The Hutton Criteria

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The Smith Period

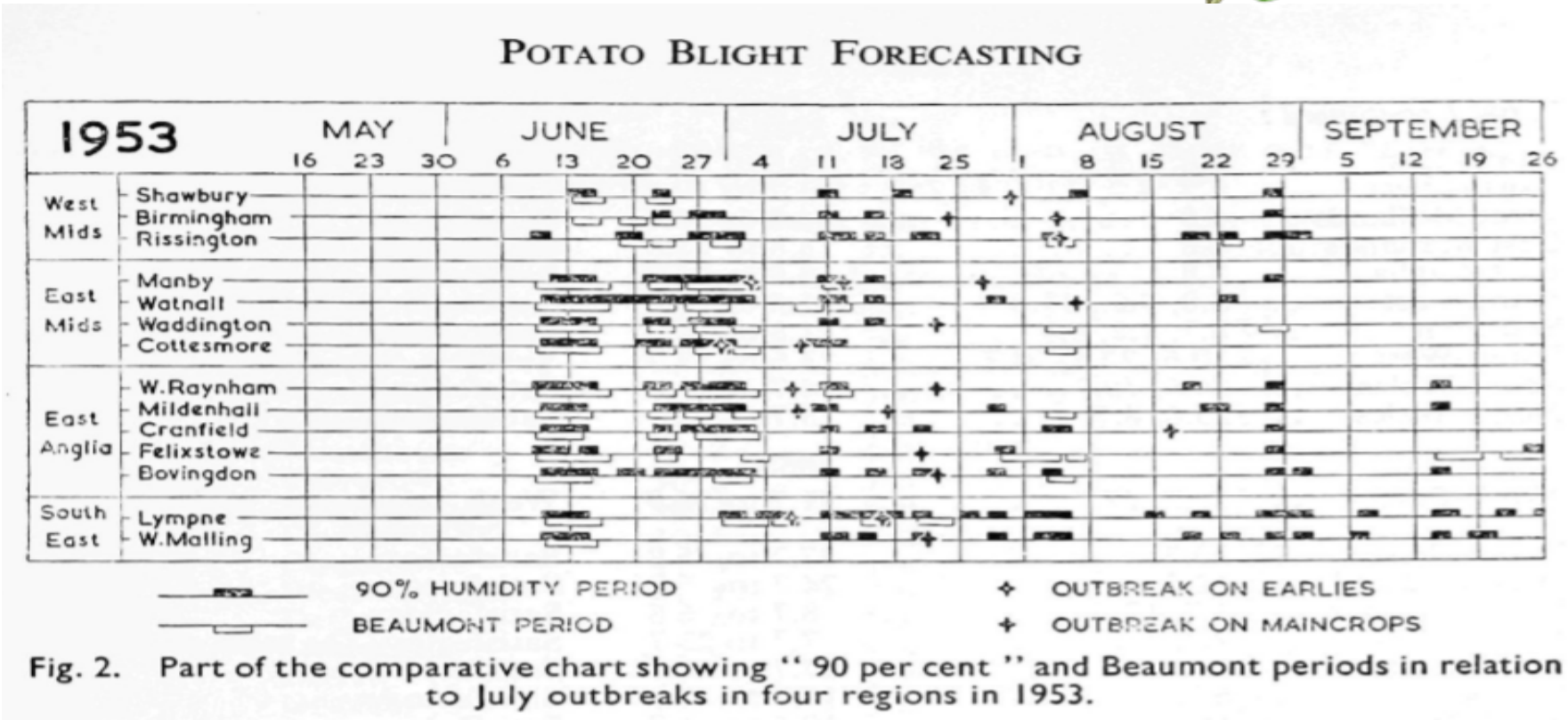


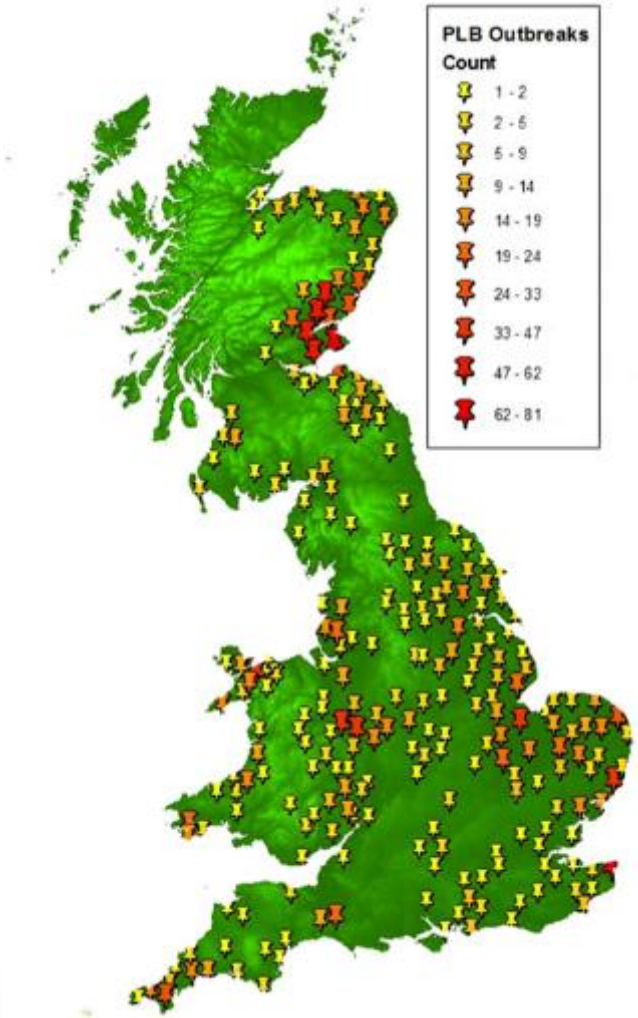
Fig. 2. Part of the comparative chart showing "90 per cent" and Beaumont periods in relation to July outbreaks in four regions in 1953.

The Smith Period

1. Historic outbreak analysis
2. Experimental criteria investigation
3. Trial Models
4. Hutton Criteria

1. Historic Outbreaks

More than 2000 potato late blight outbreaks recorded by Fight Against Blight scouts between 2003 – 2014.



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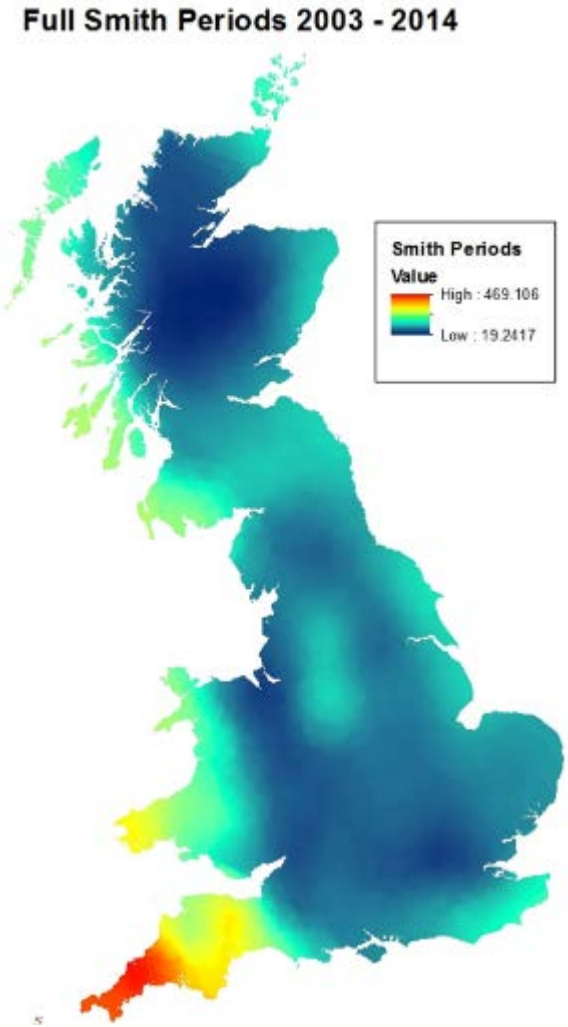
1. Historic Outbreaks

Met Office Data from 2003 -2014

- Minimum daily temperature
- Number of hours of humidity ≥90%



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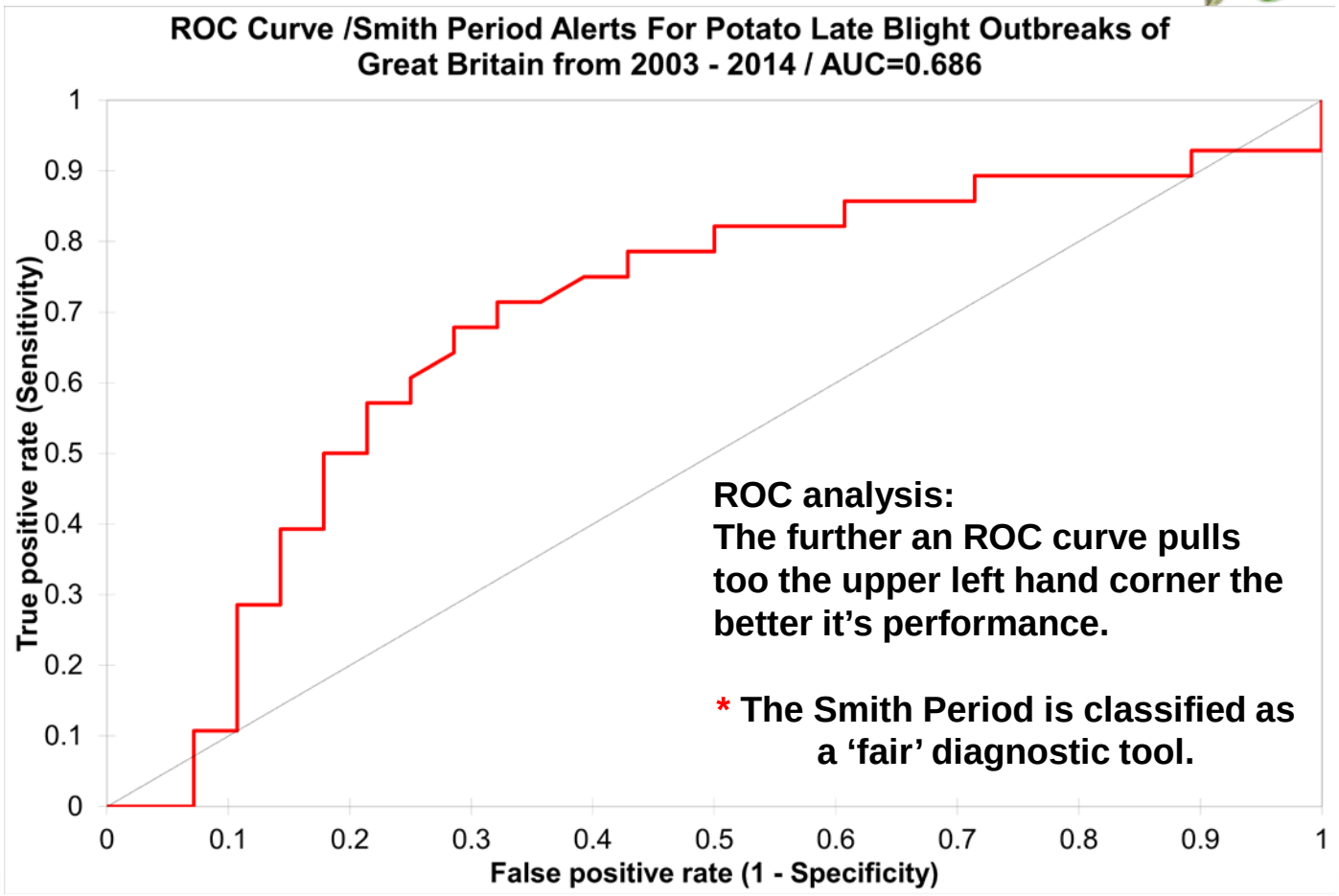

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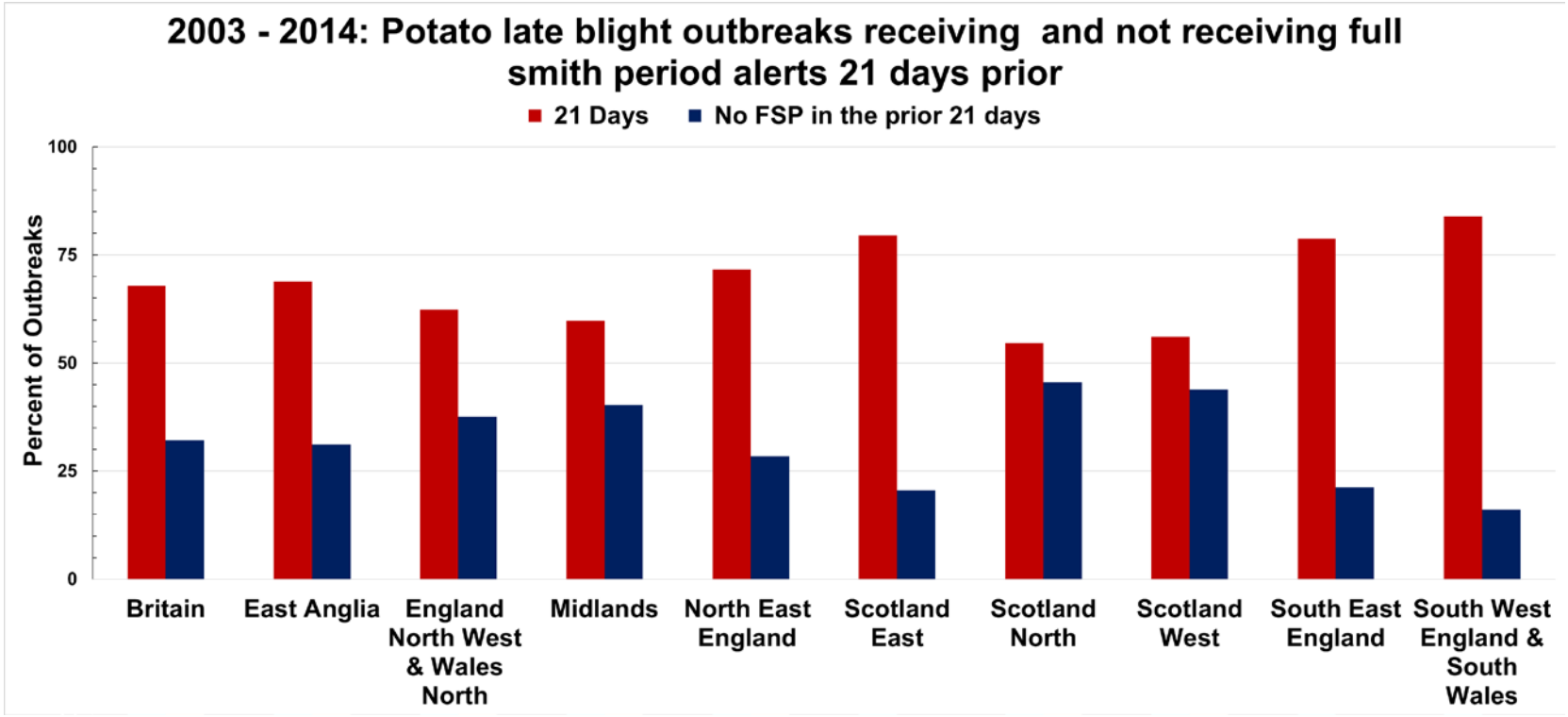

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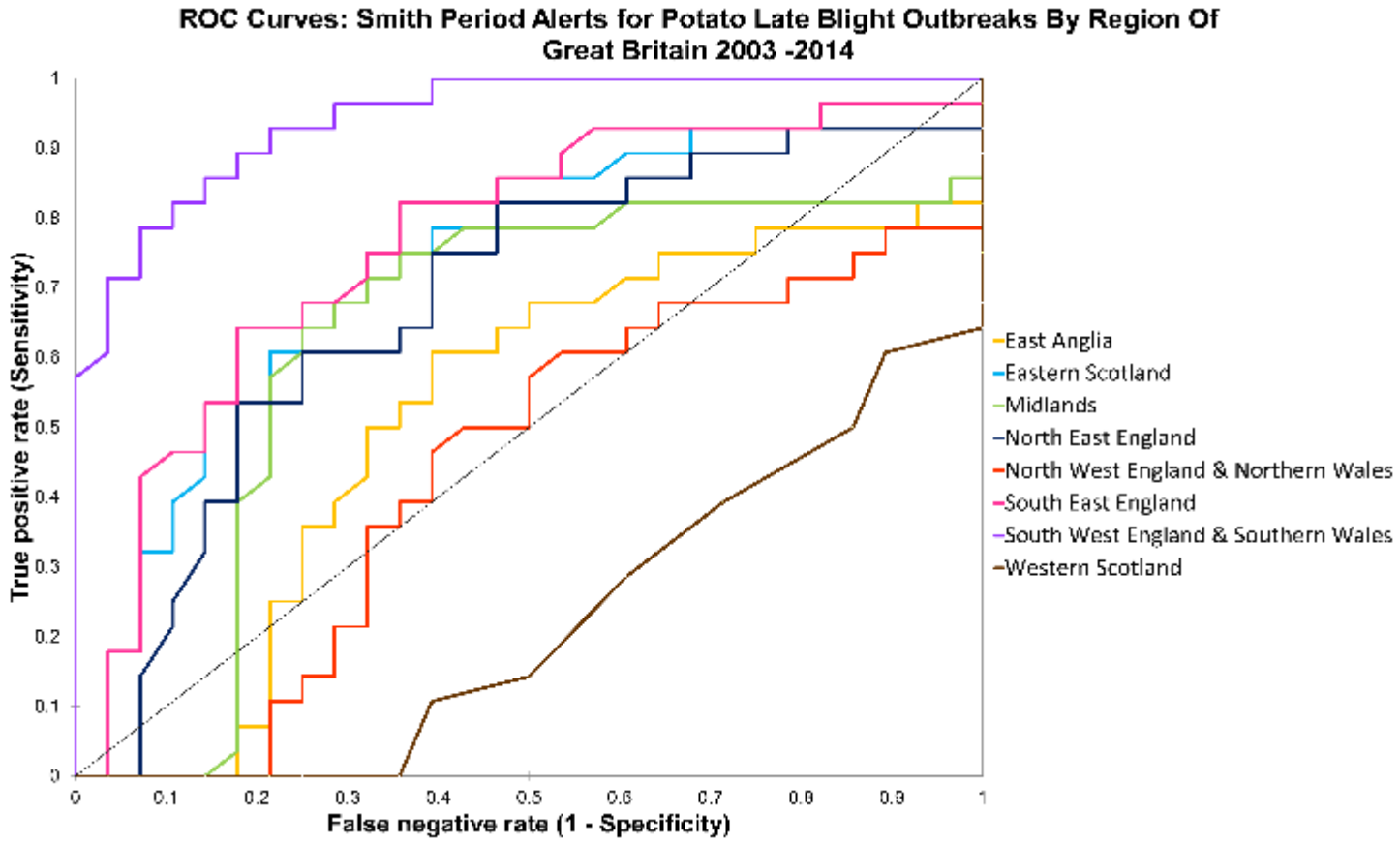

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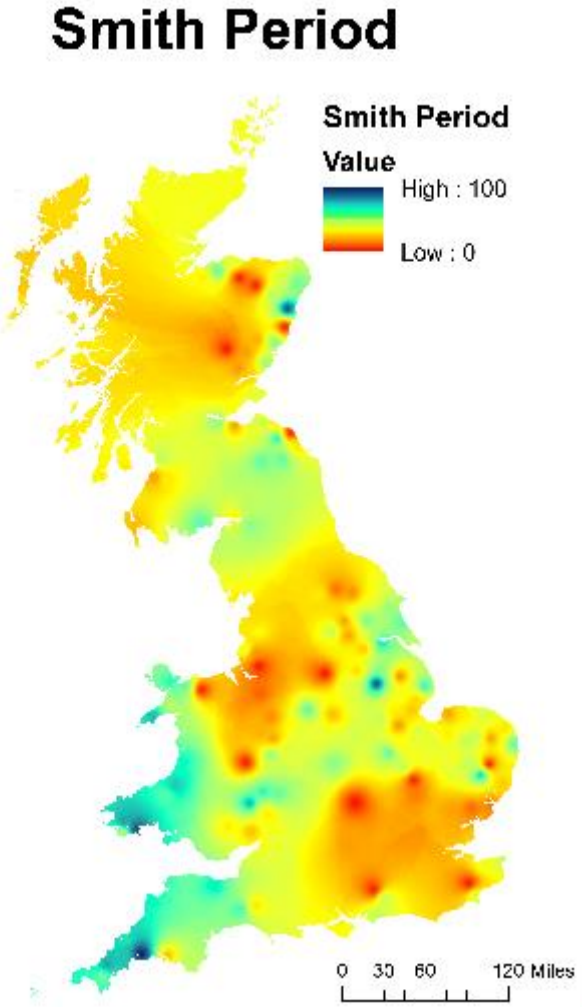


Spatial visualization of Smith Period performance.

- Smoothing of data by removing single outbreaks
- Performance variable

2. Experimental

The Smith Period:

Two consecutive days where:

1. Each day has a **minimum temperature of 10°C**
2. Each day has at least **eleven hours** with **relative humidity ≥ 90%**

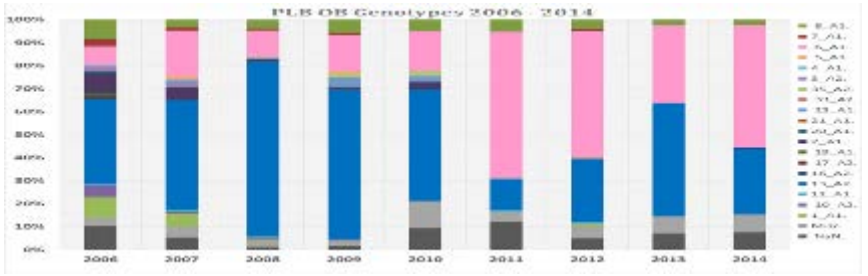
Investigate:

1. Minimum temperature threshold
2. Relative humidity threshold
3. Relative humidity duration

2. Experimental

Methods:

- Genotypes of *P. infestans* representative of current populations
- Maris Piper detached leaves and whole plant
- Gradient plate and growth rooms to control temperature
- Glycerol to control relative humidity levels in sealed chambers
- iButtons to record temperature and relative humidity



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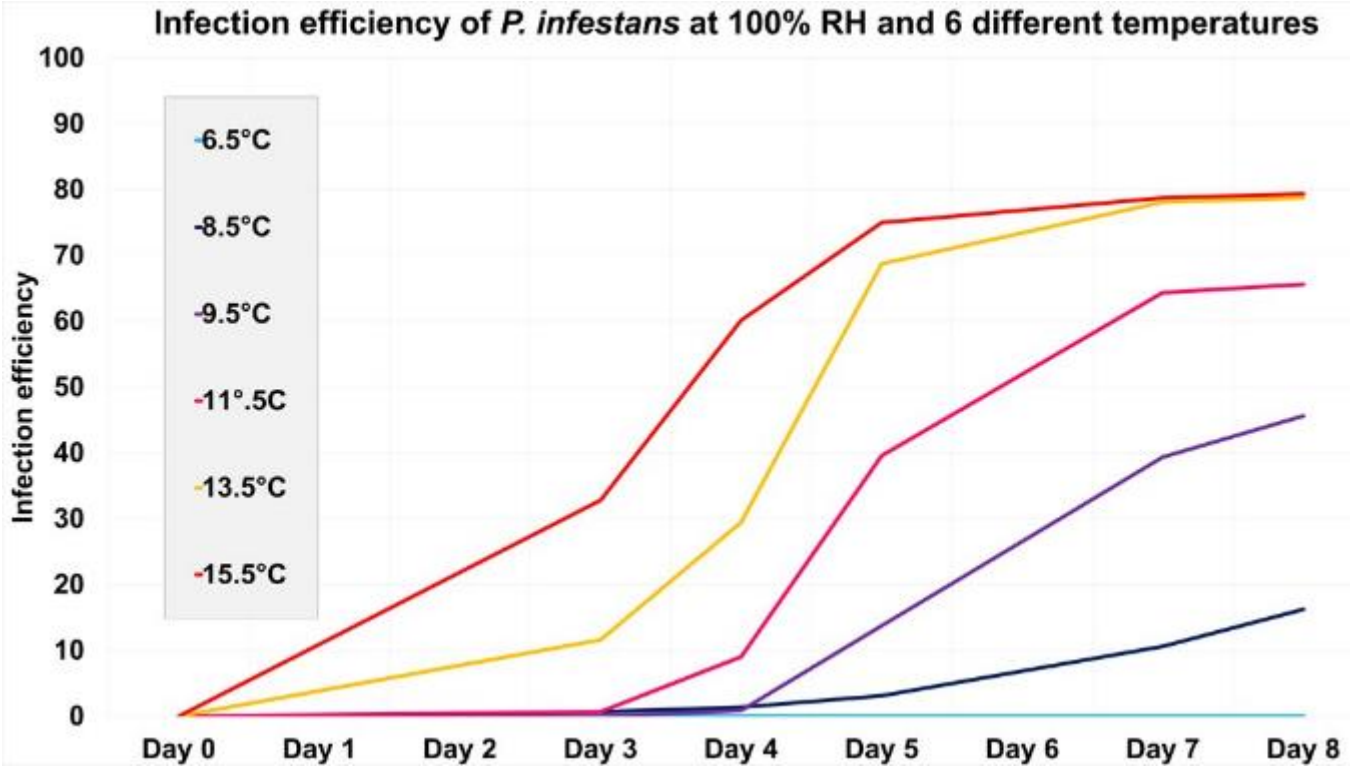
2. Experimental

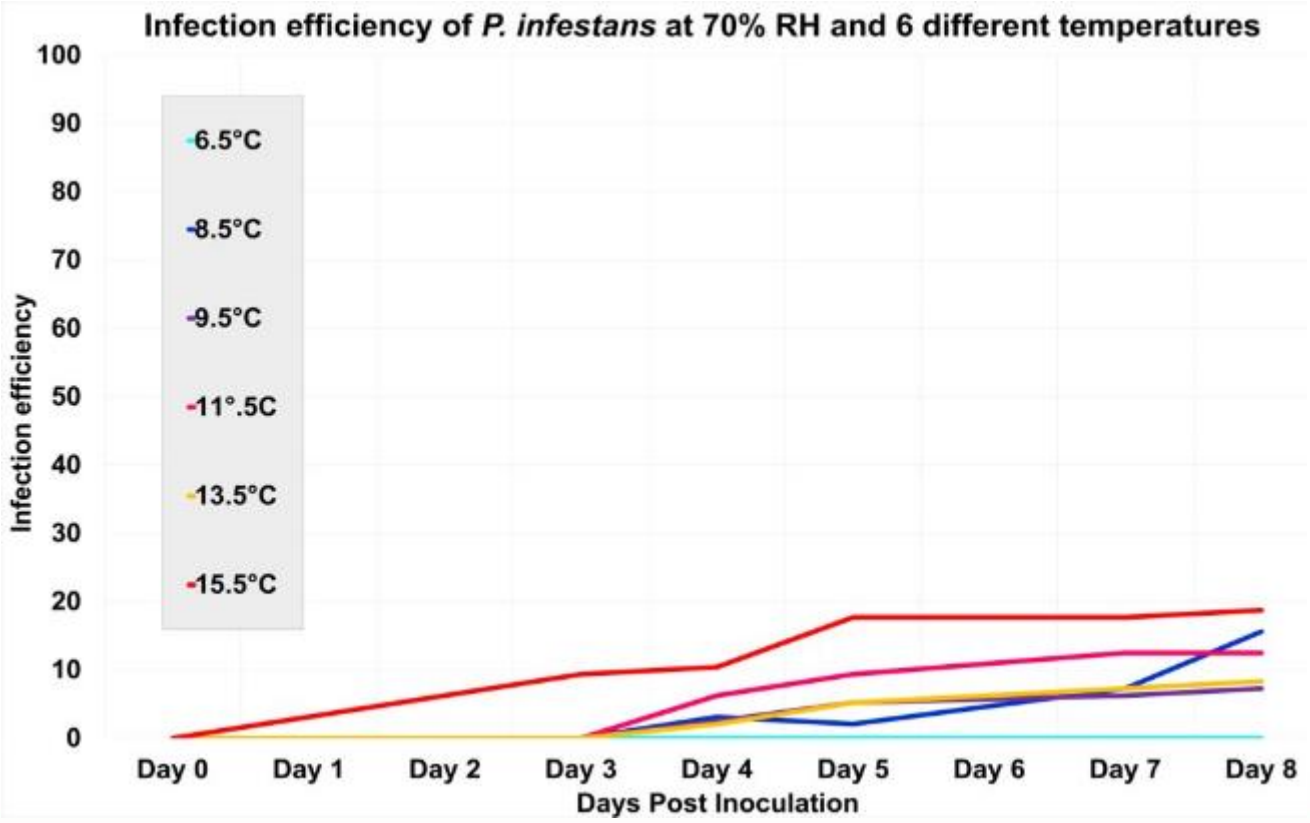
1. Minimum Temperature Threshold



Infection occurs below the 10°C threshold, but the rate of disease development is decreased.

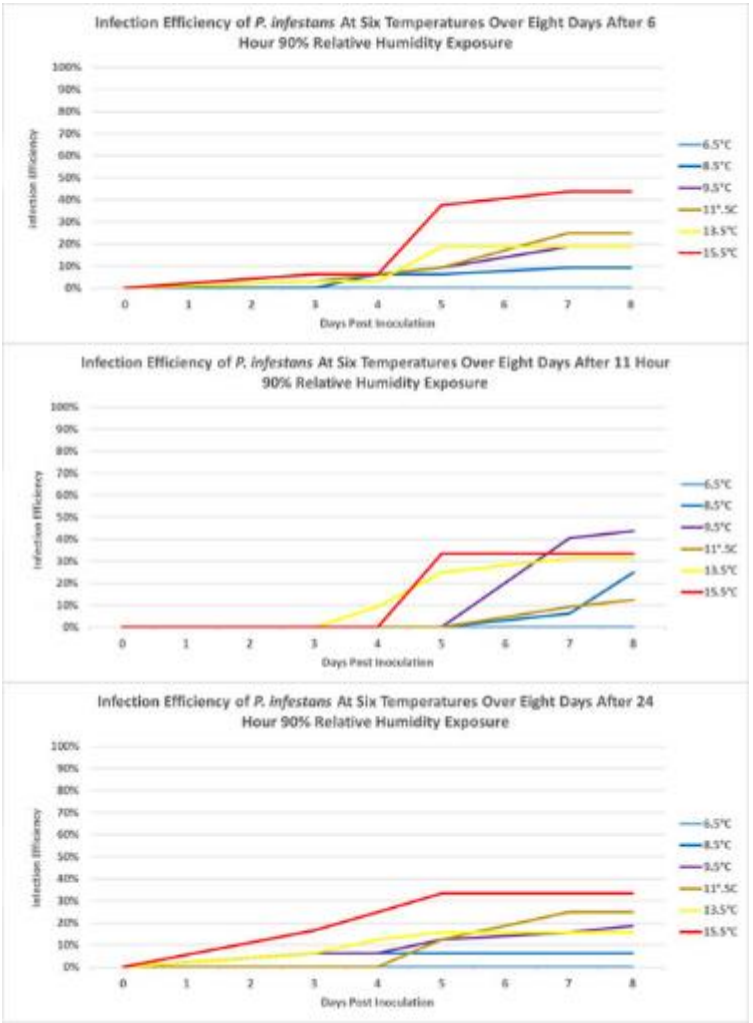
2. Experimental

2. Relative Humidity Threshold



Infection occurs below the 90% threshold, but the amount of infection is drastically decreased.

2. Experimental



3. Relative Humidity Duration

Infection at durations of 6, 11 and 24 hours of exposure to 90% relative humidity show very similar levels of infection.

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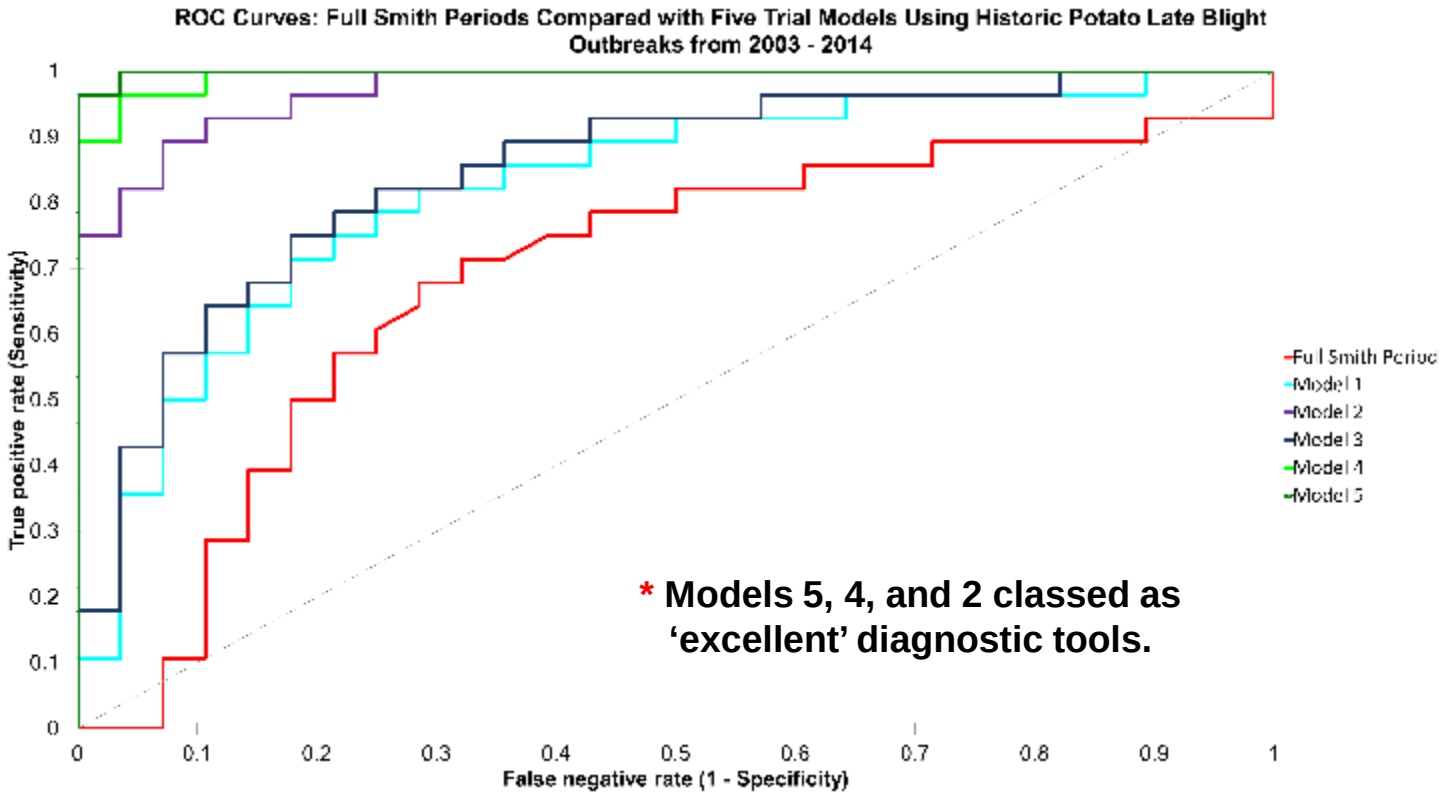
3. Trial New Models

Trial Models: Two consecutive days with durations of ≥90% Relative Humidity

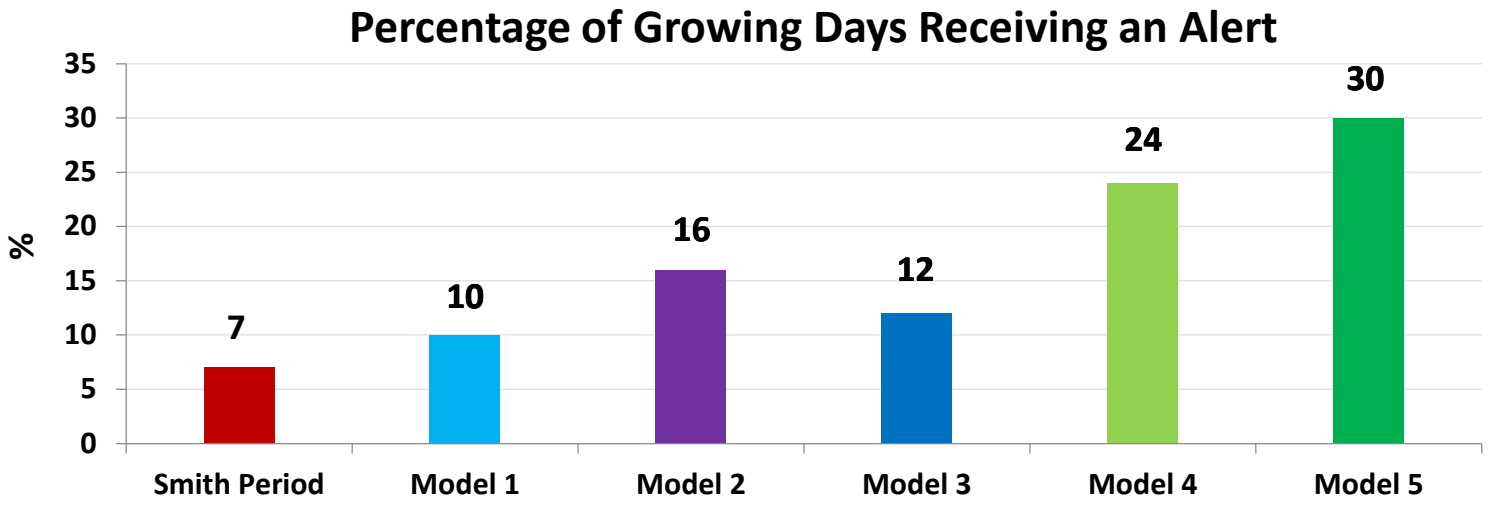
Model:	Minimum Temperature °C:	Relative Humidity Duration (h):
Smith Period	10	11
1	8	11
2	10	6
3	6	11
4	8	6
5	6	6

3. Trial New Models



*** Models 5, 4, and 2 classed as 'excellent' diagnostic tools.**

3. Trial New Models



Smith Period: area under ROC curve = 0.7 (fair), frequency ~ 1 alert per fortnight

Model 2: area under ROC curve = 0.93 (excellent), frequency ~ 1 alert per week, and most biologically plausible model according to experimental work.

4. Hutton Criteria

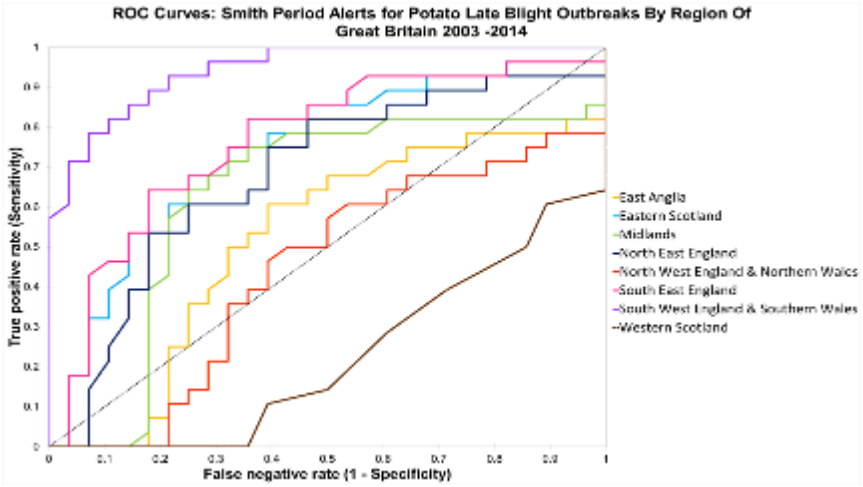
The Hutton Criteria

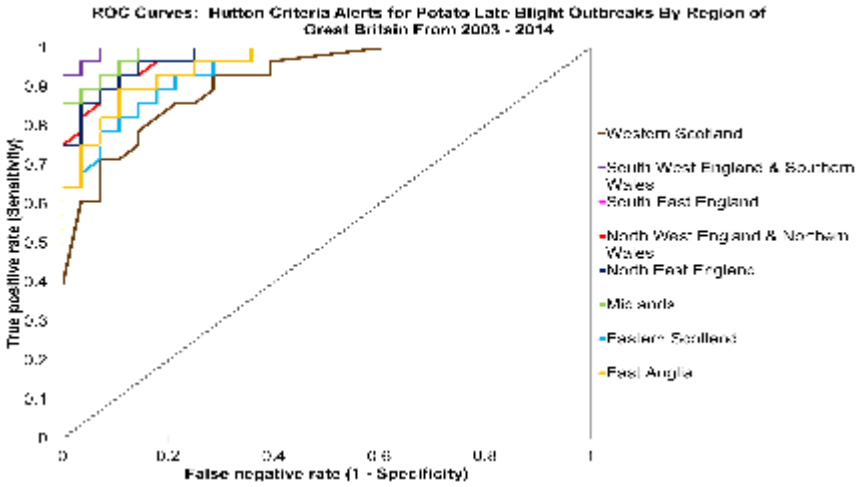
Model Two:

Two consecutive days where:

1. Each day has a **minimum temperature of 10°C**
2. Each day has at least **six hours** with **relative humidity ≥ 90%**

4. Hutton Criteria

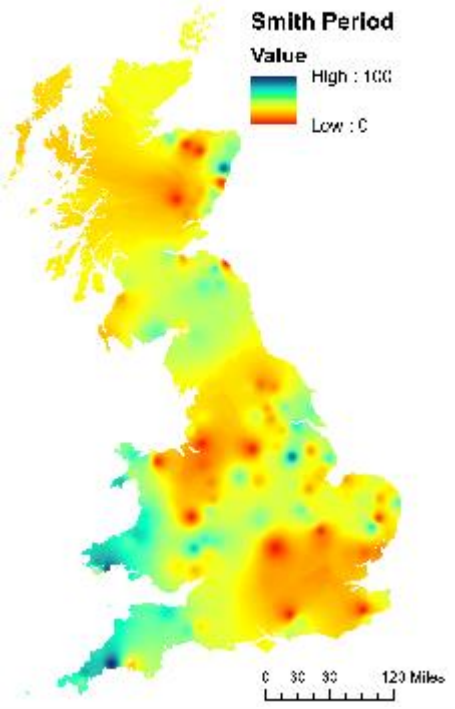




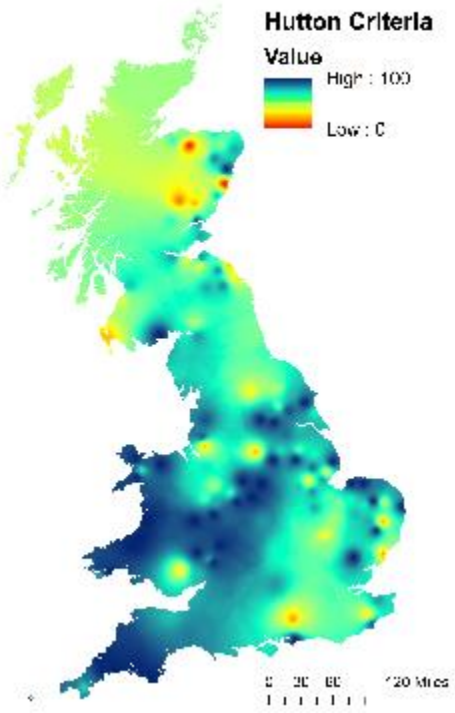
4. Hutton Criteria

Spatial visualization of potato late blight outbreaks predicted by the Smith Period compared with the Hutton Criteria.

Smith Period



Hutton Criteria



Conclusions

1. The Smith Period served us well (fair predictor)
2. It's performance, however, was not uniform across GB
3. Experimental investigations showed that:
    - The minimum temperature threshold should not change
    - The relative humidity threshold should not change
    - The duration of high relative humidity should be shortened
4. Trial Models
    - Confirmed that reducing the minimum temperature does not improve performance markedly
    - Showed that reducing both temperature and relative humidity criteria resulted in an overly sensitive system with an alert every 4 days

The Hutton Criteria: two consecutive days with a **minimum temperature of 10°C,** and at least **six hours** of **relative humidity ≥ 90%**

Acknowledgements

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