# Trial results and blight management in practice - Denmark

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**Syngenta Potato Academy 21. November 2024**

STØTTET AF
Kartoffelafgiftsfonden
SEGES INNOVATION

# Agenda

- Annus horribilis 2022
- Late blight history retrospect
- Spraying strategy 2023
- How did the season go?
- Results of field trials 2023
- Take home messages
- Road map for 2024.

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# Annus horribilis 2022

August 2022

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< Tilbage

Planter

## Virkningen af Revus over for kartoffelskimmel varierer

I forsøgsmarken i Arnborg er der i flere forsøg set vigende effekt, hvor der forsøgsmæssigt er behandlet ugentlig med Revus (mandipropamid) igennem hele vækstsæsonen.

January 2023


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# History of potato late blight and fungicide control shift in paradigmas

- Potatoes come to Europe 1537
- Late blight comes to europe in 1840's (A1) – 300 yrs. without late blight
  - Rapid spread in 1845-1847 (super spreader)
- Late blight come to Europe in 1979 (A2) – 140 yrs. after A1
  - Sexual recombination – oospores (1990's)
- Bordeaux mixture (copper sulfate + quick lime) – late 19th century
- Non-specific fungicides – beginning 1950's and 1960's
  - Mancozeb until 2013-2015 in Denmark (increase pesticide tax)
  - Mancozeb until 2020 in EU (ban)
- Specific fungicides onwards

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# Fungicides  - increase in applications

**1944** 1-2 applications

Bordeaux mixture
Non specific

**1962** 2 applications

Mancozeb
Non specific

**2023** 12-14 applications – double dosage

Specific fungicides

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# Treatment Frequency Index - fungicides


(Source: Bekæmpelsesmiddelstatistikken 2009-2021)

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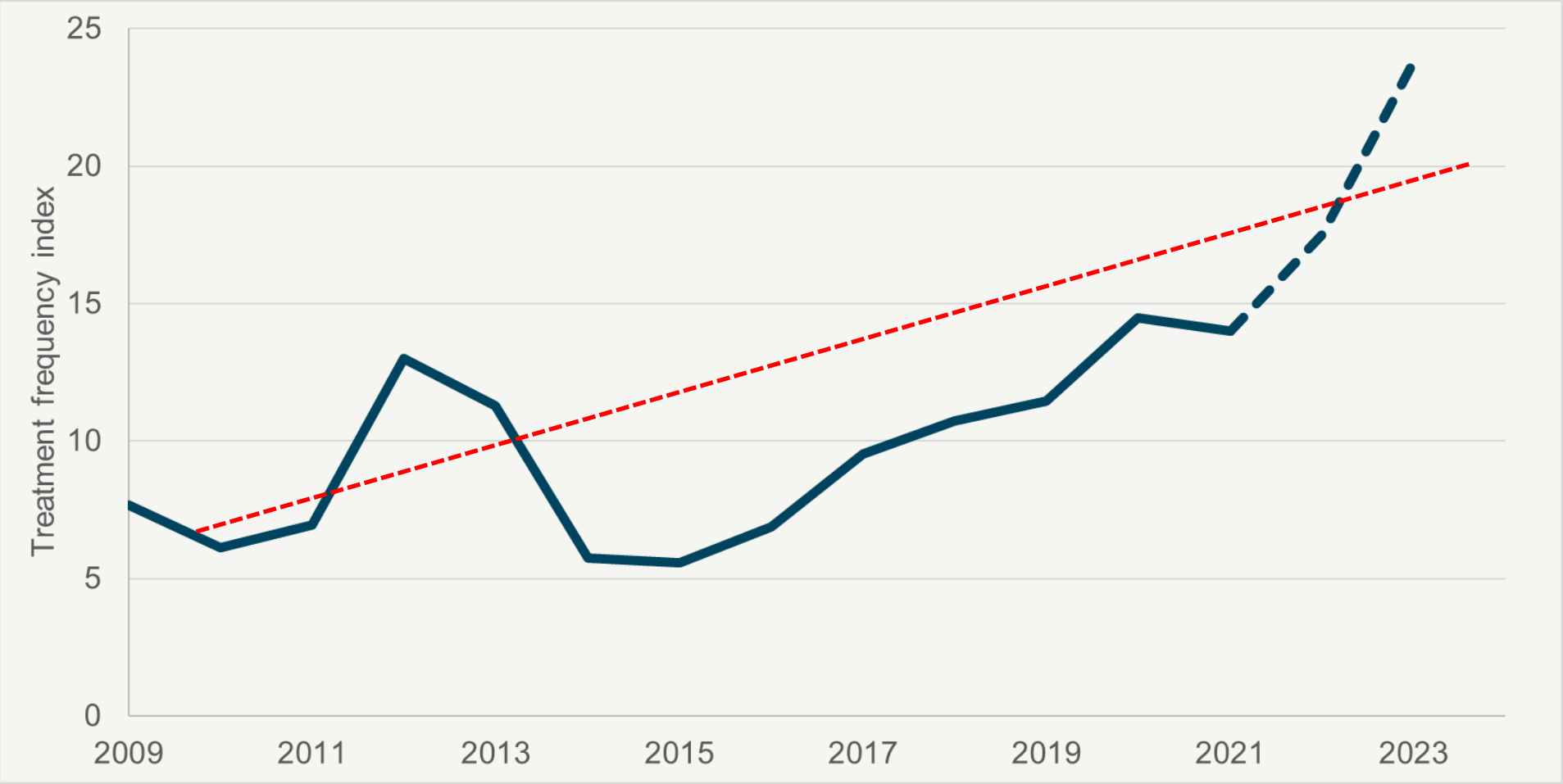
# Treatment Frequency Index - fungicides




(Source: Bekæmpelsesmiddelstatistikken 2009-2021)

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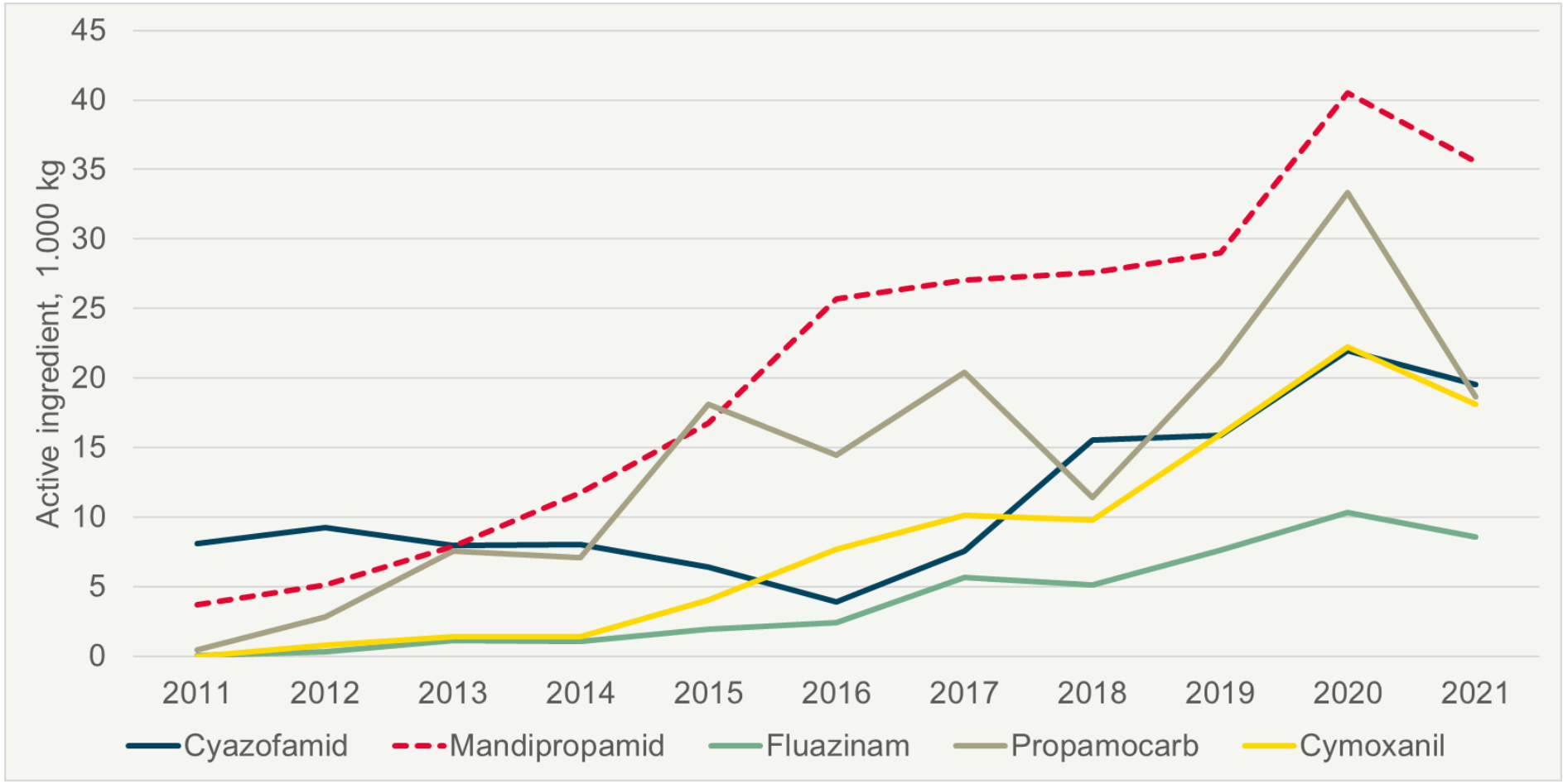
# Use of fungicides in potatoes in Denmark




(Source: Bekæmpelsesmiddelstatistikken 2011-2021)

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# Strategi 2023 – processing potatoes (Starch/chips/french fries)

| No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | No. | Volume, | Price, | Costs, | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Week | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | treatm. | l/ha | kr./kg-l | kr.-€./ha | |
| Date | 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 | | | | | |
| Cyazofamid | | | | | | | | | | | | | | | | | | |
| Mandipropamid | | | | | | | 0,6 | | | 0,6 | | | | 2 | 1,2 | 325 | 390 | |
| Fluazinam | 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 | |
| Oxathiapiprolin | | | | 0,15 | 0,15 | | | | | | | | | 2 | 0,3 | 1.457 | 437 | |
| Propamocarb + cymoxanil | | 2 | | | | | 2 | | | 2 | | | | 3 | 6 | 239 | 1.434 | |
| Cymoxanil | 0,25 | | 0,25 | | | | | 0,25 | 0,25 | | 0,25 | 0,25 | 0,25 | 7 | 1,75 | 280 | 490 | |
| Azoxystrobin | | | | | | | 0,5 | | | | | | | 1 | 0,5 | 235 | 118 | |
| | | | | | | | | | | | | | | 25 | | | **kr. 4.981** | **€. 664** |
| | Start block | | | Zorvec block | | | Middle block | | | | Final blok | | | | | | | |

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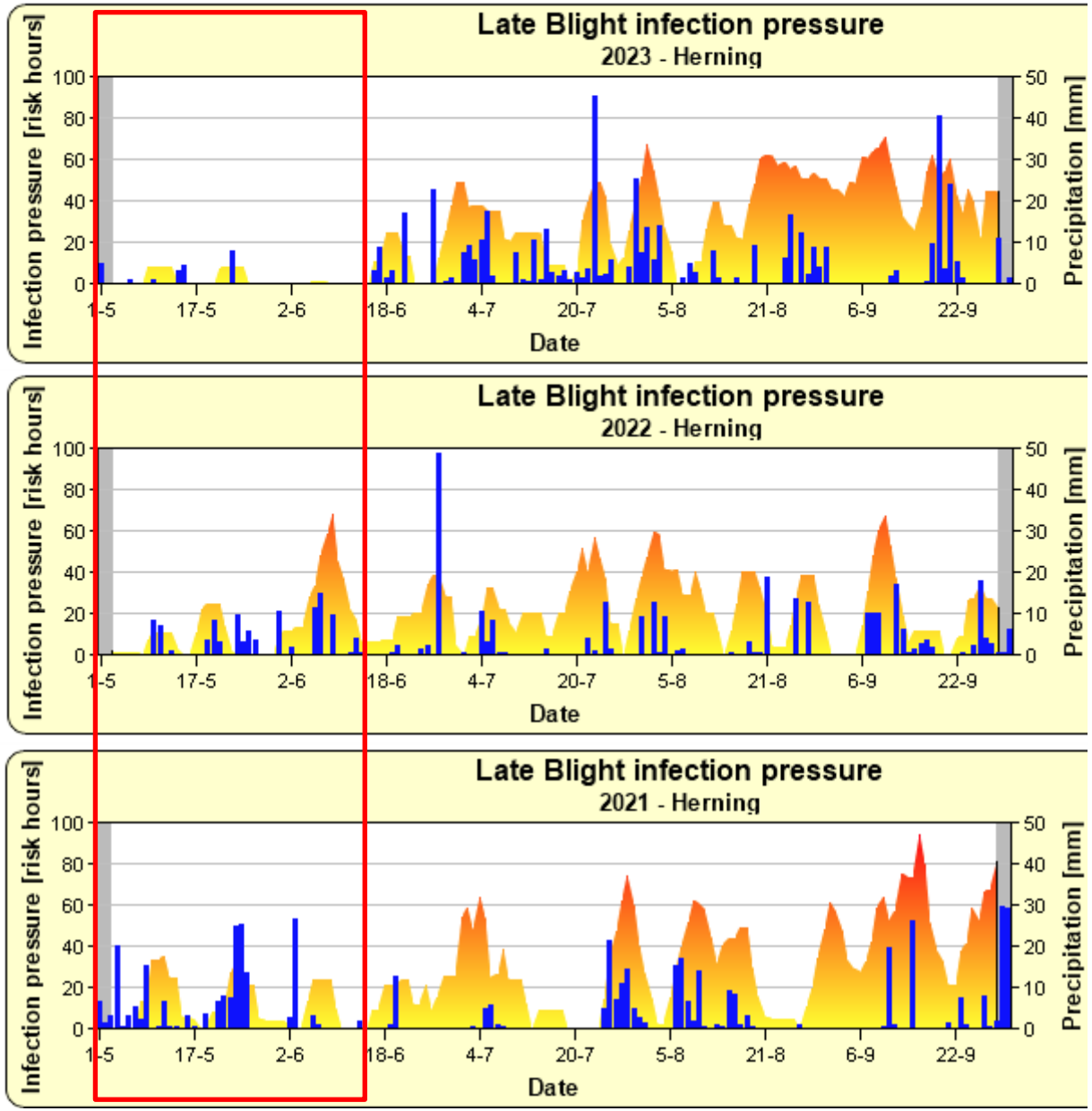


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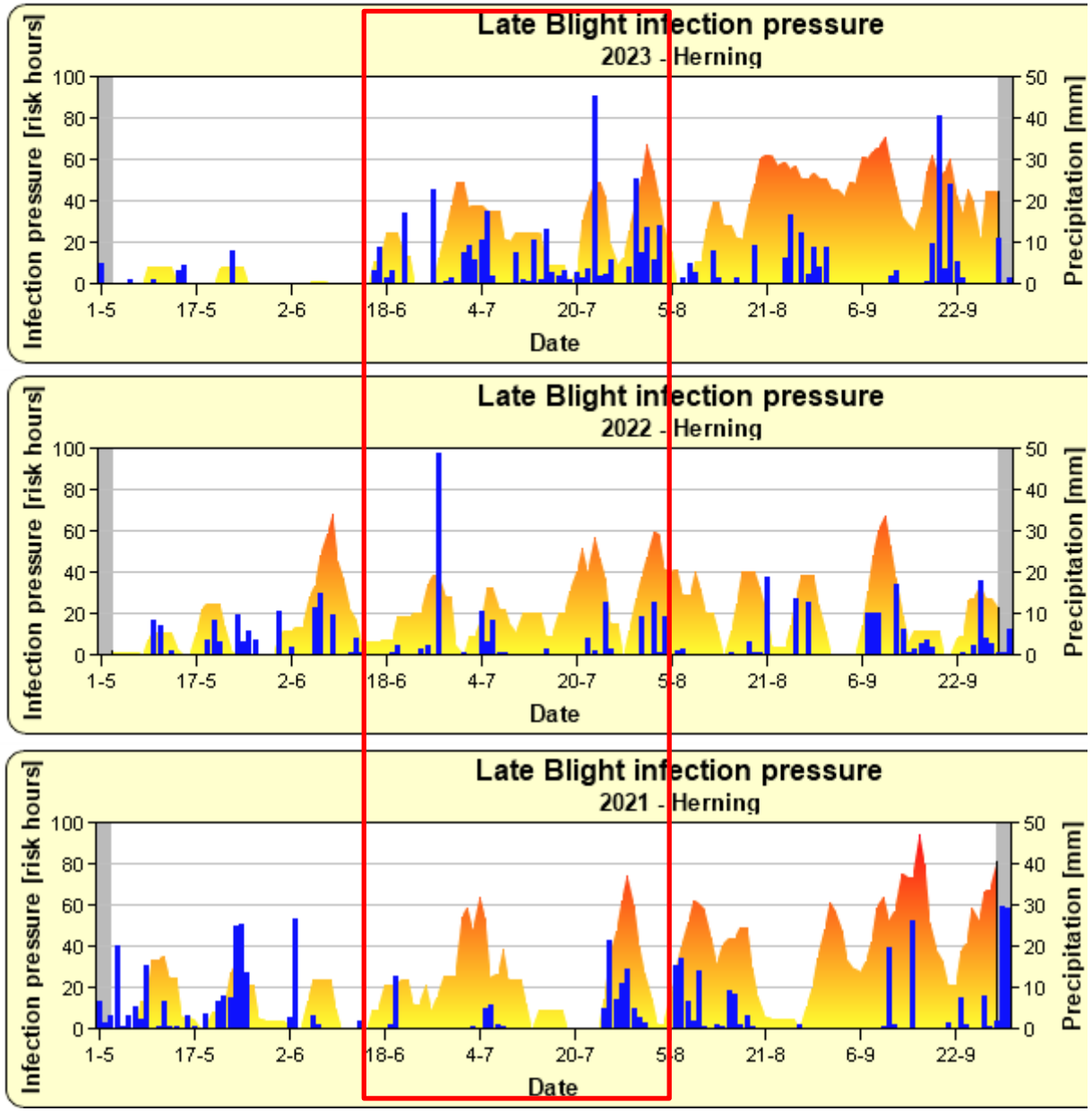


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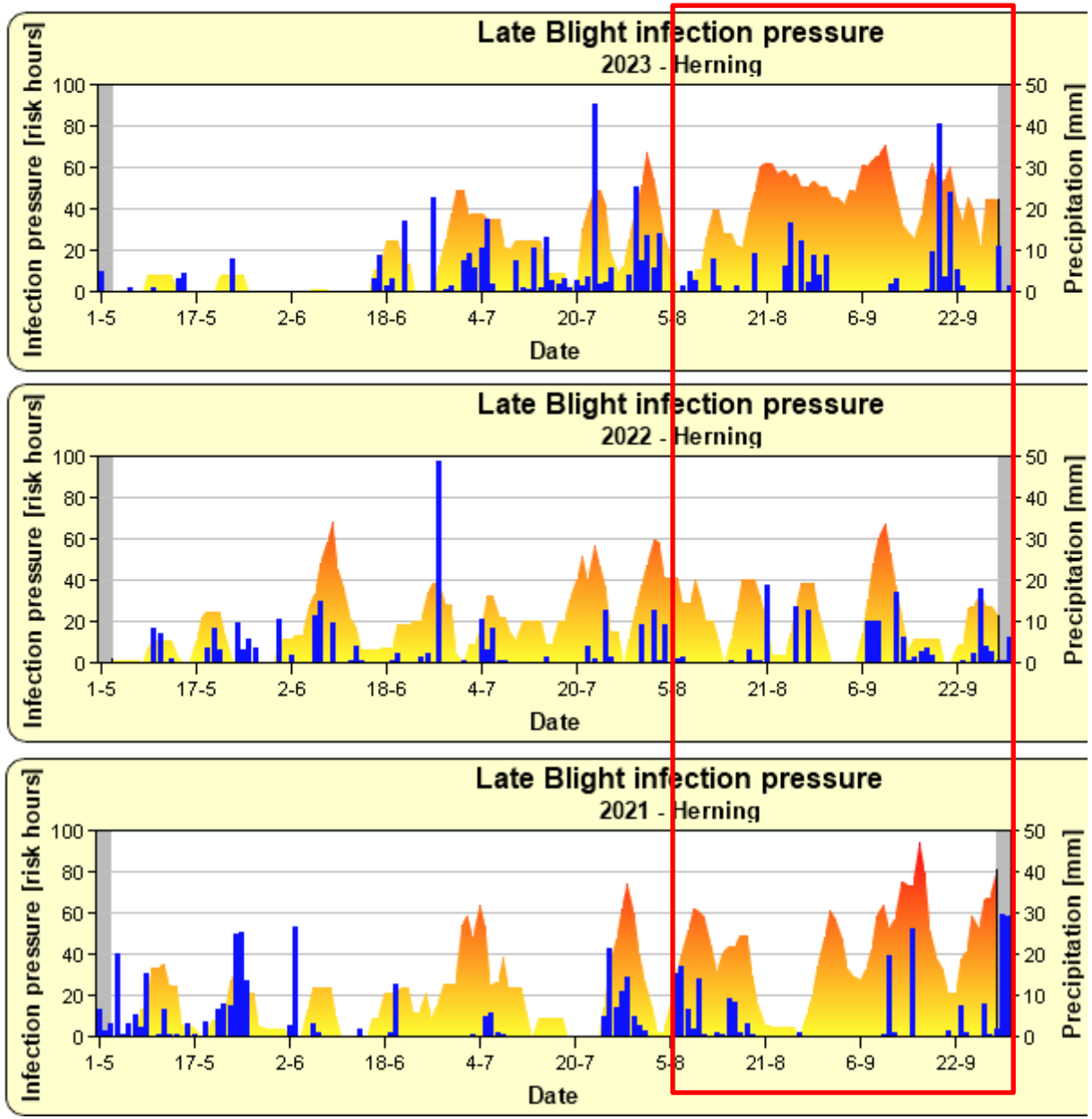


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# Field trials 2023

- ”Synergism” between fungicides
- Effekt of fungides in a middle block
- Combination of MoA og R-genes

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# Synergism between fungicides

(Bo Nyegaard, NA)


15/9

| Treatments | Late blight percent attack | | Starch, percent | Yield and Net. yield, hkg starch |
|---|---|---|---|---|
| | Arnborg | Dronninglund | | |
| *2023. 2 Trials.* | *13. sep* | *15. sep* | | |
| 1. Non treated | 100 | 100 | 19,7 c | **89 d** |
| 2. 0,30 Revus + 0,20 Shirlan Ultra | 6 | 2 | 21,7 a | 48 a |
| 3. 0,45 Revus + 0,30 Shirlan Ultra | 2 | 0,8 | 21,3 ab | 46 a |
| 4. 0,60 Revus + 0,40 Shirlan Ultra | 1 | 0,3 | 21,6 a | 48 a |
| 5. 0,20 Shirlan Ultra + 0,25 Cymbal WG | 95 | 81 | 20,3 bc | 23 c |
| 6. 0,40 Shirlan Ultra + 0,25 Cymbal WG | 82 | 51 | 20,7 abc | 29 bc |
| 7. 0,60 Revus + 0,25 Cymbal WG | 16 | 0,4 | 21,3 ab | 52 a |
| 8. 0,40 Shirlan Ultra + 1,4 Propamocarb 722 SL | 2 | 0,6 | 21,4 ab | 44 a |
| 9. 0,40 Shirlan Ultra + 0,7 Propamocarb 722 SL | 0,4 | 0,05 | 21,5 ab | 43 ab |
| 10. 0,40 Shirlan Ultra + 0,25 Cymbal WG + 0,7 Propamocarb 722 SL | 0,5 | 0 | 21,5 a | 48 a |
| 11. 0,40 Shirlan Ultra + 0,25 Cymbal WG + 1,4 Propamocarb 722 SL | 0,2 | 0 | 21,6 a | 49 a |
| *LSD* | | | | *9* |

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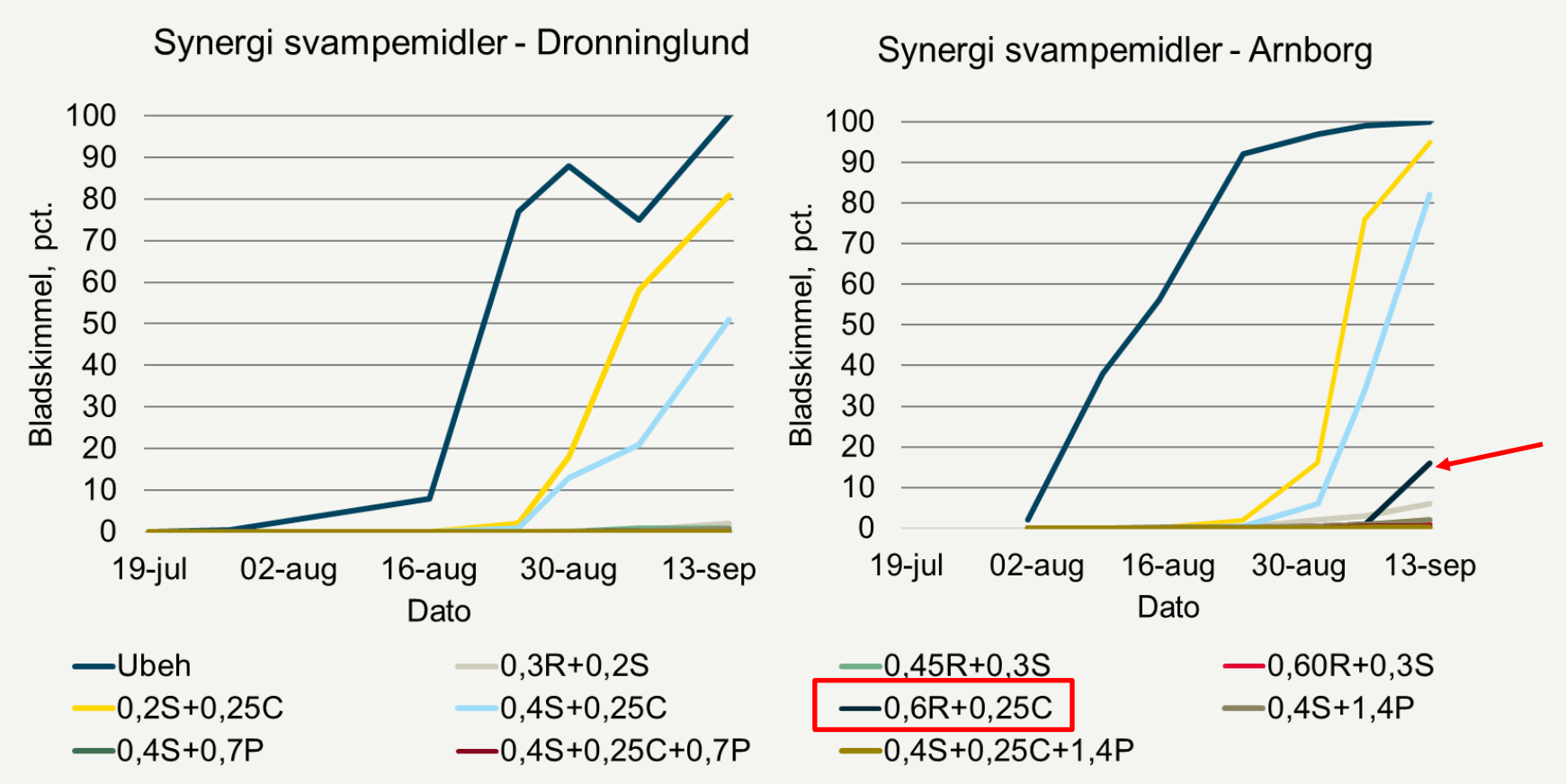
# Development in late blight

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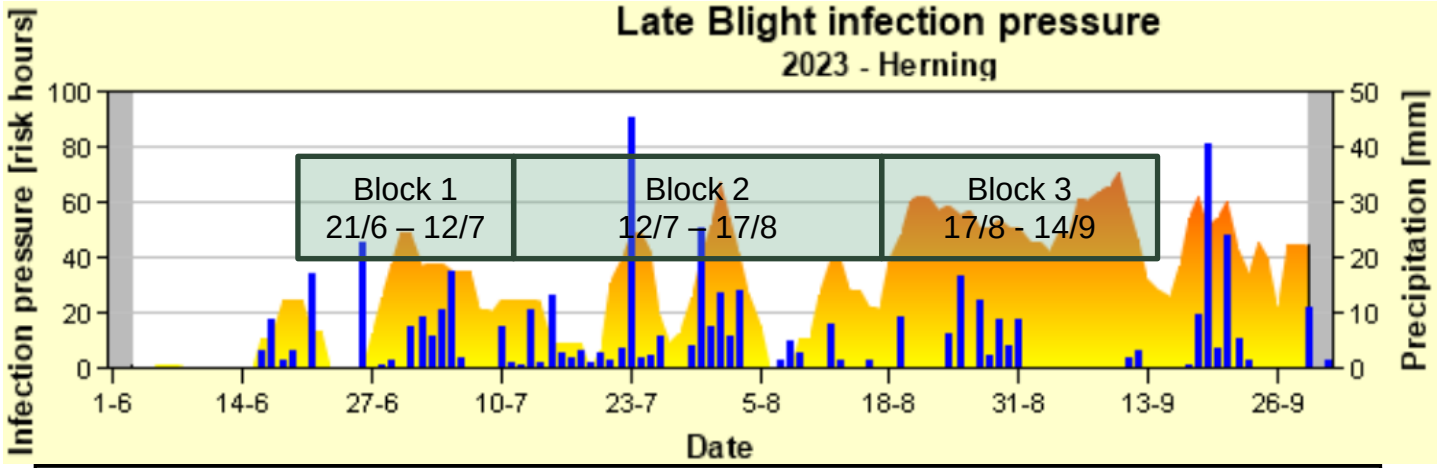
# Combination of fungicides in middle block




| Trial design | | | |
|---|---|---|---|
| No. | Block 1 | Block 2 | Block 3 |
| 1 | Non- treated | | |
| 2 | 3 x 0,4 Shirlan | 5 x 0,4 Shirlan + 0,25 Cymbal | 5 x 0,3 Shirlan |
| 3 | 3 x 0,4 Shirlan | 5 x 0,4 Shirlan + 0,6 Revus | 5 x 0,3 Shirlan |
| 4 | 3 x 0,4 Shirlan | 5 x 0,4 Shirlan + 0,5 Amistar | 5 x 0,3 Shirlan |
| 5 | 3 x 0,4 Shirlan | 5 x 0,4 Shirlan + 1,4 Sporax | 5 x 0,3 Shirlan |
| 6 | 3 x 0,4 Shirlan | 5 x 0,4 Shirlan + 2,0 Proxanil | 5 x 0,3 Shirlan |
| 7 | 3 x 0,4 Shirlan | 5 x 0,6 Evagio Plus | 5 x 0,3 Shirlan |
| 8 | 3 x 0,4 Shirlan | 5 x 0,5 Vendetta | 5 x 0,3 Shirlan |
| 9 | 3 x 0,4 Shirlan | 5 x 0,4 Shirlan 2 x 0,15 Zorvec | 5 x 0,3 Shirlan |
| 10 | 3 x 0,4 Shirlan | 5 x 0,4 Shirlan 2 x 0,15 Zorvec | 5 x 0,3 Shirlan |

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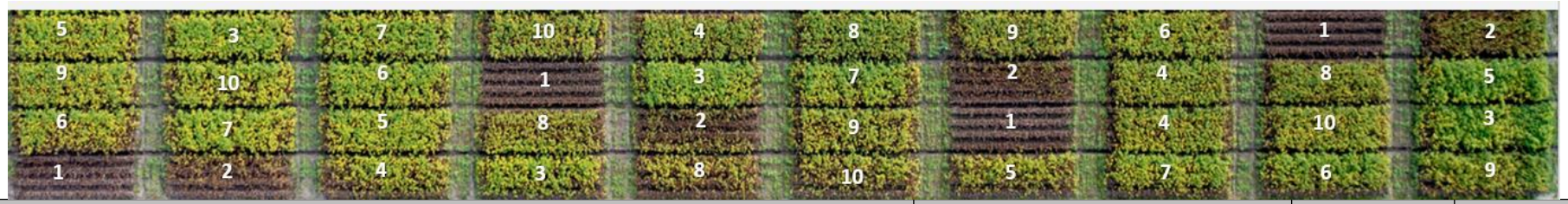


15/9

| Treatments | | Late blight, percent attack | | Starch, percent | Yield |
|---|---|---|---|---|---|
| | | Arnborg | Dronninglund | | hkg stivelse |
| *2023. 2 forsøg.* | | *6. sep* | *7. sep* | | *1 trial* |
| 1. | Ubehandlet | 98 | 85 | 21,6 | **109** |
| 2. | 0,4 l Shirlan + 0,25 l Cymbal WG | 48 | 8 | 22,1 | 20 |
| 3. | 0,4 l Shirlan + 0,6 l Revus | 2 | 0,08 | 23,0 | 41 |
| 4. | 0,4 l Shirlan + 0,5 l Amistar | 2 | 8 | 22,5 | 35 |
| 5. | 0,4 l Shirlan + 1,4 Propamocarb 722 SL | 4 | 5 | 23,5 | 41 |
| 6. | 0,4 l Shirlan + 2,0 l Proxanil | 6 | 10 | 22,8 | 38 |
| 7. | 0,6 l Evagio Plus | 2 | 0,01 | 23,4 | 46 |
| 8. | 0,5 l Vendetta | 6 | 14 | 22,7 | 35 |
| 9. | 0,4 l Shirlan + 0,15 Zorvec Enicade (12/7, 21/7) | 13 | 0,5 | 23,2 | 39 |
| 10. | 0,4 l Shirlan + 0,15 Zorvec Enicade (6/7, 17/7) | 8 | 0,04 | 22,9 | 40 |
| *LSD* | | | | | *9* |

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# Combination of MoA og R-genes - hypothesis

| Genotype | MoA | | R-gene |
|---|---|---|---|
| | Mandipropamid | Fluazinam | Nofy |
| EU 41 | + | + | - |
| EU41+EU37 | + | - | - |
| EU 43 | - | + | + |
| EU43+EU37 | - | - | + |
| Other | + | + | + |
| Other+EU37 | + | - | + |

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# Combination of MoA og R-genes - hypothesis

| Genotype | MoA | | R-gene |
|---|---|---|---|
| | Mandipropamid | Fluazinam | Fyone |
| EU 41 | + | + | + |
| EU41+EU37 | + | - | + |
| EU 43 | - | + | + |
| EU43+EU37 | - | - | + |
| Other | + | + | + |
| Other+EU37 | + | - | + |

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# Combination of MoA og R-genes

| Treatment | | Late blight, percent | | No of treat-ments | Yield and net | |
|---|---|---|---|---|---|---|
| | | 2022 | 2023 | | hkg stivelse | net yield, kr. pr. ha |
| *2022-2023. 2 trials. Nofy/AKV304 - Arnborg* | | *31. aug* | *13. sep.* | | | |
| 1. | Non treated | 0,2 | 0 | 0 | **125** | **54.392** |
| 2. | Routine 1/2-3/4 dosage | 0 | 0 | 12,5 | -3 | -3.830 |
| 5. | Skimmelstyring model HRB. | 0 | 0 | 8,5 | -1 | -2.764 |
| *LSD* | | | | | *ns* | |
| | | | | | | |
| *2022-2023. 2 forsøg. Nofy/AKV304 - Dronninglund* | | *16. sep.* | *15. sep.* | | | |
| 1. | Non treated | 100 | 48 | 0 | **101** | **44.126** |
| 2. | Routine 1/2-3/4 dosage | 100 | 0,2 | 11,5 | 8 | 997 |
| 5. | Skimmelstyring model HRB. | 20 | 0 | 9 | 36 | 13.432 |
| *LSD* | | | | | *16* | |

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# ”Take home message”

- High risk - development of resistance to fluazinam (Shirlan/Banjo/Zignal)
- High risk - development of resistance to oxathiapiprolin (Zorvec Enicade)
- High risk - breakdown of variety resistance – need for more resistance genes
- Always mixing strategies
- Always alternating strategies
- Two sprays with Zorvec before high risk periode and occurence of late blight
- Wait with mandipropamid to after Zorvec block?
- Combination of R-gene resistance and MoA
- Gradual phasing in of resistant varieties (8-10 years)
- DSS - ICM

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# Roadmap for 2024 – Coordination and communication

- Potota workshop in December
- Strategy devellopment in January 2024
  - Coordination of different strategies from scientists, advisers
  - Dynamic but important principles
  - No strong man solution or solution based on local commercial interests
  - Information of clear key messages to farmers – no confusion

- <u>Important questions</u>
  - Use of mandipromamid in mixtures; how many times and when to start?
  - Different combinations of fungicides (effect) in low and high risk periods
  - Costs and pesticide use

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