

The Smith Period Review

An evaluation of how well the Smith Period has functioned as a predictor of potato late blight development across Great Britain between 2003 – 2014 and recommendations of how it may be improved

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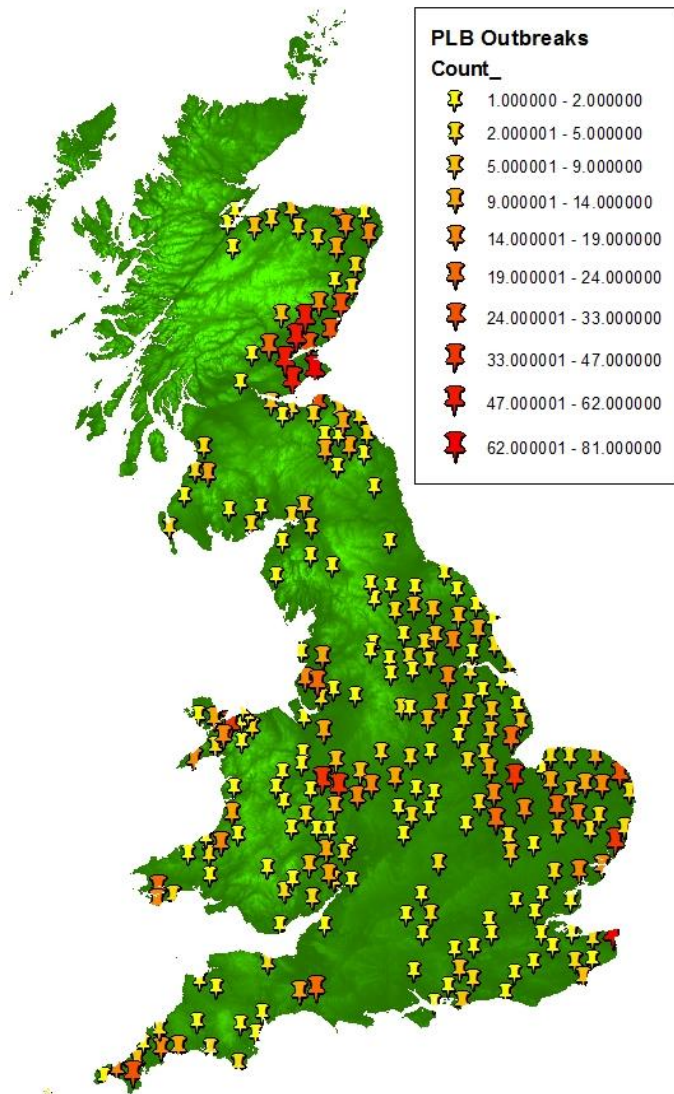


The Smith Period:

- A set of temperature and relative humidity requirements used to indicate periods of high risk for potato late blight development
- Defined in 1956 by L.P. Smith through refinement of the previous Beaumont Criteria
- A full Smith period:
 - Two consecutive days where the minimum temperature does not fall below 10°C and there are at least 11 hours in each day where the relative humidity is $\geq 90\%$

Blight Watch and the Fight Against Blight

FAB: >2000 PLB Outbreaks 2003 -2014



Blightwatch

AHDB
POTATOES

Met Office

The James Hutton Institute

- Blight Watch – provides free alerts via email and text when a Smith Period occurs and online minimum temperature and daily relative humidity hours based on post code district
- Fight Against Blight
 - > 2000 potato late blight outbreaks across Great Britain for 2003 - 2014
 - Id Number
 - Post Code
 - Scout name
 - Date of Collection
 - Date Received
 - Variety of potato
 - Source of disease
 - Stage of outbreak
 - Genotype of isolate (2006 - 2014)

AHDB Grower Map and Outbreak Map

Selected plantings and sample crops

Plantings in sample

ha per 5-km sq. OS quadrant

below 20 ha

20 to 40 ha

40 to 80 ha

80 to 160 ha

160 to 320 ha

• Grower Panel crop

■ Plantings not in sample

Simple background map

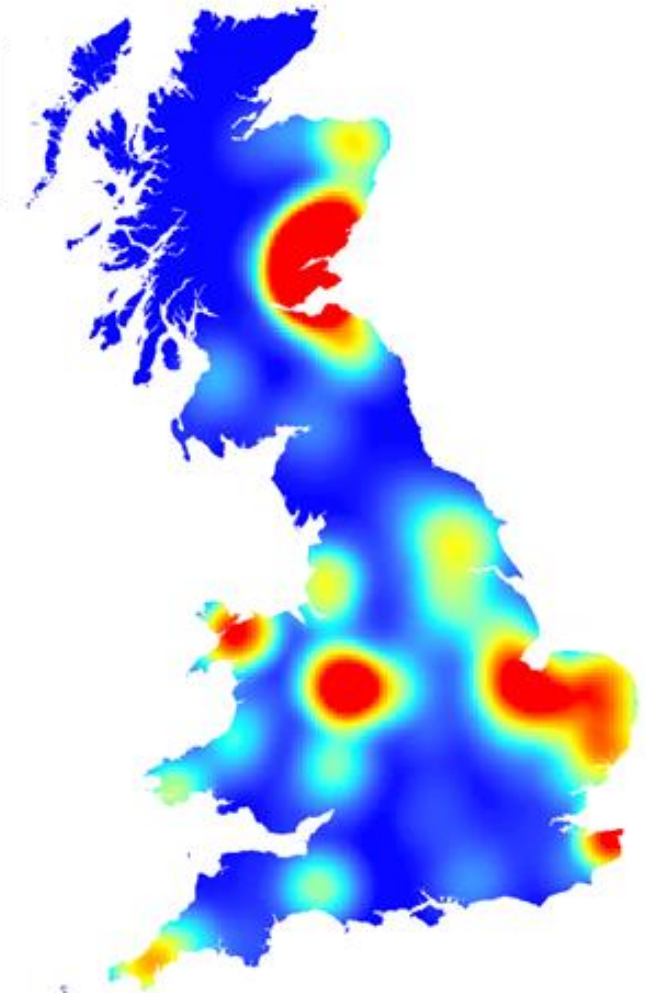
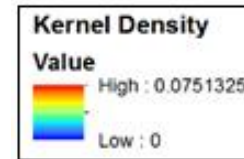
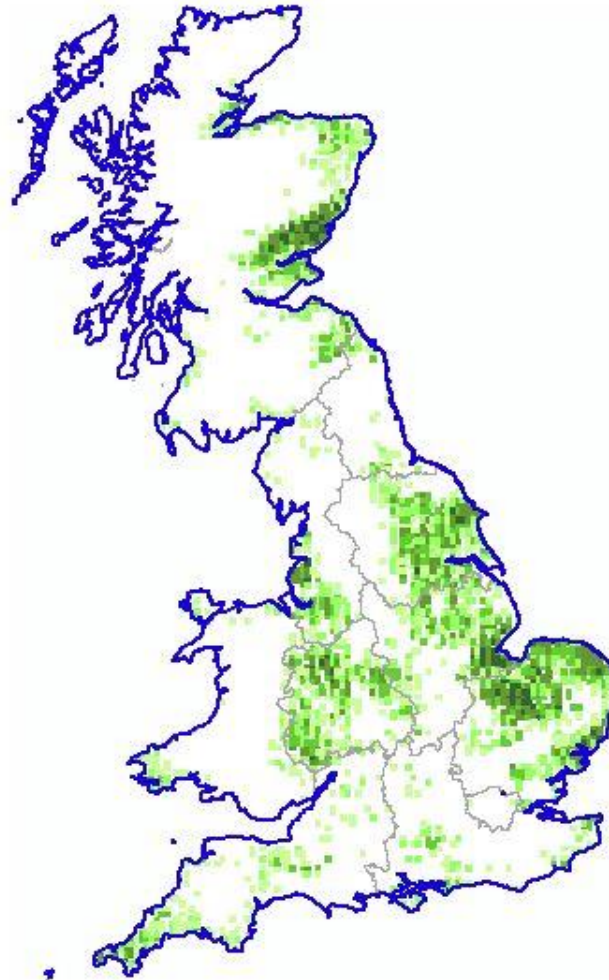
Current sample includes:

Varieties: All

Market sectors: All

GB regions: All

See the **Select** menu to amend this.

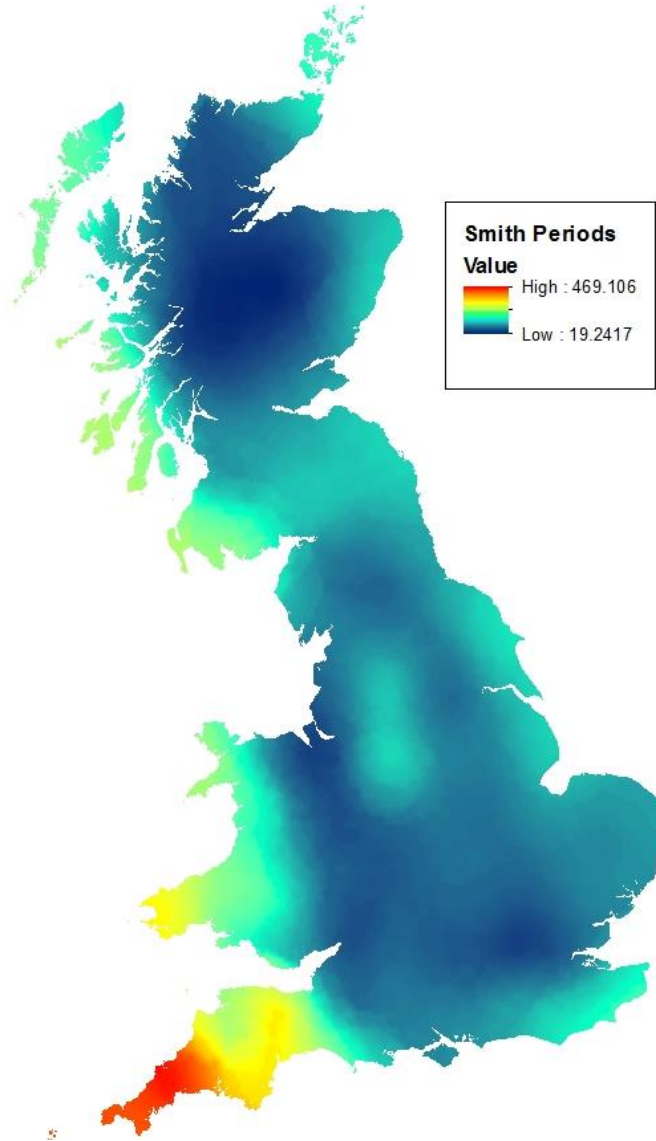


Are all reported outbreaks preceded by a Smith Period?

Historic Data Analysis

Met Office Data and Smith Period Occurrences

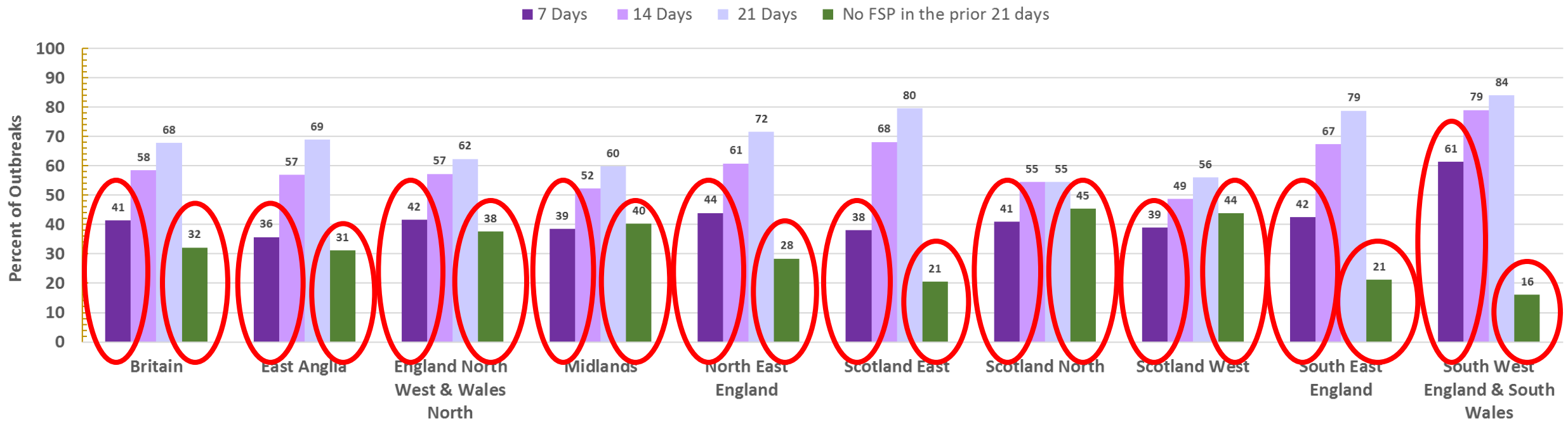
Full Smith Periods 2003 - 2014



- Met Office data for 652 interpolates locations across the UK for the 1st April – 30th September for 2003 - 2014
- An overview of Smith Period occurrences from 2003 – 2014 shows that they predominate in coastal regions and specifically along the west coast of Great Britain

How has the Smith Period been doing?

2003 - 2014 - percentage of recorded potato late blight outbreaks receiving full smith period alerts 7,14 and 21 days prior



FSP Spatially – 7 days

PLB OB FSP alert in previous 7 days

PLB OB >1 FSP alert in previous 7 days

PLBOB =>3 FSP alert in previous 7 days



Occurrence of full smith periods across Britain within the first seven days of an outbreak. The maps show successively, the removal of outbreak locations where only 1 and then 2 outbreaks had been recorded.

Key Point:

- There are clear 'hot spots' along the south west coast of England as well as some eastern coastal areas
- South East England as well as some areas in mid northern England are not performing well

Are the Smith temperature and humidity criteria optimal indicators for blight infection and spread?

Experimental Analysis

Temperature:

Previous experimental data from the institute shows infection below 10°C

Literature review shows infection below 10°C

Current experimental work shows infection below 10°C

Relative Humidity:

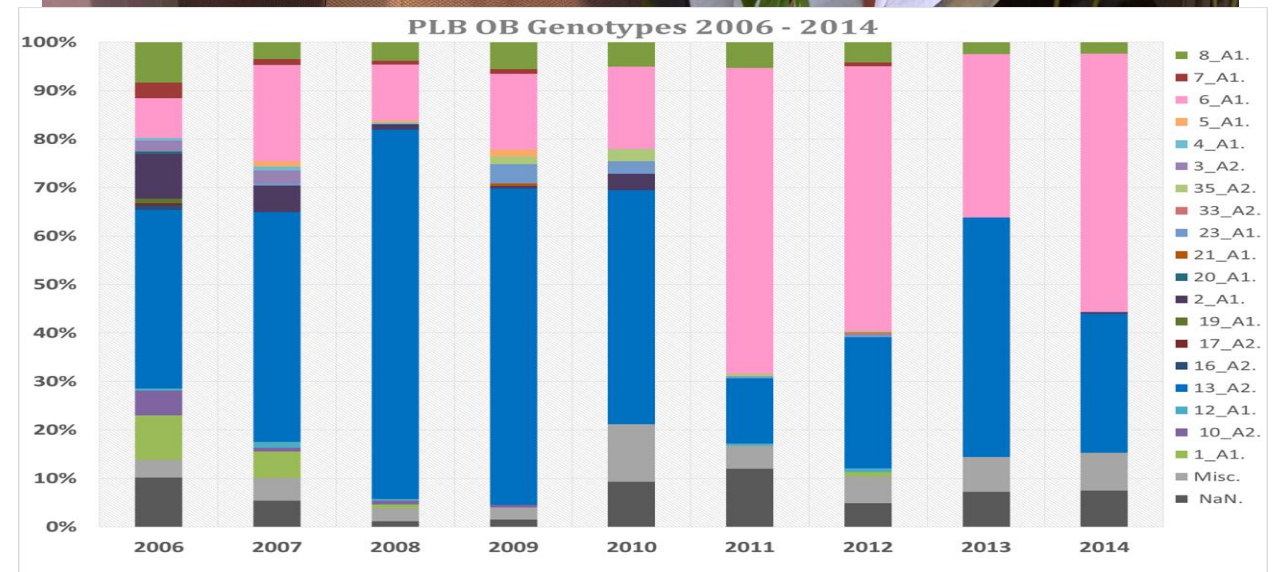
Lack of data regarding infection ability below 90%RH

Previous experimental work at the institute shows infection at 100%RH at durations shorter than ten hours

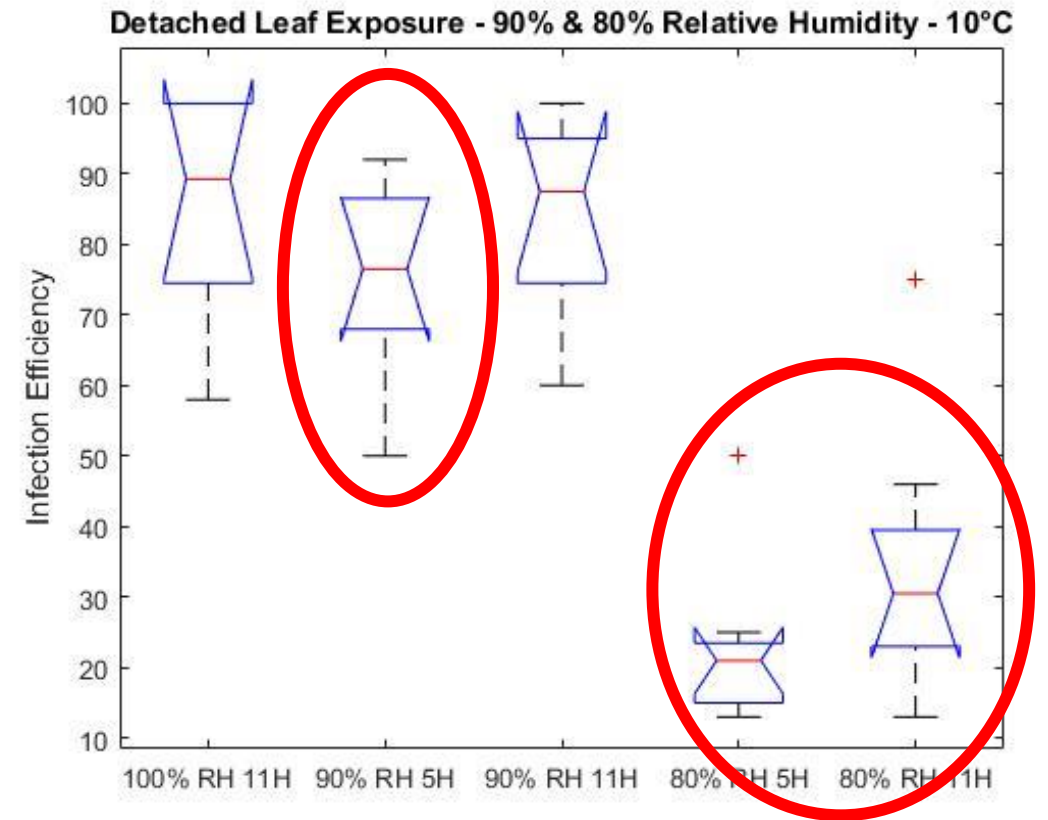
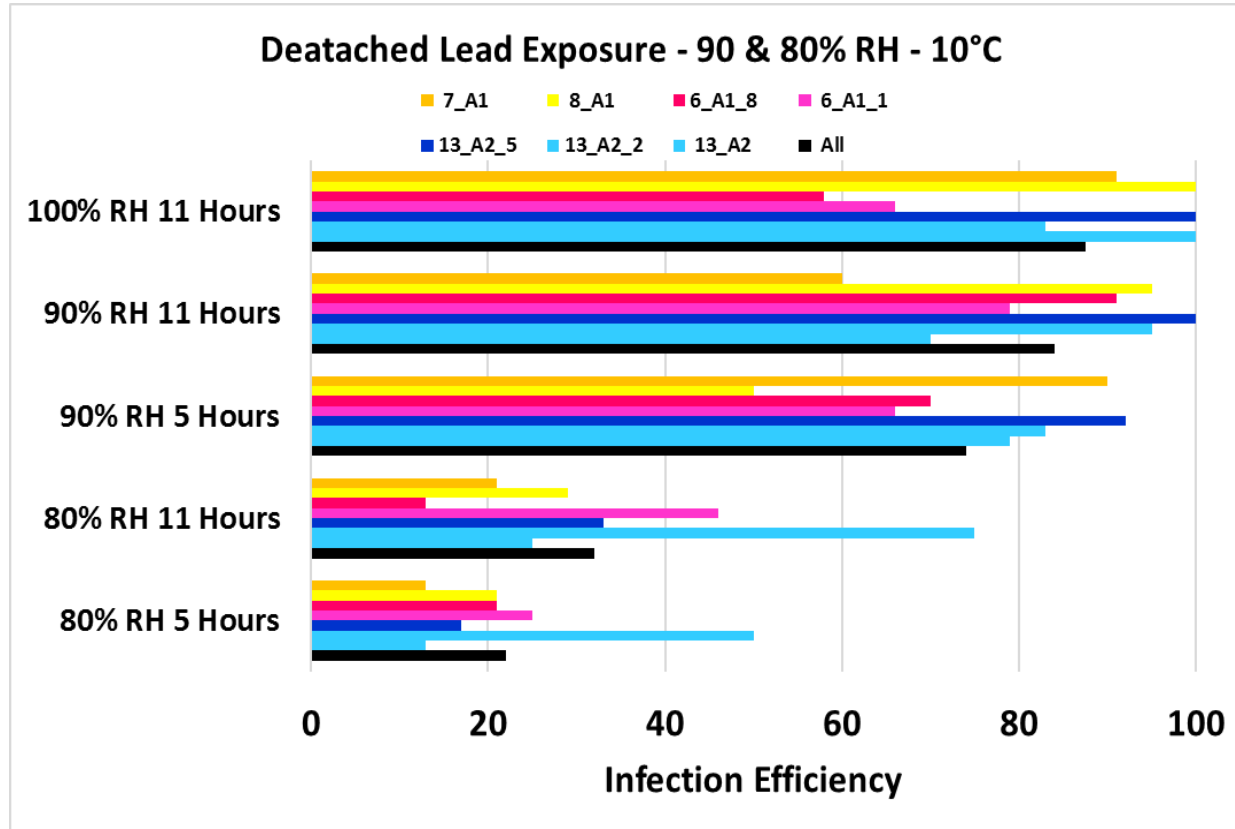
Current experimental work shows infection at 90%RH at durations shorter than ten hours

Methods

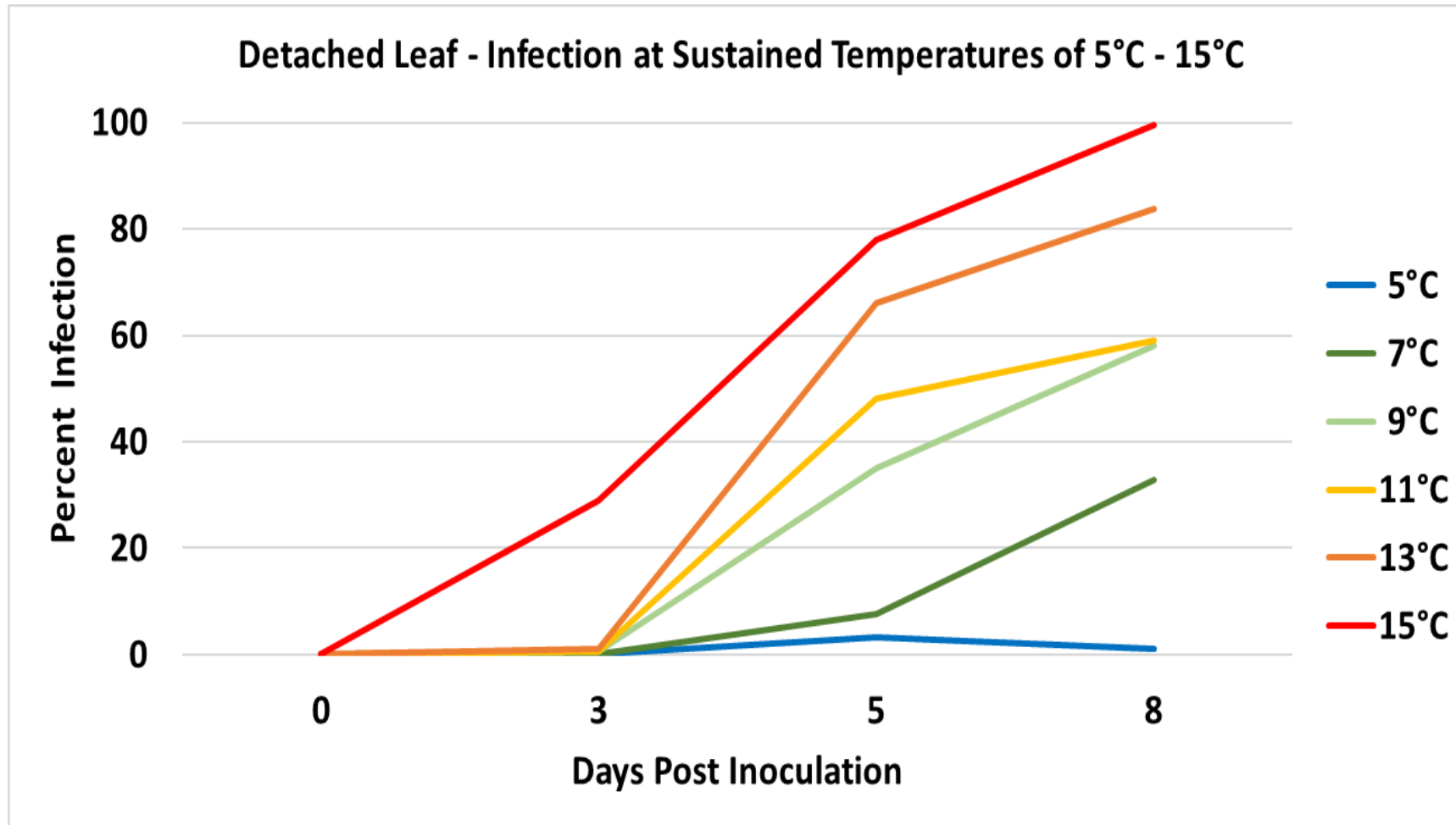
- Detached leaves and whole plants were used to test infection
- Growth rooms and gradient plate used to control temperature
- Humidity chambers placed within the growth rooms or gradient plate- created using glycerol and water solutions
- I-buttons used to monitor temperature and relative humidity conditions within chambers at all times



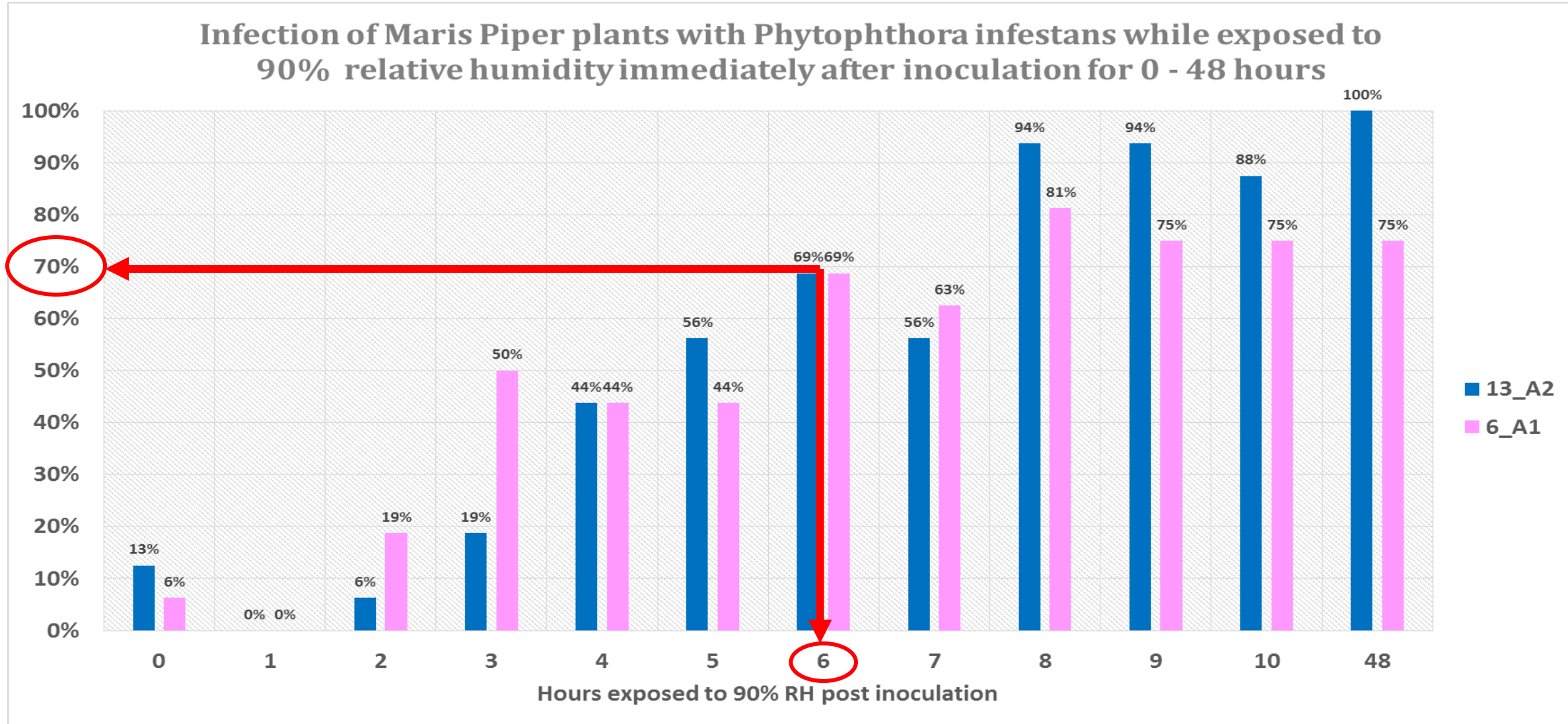
Detached Leaf Exposure - 80 & 90% RH - 10°C



Detached Leaf – Infection below 10°C



Whole Plant Infection at 10°C and 90% RH



$\chi^2(23, N=380) = 146.50$, two tailed P-Value is < 0.0001 . The result is significant at $p < 0.01$ between the trials.

Applying experimental results to historic data set

(1) Relative humidity should not be below 90%

(2) Duration of relative humidity exposure should be reduced

(3) How important is temperature?

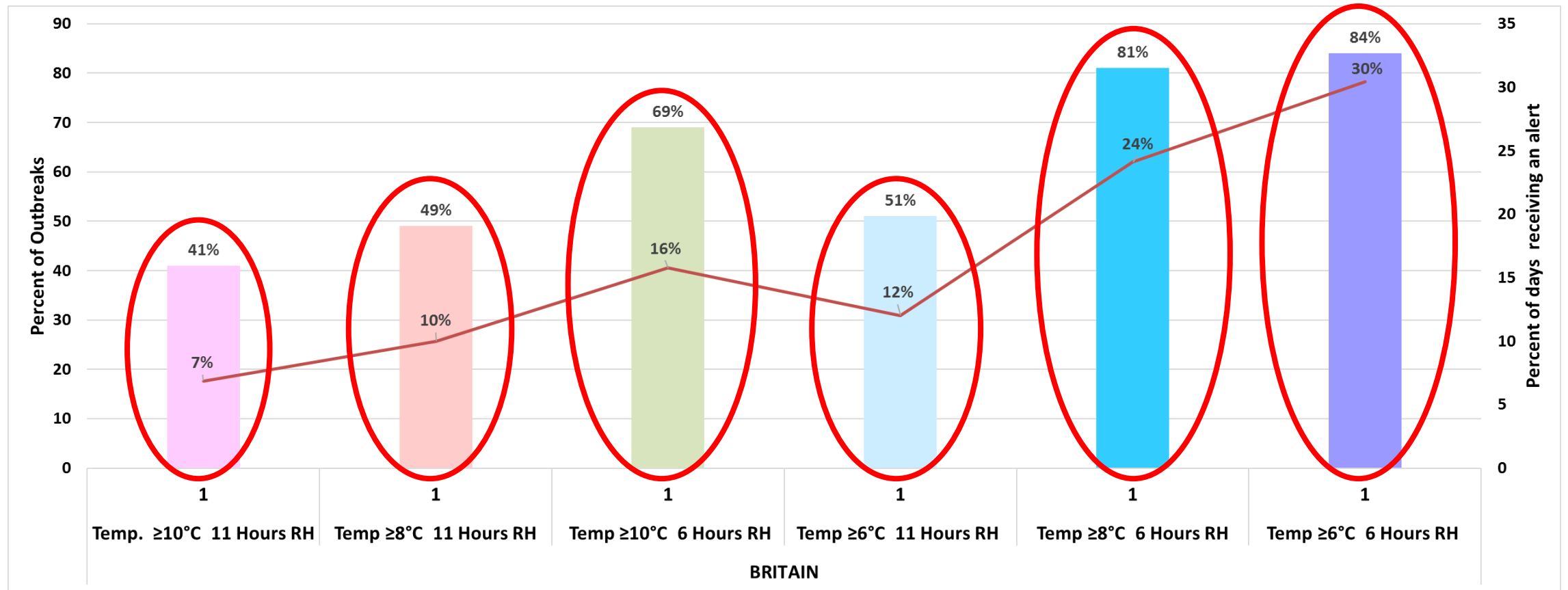
Trial Periods 1 - 5

- Aim to test the two criteria, temperature and humidity independently

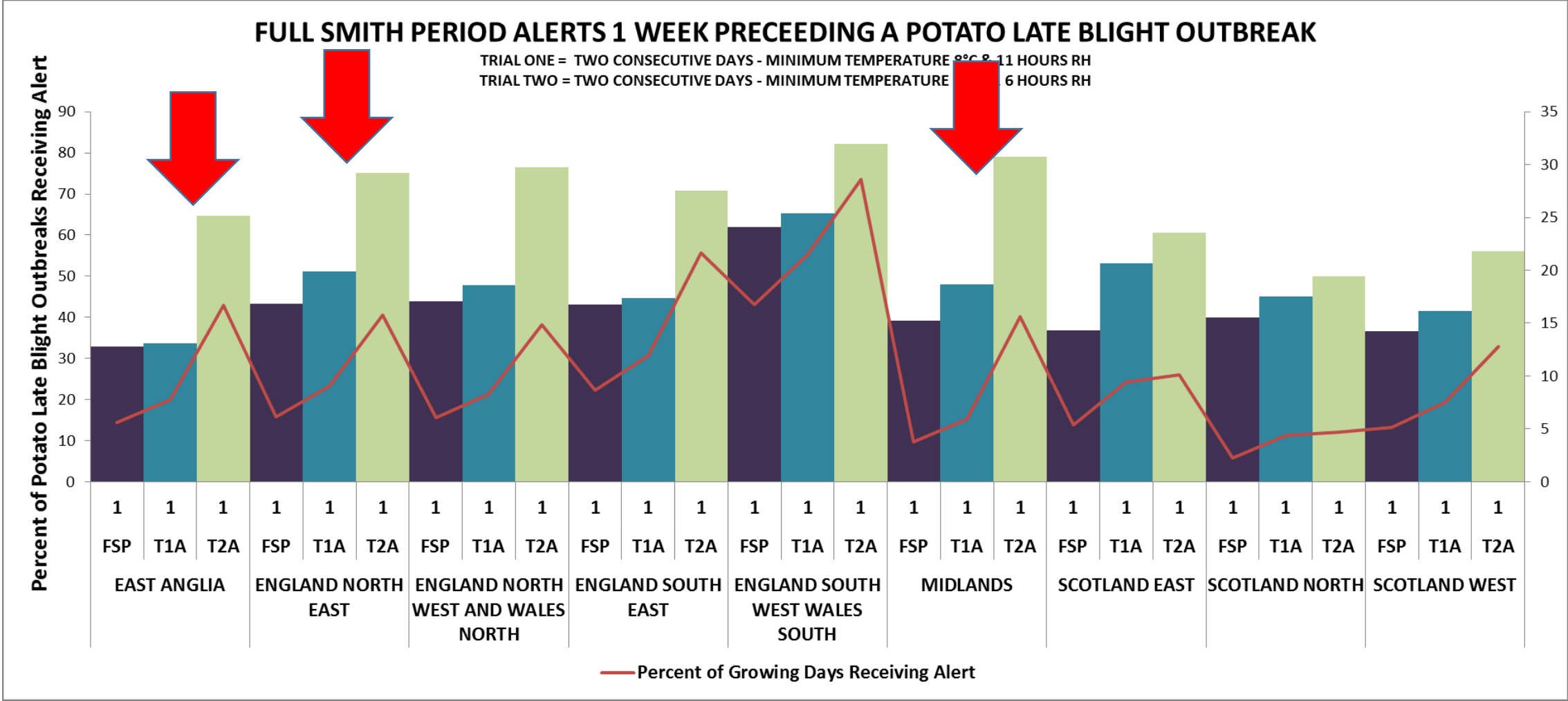
Alert	Duration	Temperature Minimum	Hours of relative Humidity $\geq 90\%$
Full Smith Period	2 consecutive days	$\geq 10^{\circ}\text{C}$	11
Trial 1	2 consecutive days	$\geq 8^{\circ}\text{C}$	11
Trial 2	2 consecutive days	$\geq 10^{\circ}\text{C}$	6
Trial 3	2 consecutive days	$\geq 6^{\circ}\text{C}$	11
Trial 4	2 consecutive days	$\geq 8^{\circ}\text{C}$	6
Trial 5	2 consecutive days	$\geq 6^{\circ}\text{C}$	6

Results of Alternative Smith Criteria

Proportion of outbreaks receiving an alert in the previous 7 days:

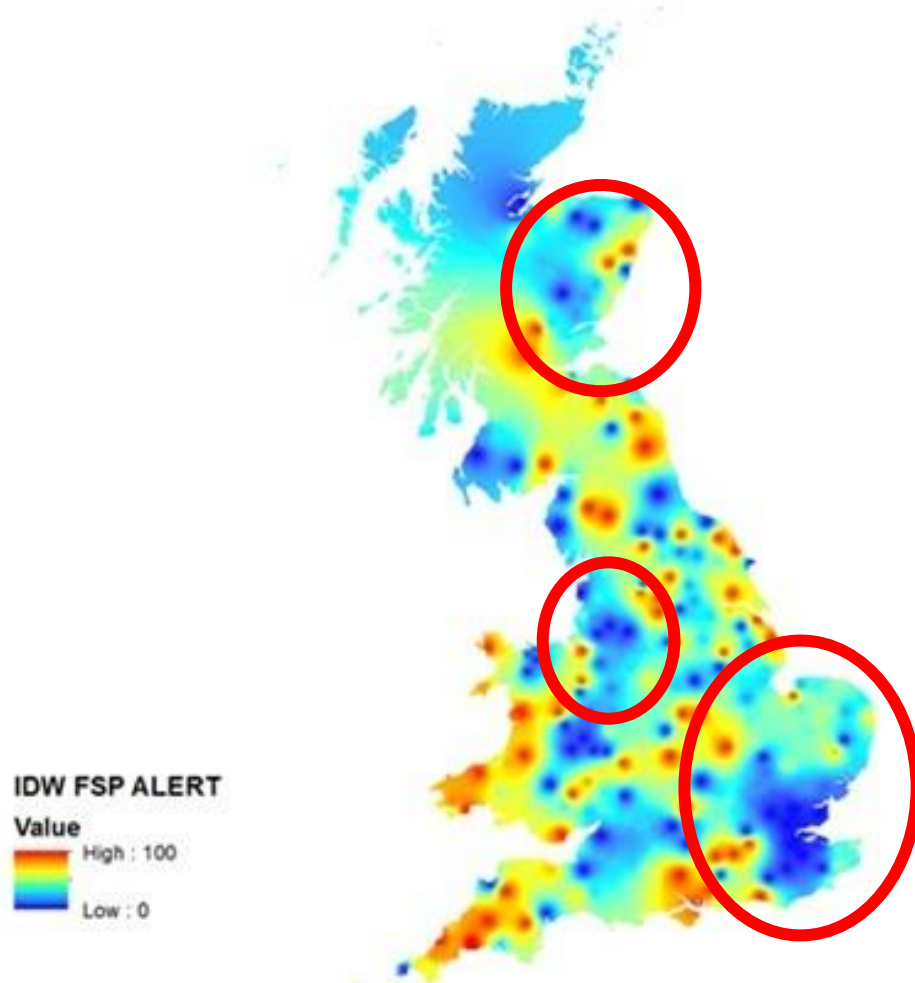


Regional comparison of trials one and two

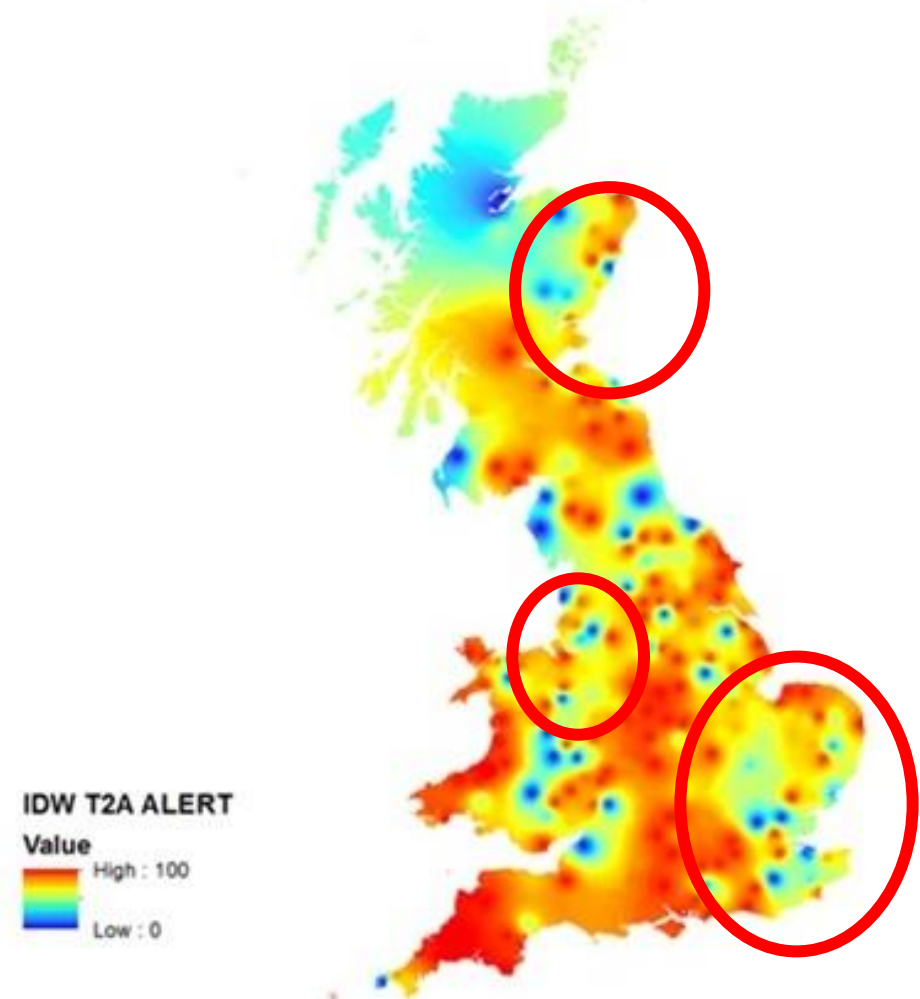


Improvements in PLB outbreak prediction

PLB OB - FSP alert in previous 7 days



PLB OB - T2A alert previous 7 days



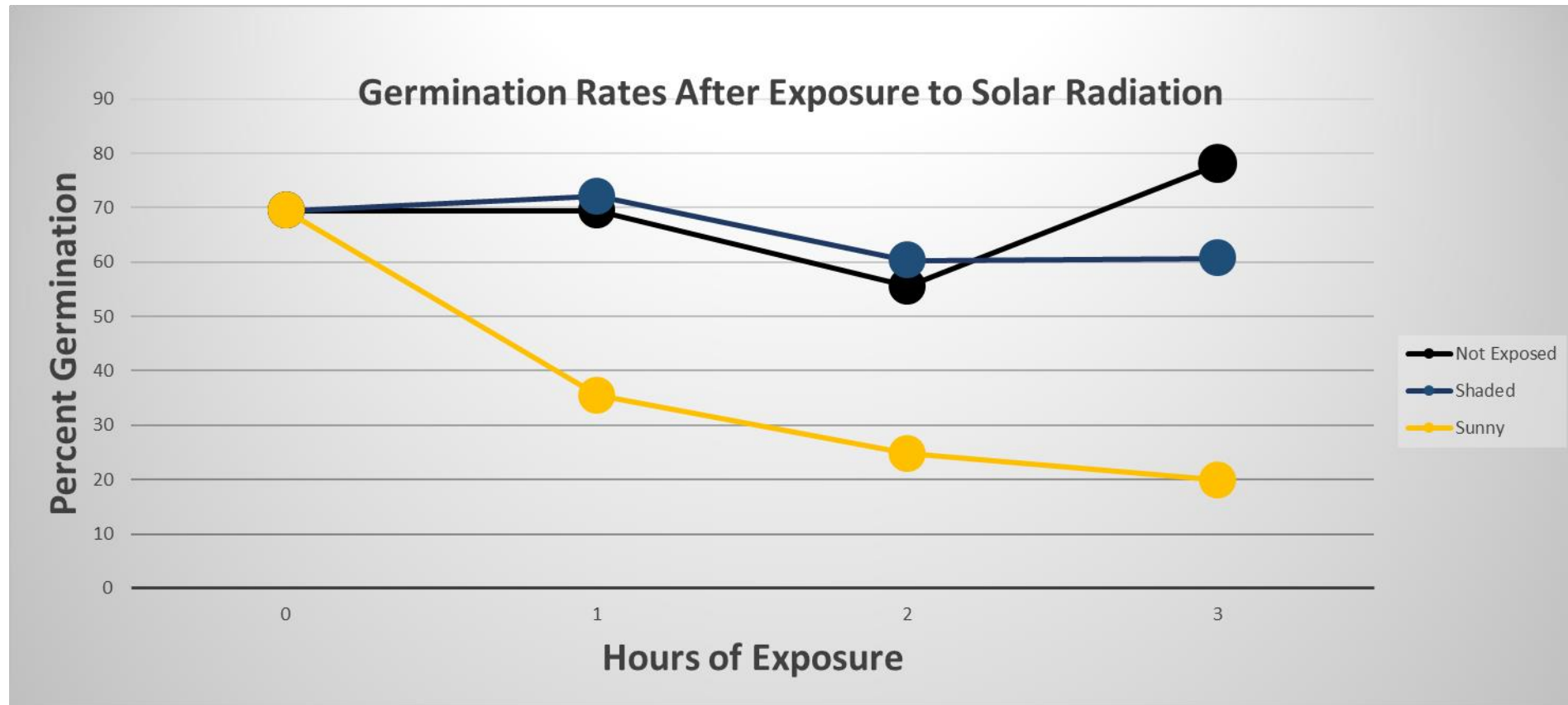
Can we add more elements to the criteria?

Spore survival in solar radiation?

Spore survival after exposure to solar radiation



Preliminary results of spore germination after solar radiation exposure



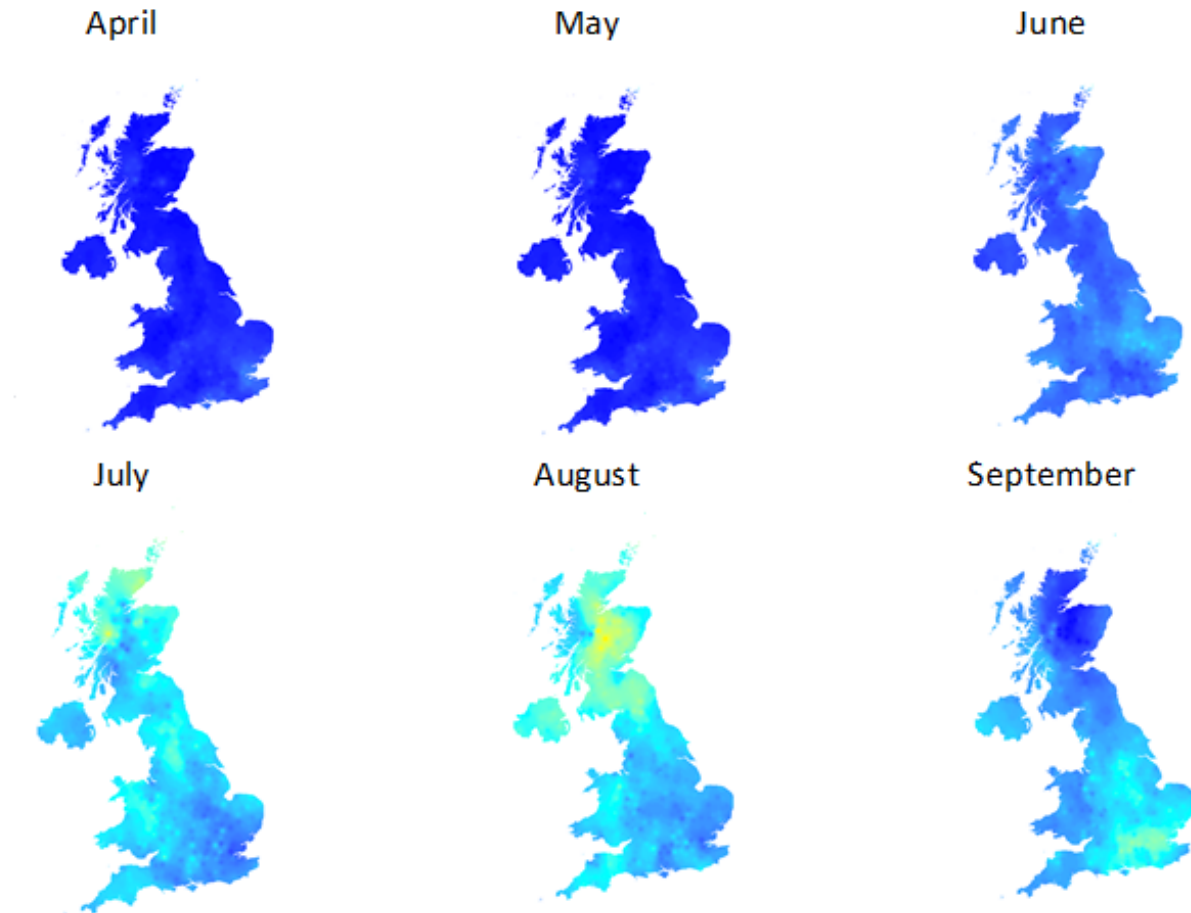
Conclusions

1. There has been a Smith Period alert in the previous seven days before 41% of the PLB outbreaks from 2003 – 2014
2. The Smith Period performs best in south western coastal regions than central areas or the north east
3. Infection occurs at lower temperatures – but lowering this threshold does not significantly improve performance
4. Reducing the duration of high humidity required improves Smith Period performance across Great Britain
5. Adding more criteria such as solar radiation survival will further improve identification of high risk blight periods

Thank you for time

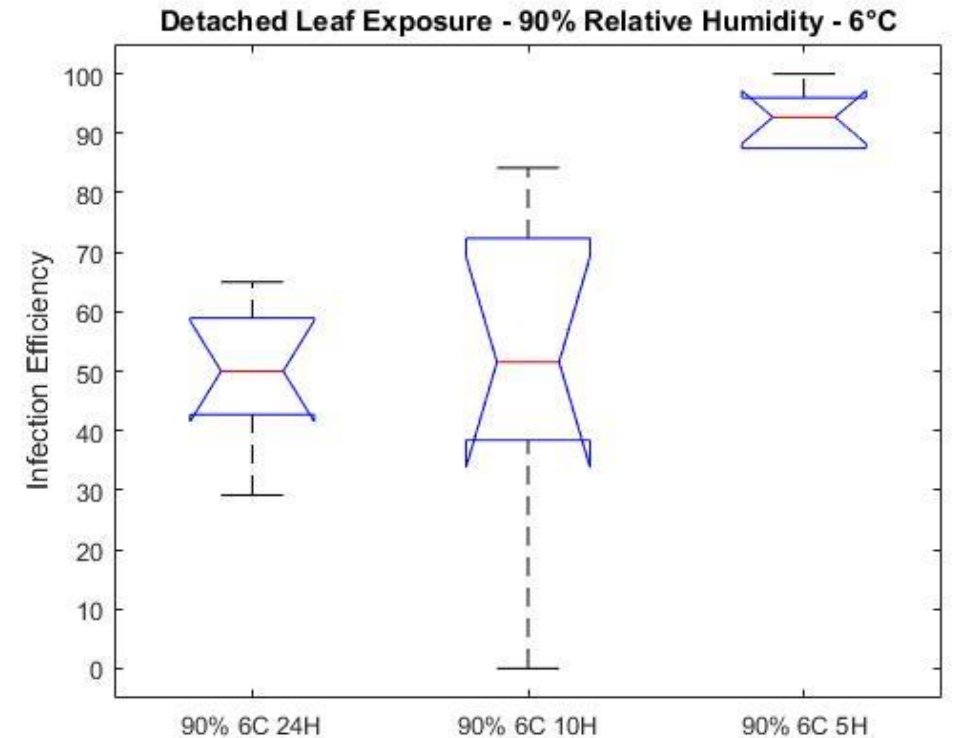
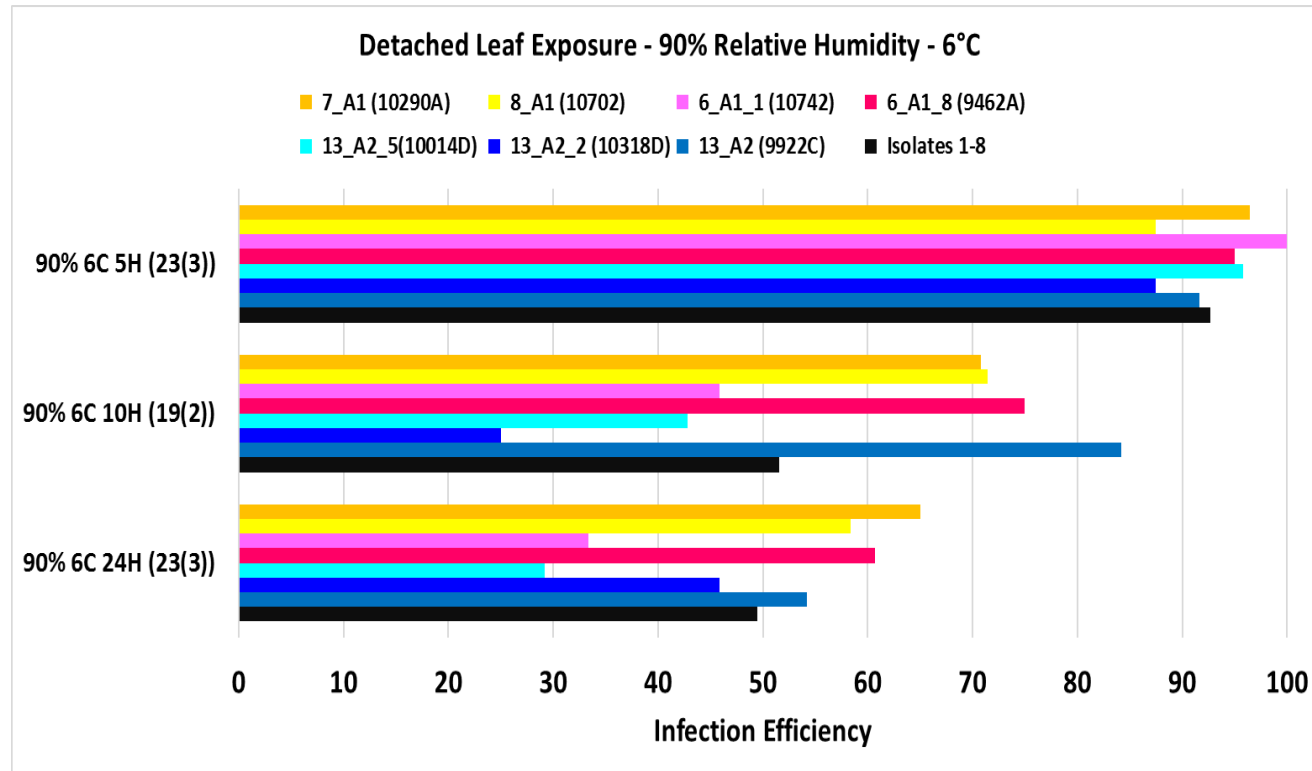
Smith Period Occurrences Monthly

Full Smith Period Occurrence 2003 – 2014 –
Interpolated Percentage by Month and Location

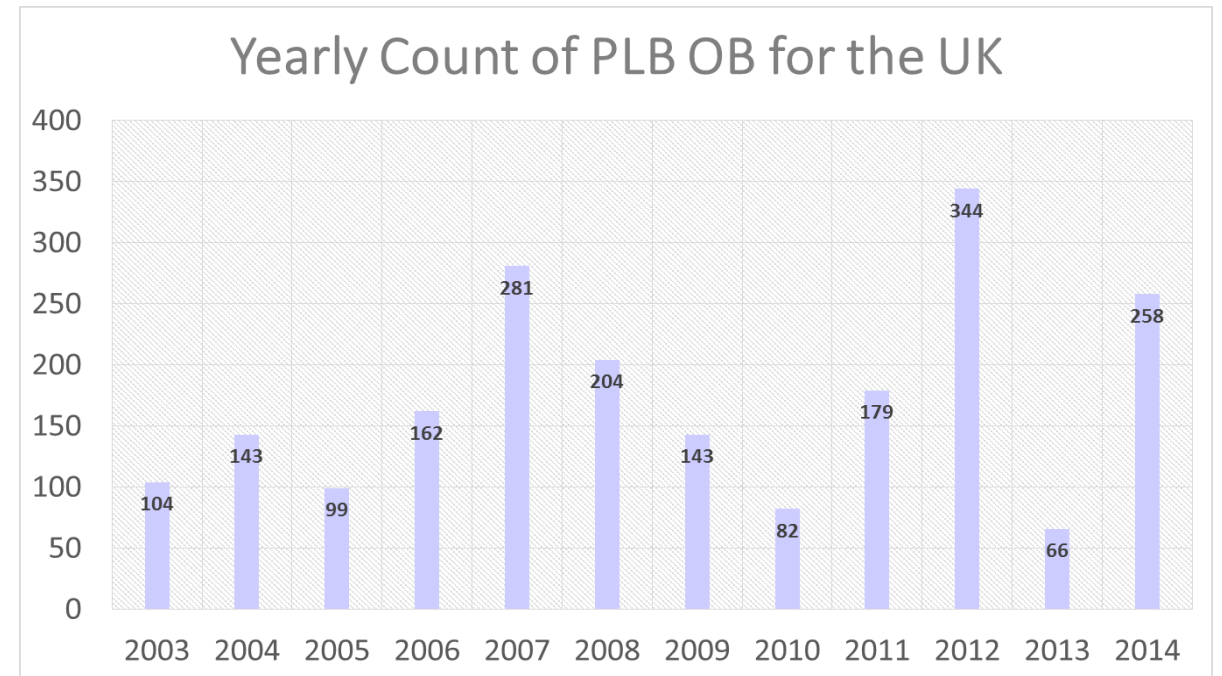
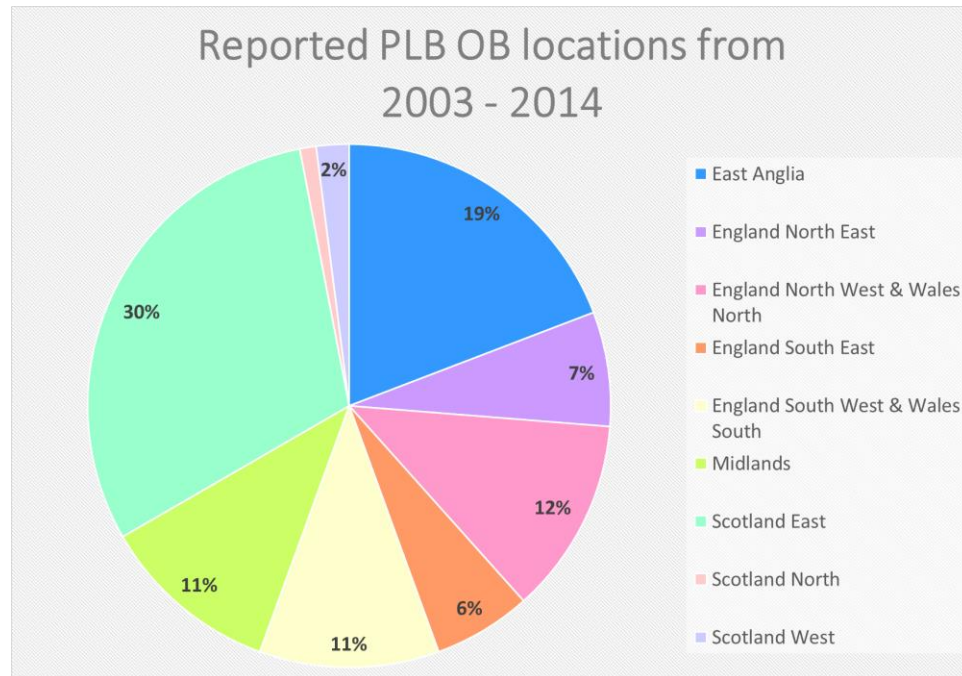


- April and May, the early growing season shows the lowest occurrence overall for SPs
- Scotland appears to experience the highest proportion of SPs in July and August each year
- The south east of England appears to experience a high proportion in September

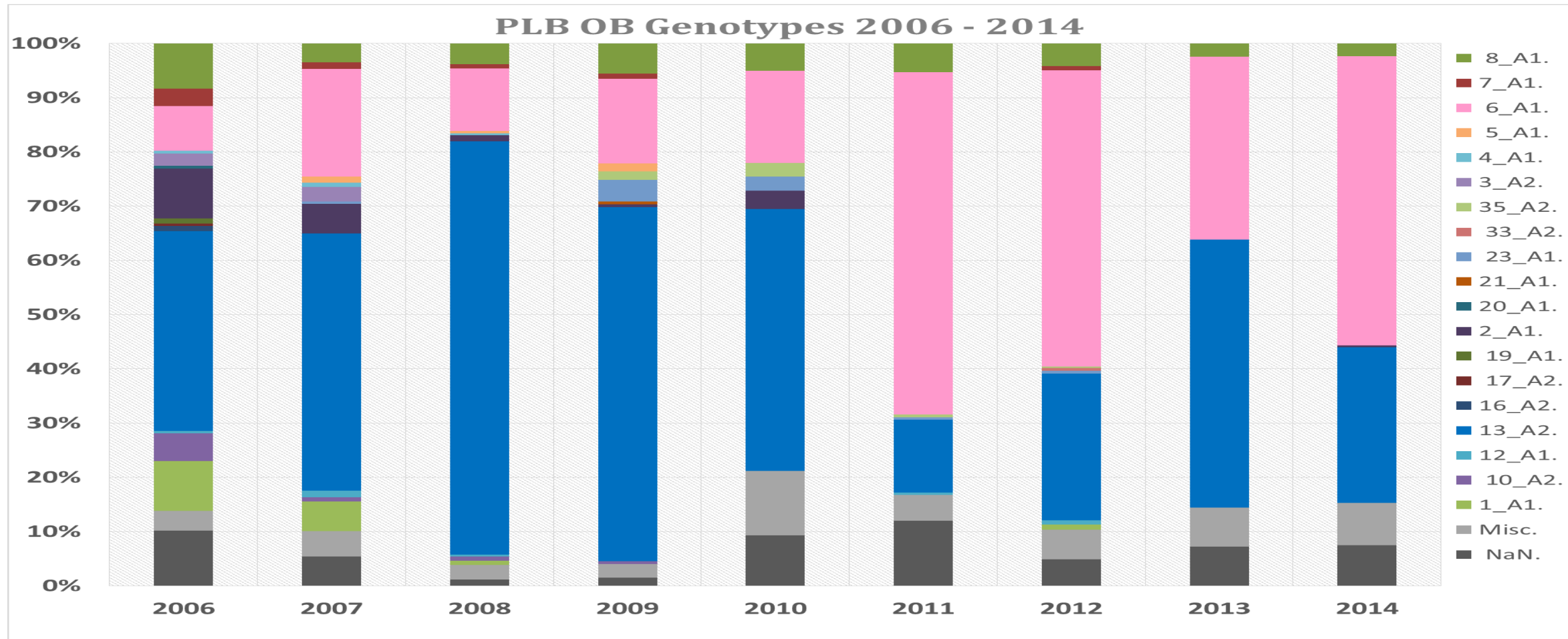
Detached Leaf Exposure - 90% RH - 6°C



Potato late blight outbreaks by region and by year



Genotype



- Seven isolates selected for experimental testing