ECOSOL - IPM approaches for the control of late blight

James Lynott, Alison Lees, David Cooke, Jens Grønbech Hansen, Isaac Abuley, Poul Lassen, Hans Hausladen, Nicole Belle, Mati Koppel, Britt Puidet, Marjo Hokka, Riina Lukkala.

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- **Finland**
  PETLA
  - Marjo Hokka
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- **Denmark**
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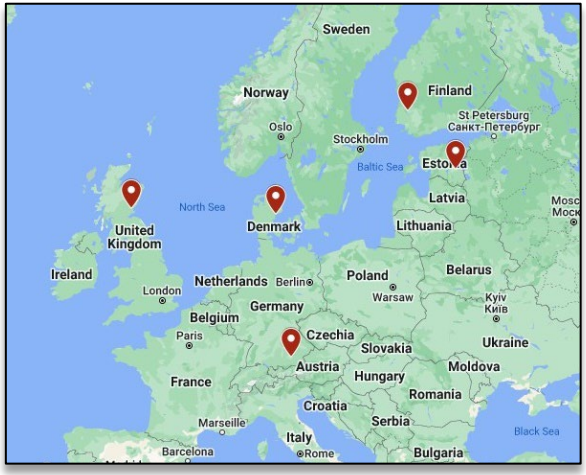

- **Estonia**
  University of Life Sciences
  - Mati Koppel
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  The James Hutton Institute
  - Alison Lees
  - David Cooke
  - James Lynott

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- **Stakeholders**
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  - FytoFend

IPM Strategy Trials

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Why investigate late blight IPM?

- Important to respond to an evolving pathogen population
  - Resistance to active ingredients
  - Resistance to host R-genes
- Loss and restrictions on use of fungicide actives.

- **Hypothesis**: Can we reduce chemical input using BCAs and achieve successful late blight control?
- Implemented field trials which utilised several components of the potato IPM toolbox.

Host Resistance | Fungicides | Biocontrol Agents | Decision Support

Preliminary testing

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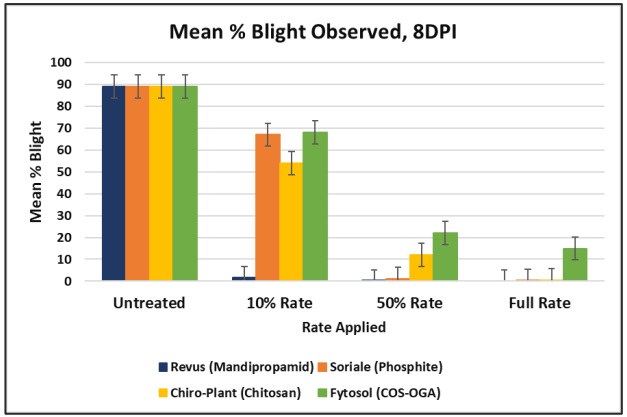
- Glasshouse based experiments with biocontrol agents (BCAs) and plant resistance inducers (PRIs).
- Mode of activity studies with BCAs and PRIs
- Field trials with solo BCAs
- IPM strategy simulations
  - Weather data
  - Late blight infection pressure
  - Risk prediction (Low/High risk periods)



IPM Strategy Field Trials

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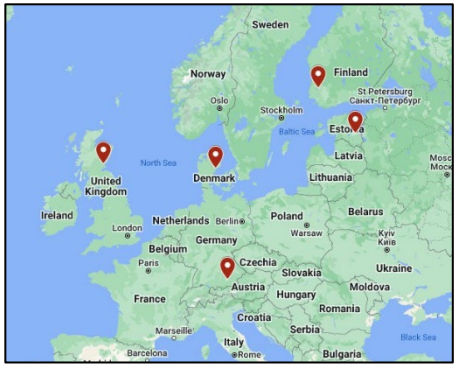
Field Trials in 2022 & 2023

- Common protocol used across 5 countries
  - Plot size, replicates, susceptible/resistant cultivars
  - Natural infection
  - Fungicide treatments as per local guidelines



IPM Strategy Field Trials 2022

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- **Treatments:**
  - **1.** Untreated
  - **2.** Standard Fungicide treatment
  - **3.** BCA 1 only – Chiproplant (Chitosan)
  - **4.** BCA 2 only – Polyversum (*P. oligandrum*)
  - **5.** IPM 1: **Strategy 1** with BCA 1
  - **6.** IPM 2: **Strategy 2** with BCA 1
  - **7.** IPM 3: **Strategy 1** with BCA 2
  - **8.** IPM 4: **Strategy 2** with BCA 2

- **Cultivars:**
  - 1. Moderately susceptible
  - 2. Intermediate
  - 3. Moderately resistant
- **Plot Size**
  - 20-25m^2
- **4 Replicates**

	LOW RISK	MED-HIGH RISK
Strategy 1	Full rate BCA	0.75 Fungicide
Strategy 2		0.75 Fungicide + FR BCA

IPM Strategy Field Trials 2022

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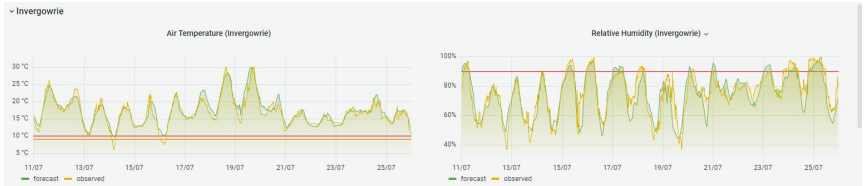
Scotland - Hutton Criteria



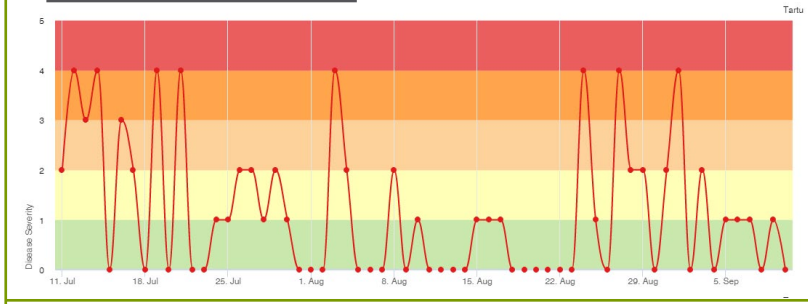
Invergowrie (Forecasts)

Time	Humidity Hours > 90%	Minimum Temperature
10 July 2022	3.0	13.3 °C
11 July 2022	7.0	12.8 °C
12 July 2022	0	13.0 °C
13 July 2022	0	10.7 °C
14 July 2022	0	9.8 °C
15 July 2022	7.0	11.9 °C
16 July 2022	7.0	10.3 °C
17 July 2022	9.0	15.0 °C
18 July 2022	1.0	15.7 °C
19 July 2022	0	16.0 °C
20 July 2022	4.0	12.8 °C
21 July 2022	2.0	12.2 °C
22 July 2022	0	12.7 °C
23 July 2022	7.0	13.2 °C
24 July 2022	12.0	15.1 °C
25 July 2022	8.0	11.4 °C

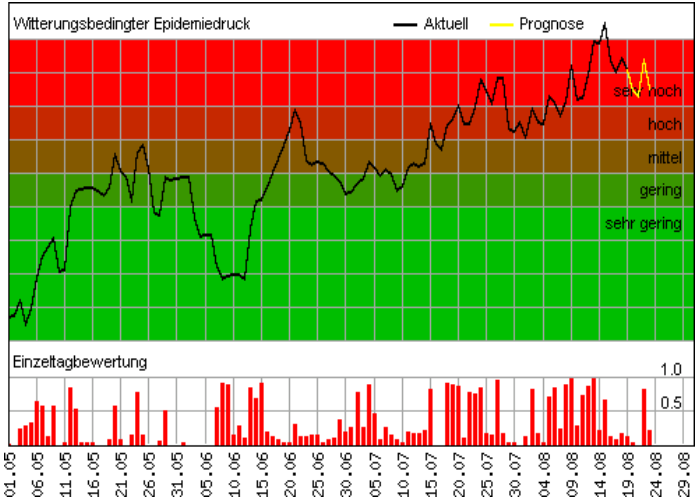
Invergowrie (Observed)

Time	Humidity Hours > 90%	Minimum Temperature
10 July 2022	5.0	11.2 °C
11 July 2022	4.8	11.2 °C
12 July 2022	0	12.1 °C
13 July 2022	0	9.8 °C
14 July 2022	0.3	6.2 °C
15 July 2022	9.1	9.8 °C
16 July 2022	6.9	7.7 °C
17 July 2022	2.7	15.2 °C
18 July 2022	6.3	14.5 °C
19 July 2022	0.3	13.6 °C
20 July 2022	2.6	11.4 °C
21 July 2022	0.4	11.6 °C
22 July 2022	0.3	13.2 °C
23 July 2022	6.2	13.5 °C
24 July 2022	13.6	14.8 °C
25 July 2022	10.4	10.6 °C

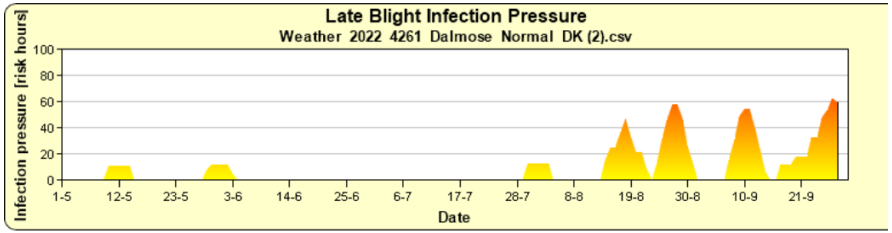
Estonia - BliteCast



Germany - PhytophthoraModell Weihenstephan, ISIP



Denmark & Finland - BlightManager



Results - 2022 Trials

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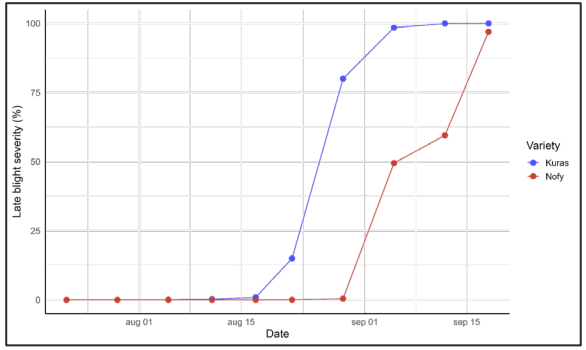
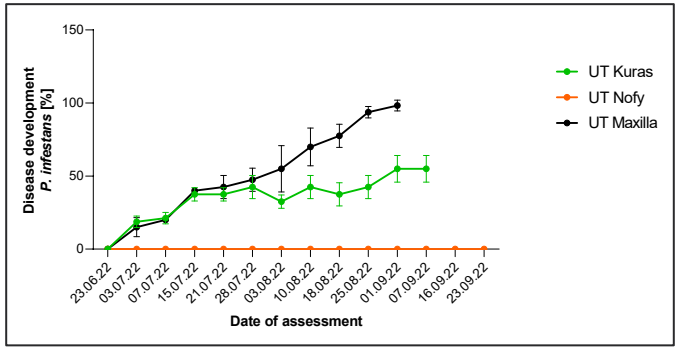
- Different locations presented different challenges!
  - Scotland - Very late epidemic, poor disease data.
  - Estonia - Very low levels of disease, only 3% in untreated.

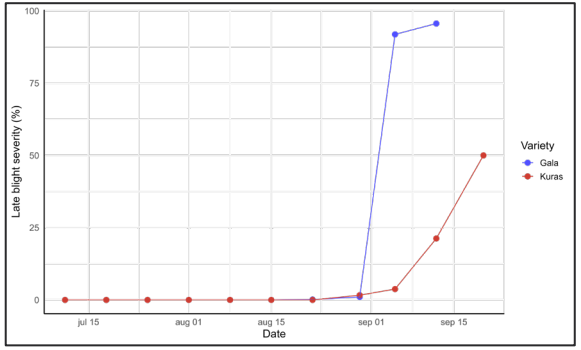
Denmark



Germany



Finland



Results 2022 Trials

EcoSol Eco-friendly solutions for the integrated management of late and early blight of potatoes

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% Efficacy: Efficacy of control based on disease levels (AUDPC) compared to untreated plots.

	Denmark		Germany		Finland	
	Kuras	Nofy	Kuras	Maxilla	Gala	Kuras
2. Standard Fung Trt	80	99	69	47	55	100
3. BCA 1 only - ChiproPlant	11	0	11	11	14	29
4. BCA 2 only - Polyversum	9	0	11	13	16	5
5. IPM 1: **Strategy 1** with BCA 1	93	98	41	32	49	99
6. IPM 2: **Strategy 2** with BCA 1	89	99	35	32	48	99
7. IPM 3: **Strategy 1** with BCA 2	92	99	37	34	45	100
8. IPM 4: **Strategy 2** with BCA 2	87	97	45	33	48	99
Reduction in Fungicide	44%		88%		70%	53%

DSS Low Risk	3	10	3	3
DSS Med/High Risk	9	2	2	5

2022 Trial Main Points

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- Solo BCAs not significantly different from untreated plots.
- IPM strategies significantly less disease than solo BCAs.
- IPM Strategies not significantly different from full rate weekly fungicide applications (except for in Kuras in Germany).
- Difficult to determine if it was just the 0.75 rate fungicide in the IPM strategies providing all of the control.
- To try and improve the data obtained from trials in 2023 modifications made to the treatments.

IPM Strategy Field Trials 2023

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- **Treatments:**
  1. Untreated
  2. Weekly Fungicide treatment
  3. 0.75 dose fungicide
  4. Practical fungicide treatment (local DSS based)
  5. BCA 1 only – Chiproplant (Chitosan)
  6. BCA 2 only – Polyversum (*P. oligandrum*)
  7. IPM 1: **Strategy 1** with BCA 1
  8. IPM 2: **Strategy 2** with BCA 1
  9. IPM 3: **Strategy 1** with BCA 2
  10. IPM 4: **Strategy 2** with BCA 2
  11. Common DSS, BCA 1 – IPM **Strategy 1**
  12. Common DSS, BCA 1 – IPM **Strategy 2**

- **Cultivars:**
  - 1. Moderately susceptible
  - 3. Moderately resistant
- **Plot Size**
  - 20-25m^2
- **4 Replicates**

	LOW RISK	MED-HIGH RISK
Strategy 1	Full rate BCA	0.75 Fungicide
Strategy 2		0.75 Fungicide + FR BCA

- Treatments 1, 2, 5-10 same as 2022
- 0.75 dose fungicide to directly compare with IPM strategies
- Fungicide application as per local practice, with DSS
- Common DSS and risk assessment across all locations (Hutton Criteria). Single BCA – Chiproplant

Results 2023 Trials

EcoSol Eco-friendly solutions for the integrated management of late and early blight of potatoes

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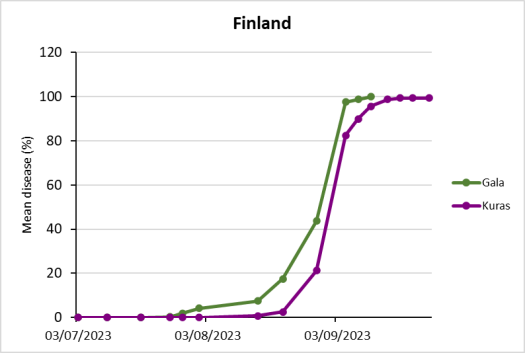
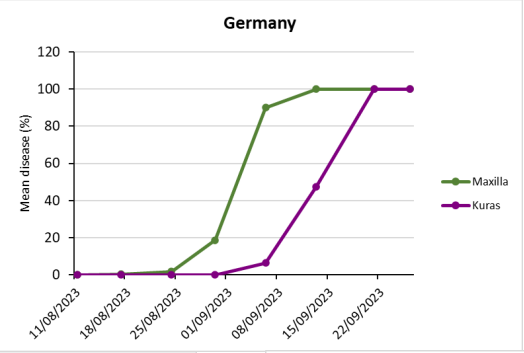
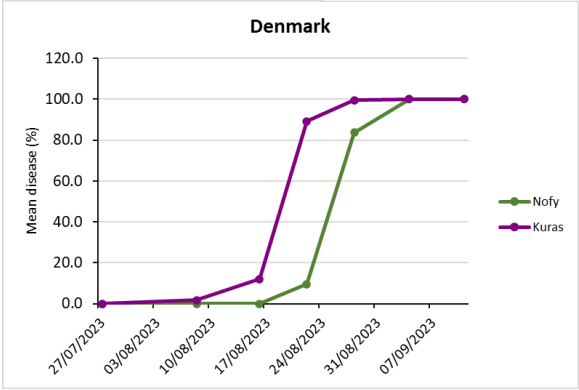
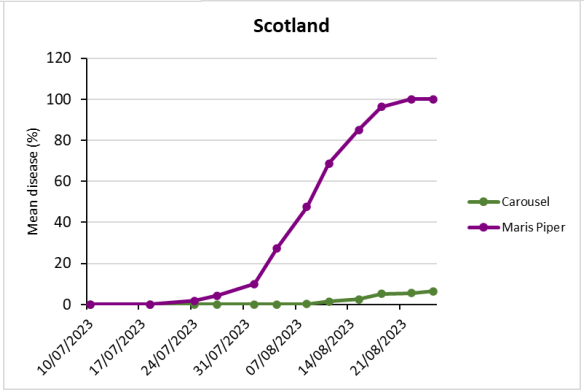
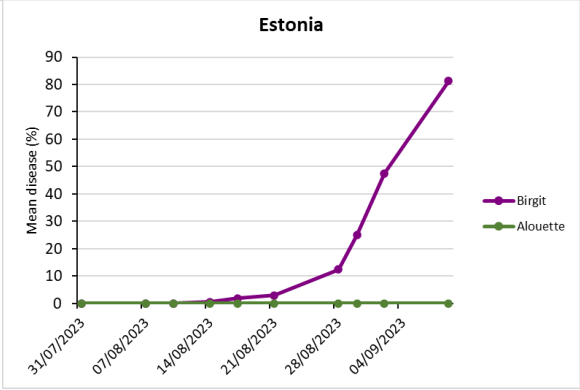
- More conducive weather for late blight
- Improved data set from all trial locations











Results 2023 Trials

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% Efficacy: Efficacy of control based on disease levels (AUDPC) compared to untreated plots.

	Scotland		Denmark		Germany		Estonia	Finland	
	M. Piper	Carousel	Kuras	Nofy	Kuras	Maxilla	Birgit	Kuras	Gala
2. Weekly fungicide treatment	91	99	97	99	97	97	84	79	92
3. 0.75 Dose fungicide	89	100	96	98	88	82	80	76	61
4. DSS fungicide treatment	95	100	95	99	95	96	78	81	84
5. BCA 1 only – Chiproplant	38	86	3	6	1	4	65	13	19
6. BCA 2 only – Polyversum	41	77	0	0	3	1	60	1	17
7. IPM 1: Strategy 1 with BCA 1	91	100	95	98	91	83	80	79	85
8. IPM 2: Strategy 2 with BCA 1	89	97	93	98	91	83	79	70	67
9. IPM 3: Strategy 1 with BCA 2	90	99	94	98	91	81	77	77	77
10. IPM 4: Strategy 2 with BCA 2	93	100	93	98	90	83	73	76	72
11. Hutton Criteria, BCA – IPM Strategy 1	-	-	94	98	90	86	82	73	89
12. Hutton Criteria, BCA – IPM Strategy 2	-	-	89	98	90	86	85	75	96
Reduction in Fungicide (Local)	34%		34%		63%		53%	33%	38%
Reduction in Fungicide (HC)	34%		34%		38%		44%	25%	25%

DSS Low Risk	1	1	6	3	1	1
DSS Med/High Risk	7	7	6	5	8	5
HC Low Risk	1	1	2	2	0	0
HC Med/High Risk	7	7	10	6	9	6

2023 Trial Main Points

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- In Scotland and Estonia, the solo BCAs provided some level of disease control, this was significantly less than the untreated although still not an acceptable level of control.

- IPM strategies provided levels of disease control comparable and not significantly different from the full rate fungicide treated plots, except for cultivar Maxilla in Germany, where the 0.75 fungicide and IPM treatments had slightly more disease than the full rate.

- In some instances, the IPM strategies which contained BCA as well as 0.75 fungicide performed slightly better than reference treatment.

Conclusions

EcoSol Eco-friendly solutions for the integrated management of late and early blight of potatoes

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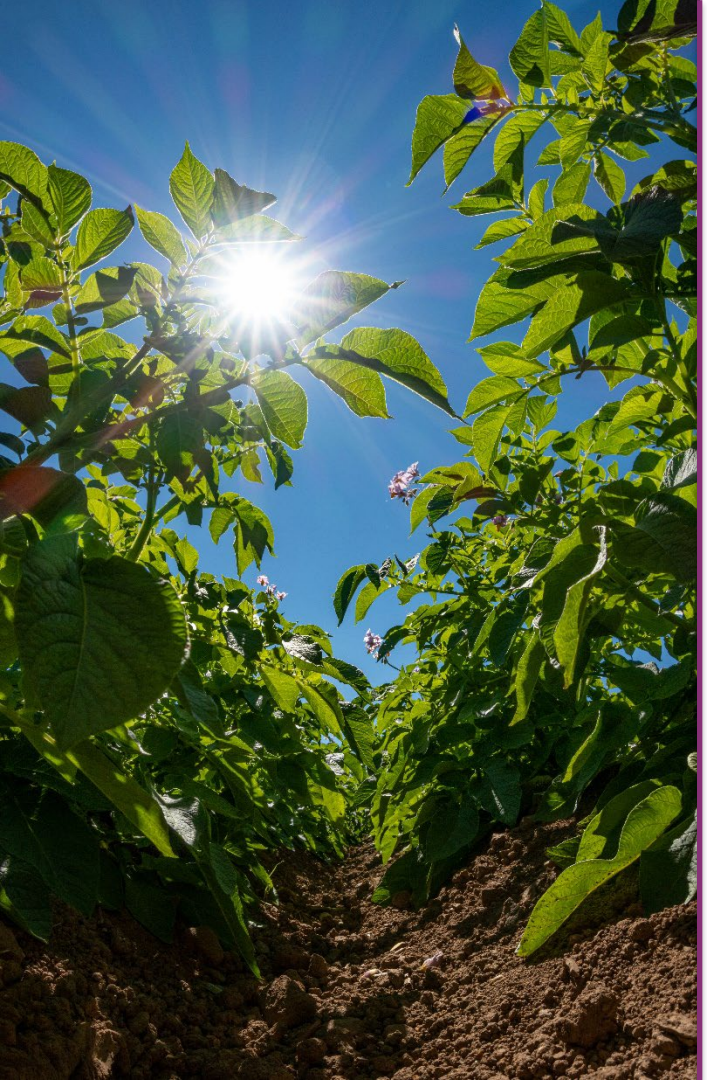
Can we reduce chemical input using BCAs and achieve successful late blight control?

- Biocontrol agents used in these trials did not provide sufficient levels of control when used alone.
- Use of BCAs and reduced fungicide levels in IPM strategy treatments based on risk level provided similar levels of control to weekly full rate fungicide.
- Chemical input can be reduced using DSS while achieving successful late blight control.



Acknowledgements

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Field Teams

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