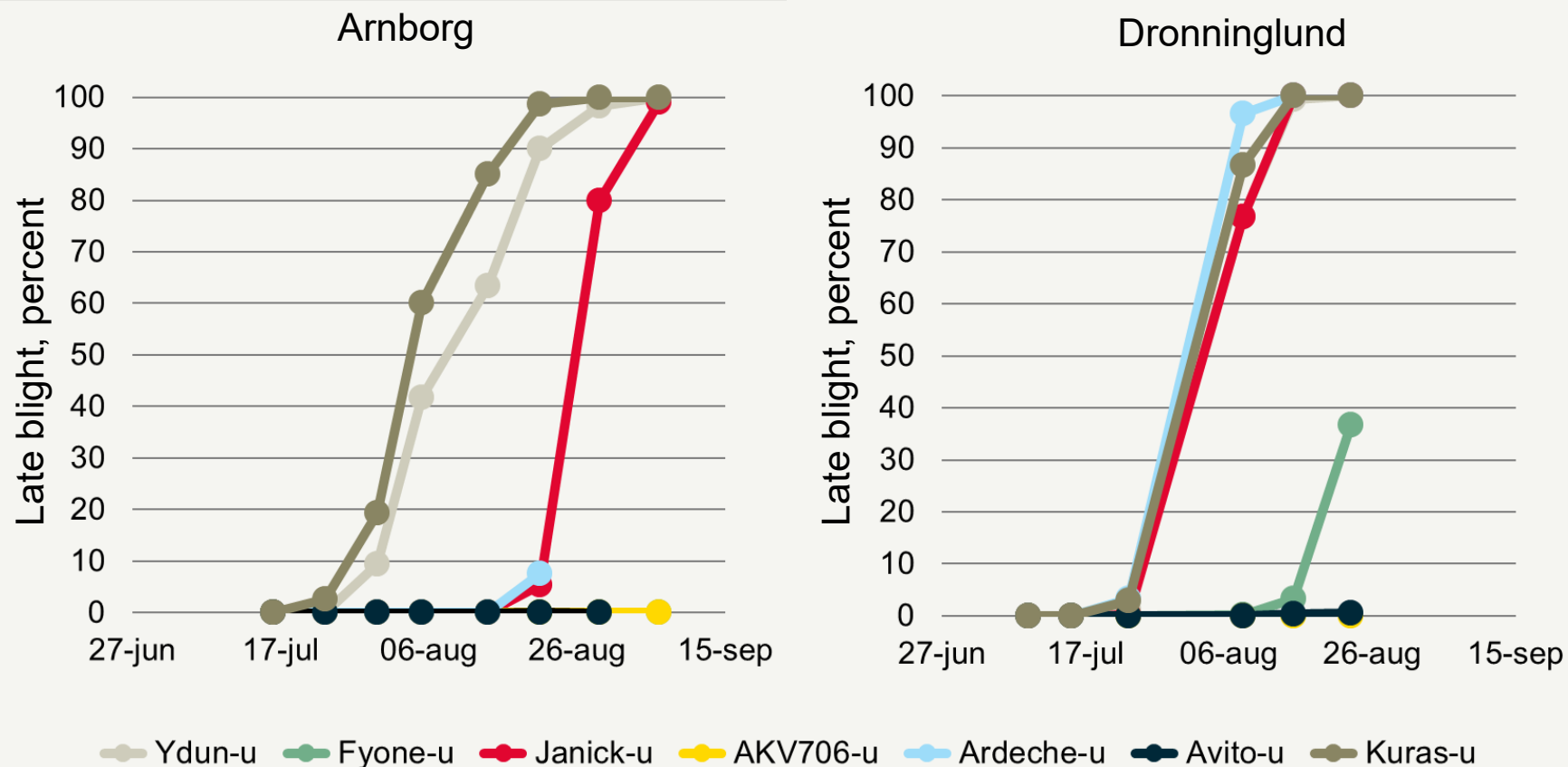


Extremely blight favorable weather conditions



Lessions learnt

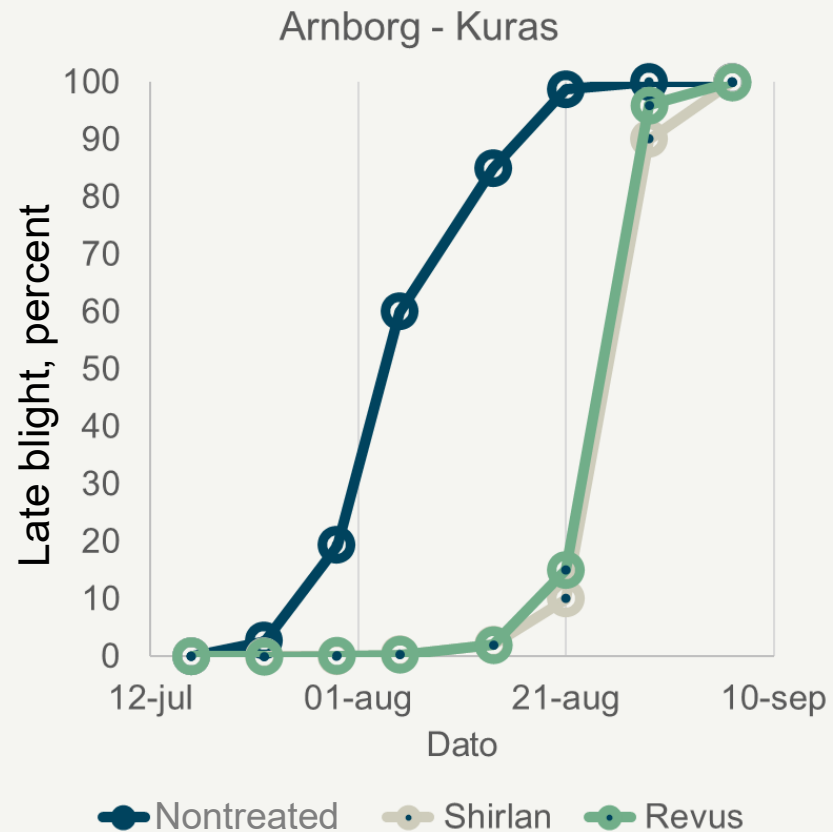
Virulence – break down of R-genes



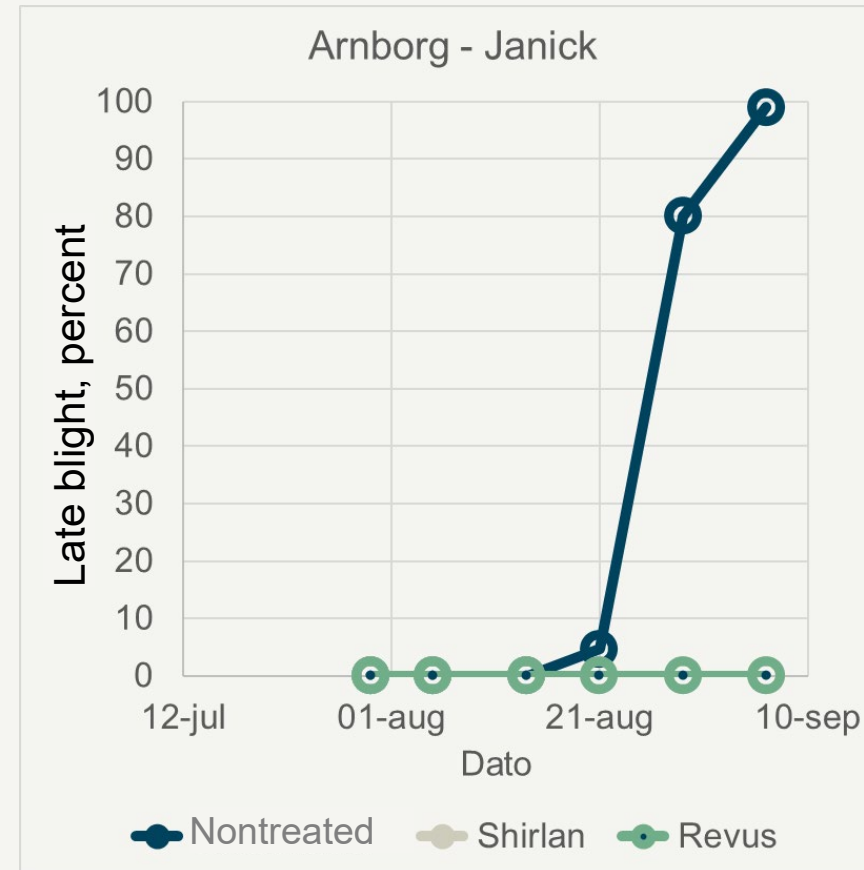
Lessons learnt 2024

Complementation og MoA and R-genes

Susceptible variety

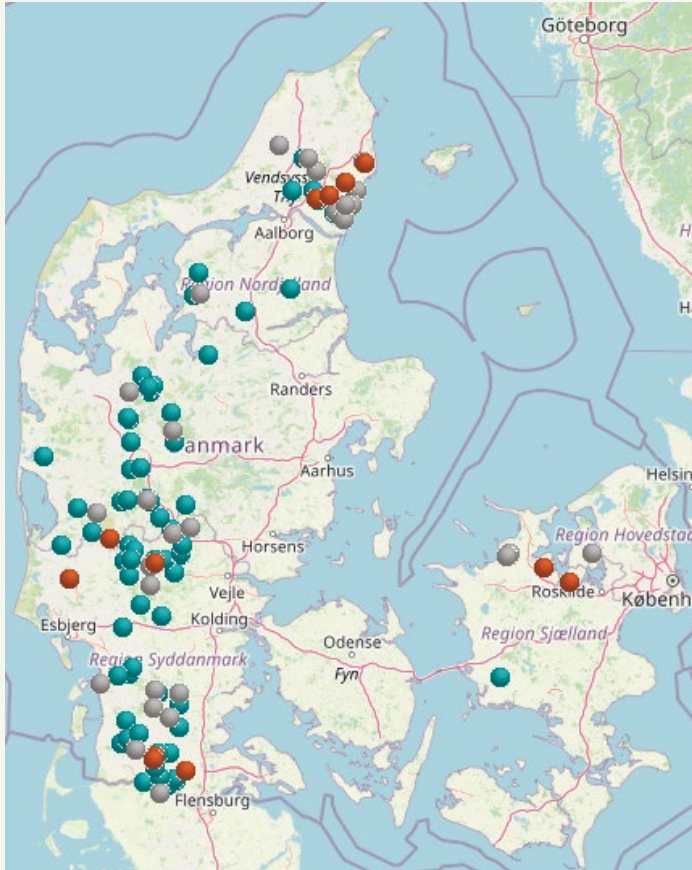


Resistant variety variety (1 R-gene)

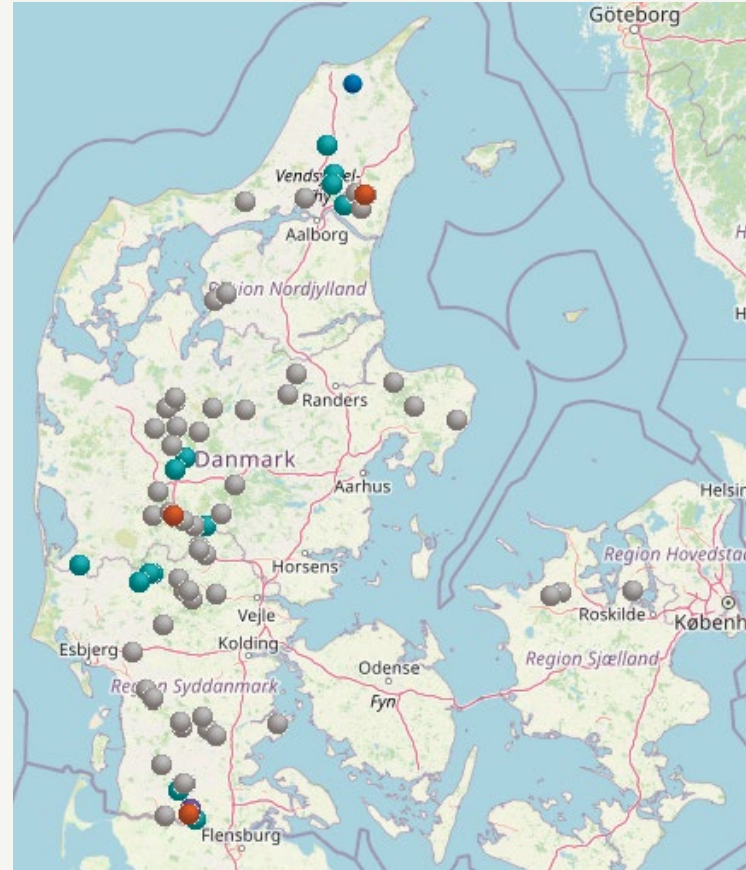


Frequency of EU 43 in Denmark

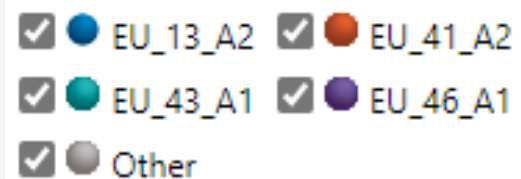
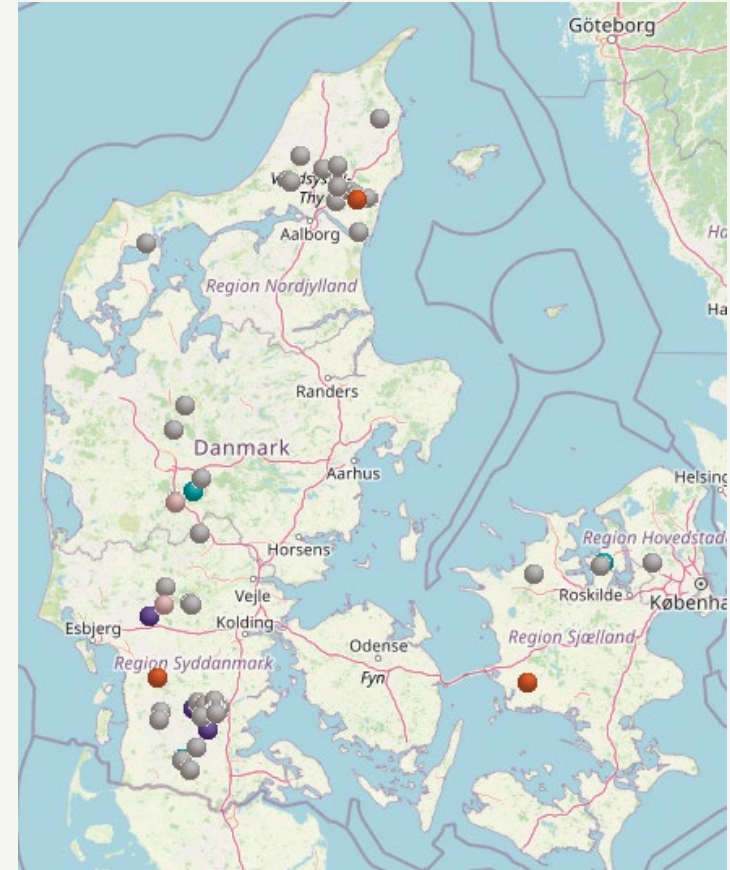
2022 (64 pct.)



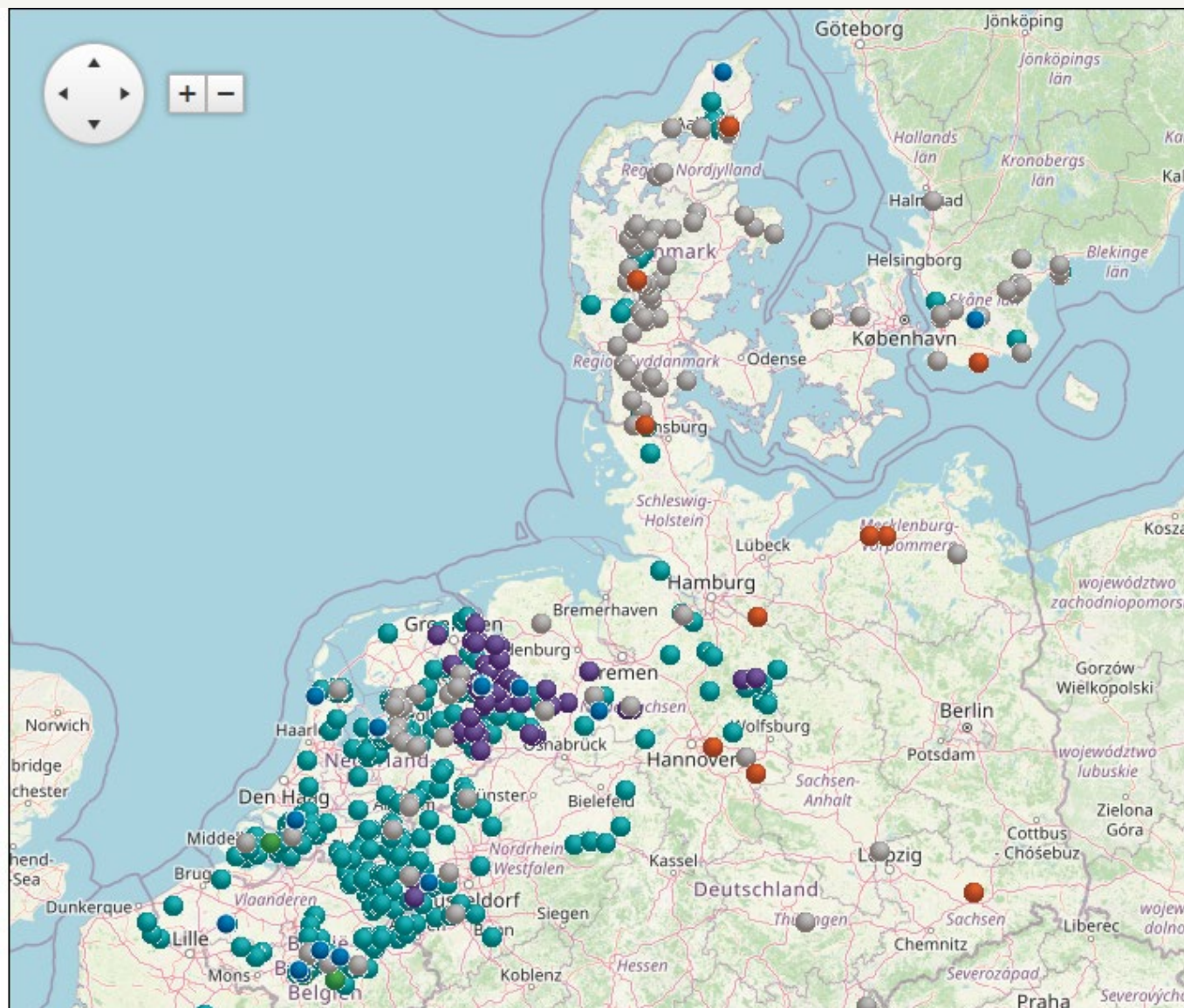
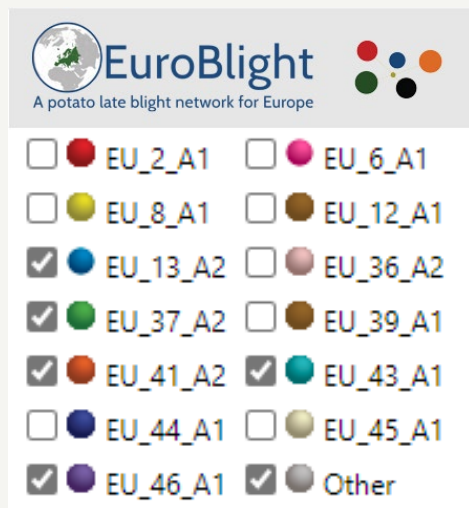
2023 (20 pct.)



2024 (5 pct.)



Genotypes in DK, Northern D, NL, Be - 2023



The 10 principles

1. Reduce inoculum pressure; volunteer potatoes, waste piles, crop rotation.
2. Mix at least two MoAs!
3. Two consecutive treatments contain at least three MoAs
4. Alternate of MoAs much as possible!
5. Never mix mandipropamid and OXTP
6. OXTP after BBCH 59, but before blight
7. Two consecutive curative sprays with both cymoxanil, propamocarb and a preventive active ingredients when blight
8. Apply good spraying techniques
9. Use DSS (BlightManager)
10. Mix resistance genes and MoAs



