Disease Predictions

Dr Caroline Young

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Outline

- Why? What?

- Forecasting & thresholds

- Practical use of disease forecasting in crops: issues

- Examples

- Project: Sclerotinia risk reporting in oilseed rape

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Why predict plant diseases?

Economic and/or environmental benefits:

- Timing of fungicide applications to improve control

- Justify fungicide applications

- Reduce the number or dose of fungicide treatments

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Forecasting or thresholds?

Forecasting

- Predicting inoculum production and/or plant infection from recorded weather data

- Forecast weather that results in inoculum and/or plant infection

Thresholds and risk factors

- How much disease or inoculum is present? Surveys; monitor plots

- Actual weather

Some overlap: forecasting/prediction/risk assessment

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What is important to measure?

- Crop stage and disease

- Inoculum

- Weather:

  Every variable

  In-field

  By location

  Regional

  Actual or forecast

  If forecast, how far ahead

What measurements will give the best prediction of infection risk or disease incidence/severity?

Assessing the benefits of disease forecasting

- Accuracy: false positives & false negatives

- Yield-loss disease relationship

- Expected price will influence treatment decisions

- Reduced yield or complete crop loss?

Lettuce: £10,000 ha^{-1}, fungicide spray £40 ha^{-1}

Oilseed rape:

	Approx. yield loss	Cost
5% sclerotinia	0.1 t	£25
10% sclerotinia	0.2 t	£50
One fungicide trt (£28-45)		£37
Two fungicide trts		£74

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Examples: UK crop & disease models

CROP	DISEASE	Weather based, threshold or forecast	PROVIDED BY:
Potato	Late blight	Threshold	*Potato Council* *Blightwatch.co.uk*
Multiple	Various	Threshold & forecast	Agrovista *www.plantsystems.co.uk*
OSR	LLS, Phoma	Threshold + inoculum,	Rothamsted Research *www.rothamsted.ac.uk/light-leaf-spot-forecast*
wheat	Septoria in early season	Disease monitoring, risk maps	*Fera* *www.cropmonitor.co.uk*
Multiple	Multiple crops (30)	Forecast, 5 days ahead	WeatherOnline *www.weatheronline.co.uk*
Brassica	Ringspot & white blister	Threshold. Ringspot inoculum.	*www.syngenta.co.uk/brassica-alert*

Examples: European forecasting

COUNTRY	DISEASE	ACTIVITY	SUPPORT & IMPLEMENTATION
Norway	Multiple, diseases and pests,	Forecasts. 80 met stations	Government, advisory service to 50% of farms. *www.vips-landbruk.no*
Denmark	Phytophthora late bight	Forecasts. 7 demonstration farms practising IPM	Government *www.landbrugsinfo.dk*
Sweden	Multiple, diseases and pests	Thresholds. Monitor plots, 5 regions	Government. *www.jordbruksverket.se*
Germany	Multiple, diseases and pests	Forecasts.	PASO, government Blight: *www.phytophthora.de*
Poland	Light leaf spot	Thresholds. 10 spore traps.	*Government* *www.spec.edu.pl* and *www.dupont.pl*
Netherlands	Multiple diseases and pests	Forecasts. EPIPRE, online PlantPLus, online	Gov., *www.bdb.be/Productendiensten/ Analysesadviezen/EPIPREadvies* Commercial, Dacom

•Current activity with forecasting. Other systems exist, including projects at research stage.
• Limited accessible evidence to demonstrate benefits

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Sclerotinia in oilseed rape: the problem

- Infection is sporadic; 18% crops affected with occasional major outbreaks with 50-80% losses

- Fungicide timing must be protectant

- Infection risk phase is longer than 3 weeks

- Flowering duration is variable

- No coordinated system of monitoring in UK

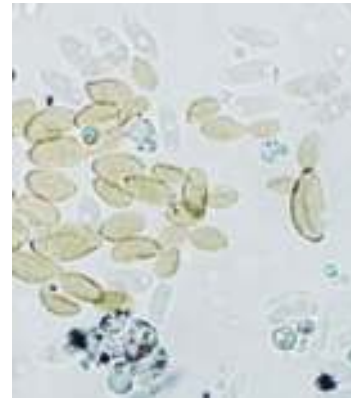- Without forecasting, it is not clear if a fungicide treatment is timed correctly or will be necessary

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Sclerotinia infection in oilseed rape

Apothecia

Airborne spores and infection

Sclerotia in stems

Lesion development

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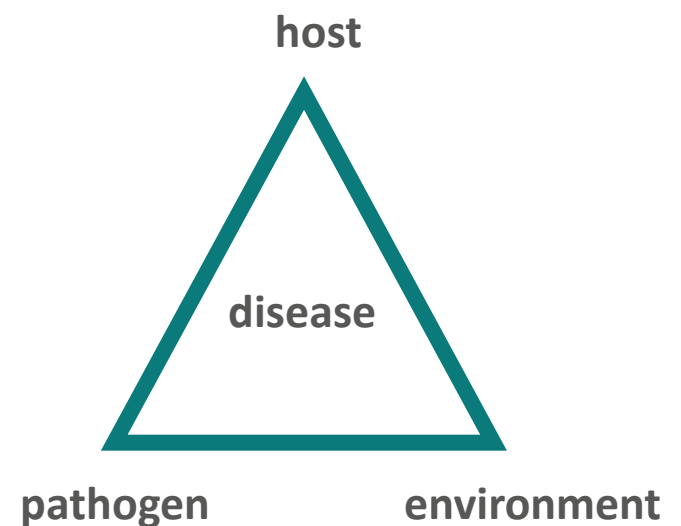# Forecasting sclerotinia in oilseed rape: what is important to measure?

Risk factors

Crop flowering stage

Germinated sclerotia = inoculum

Spore inoculum levels: on petals or in air

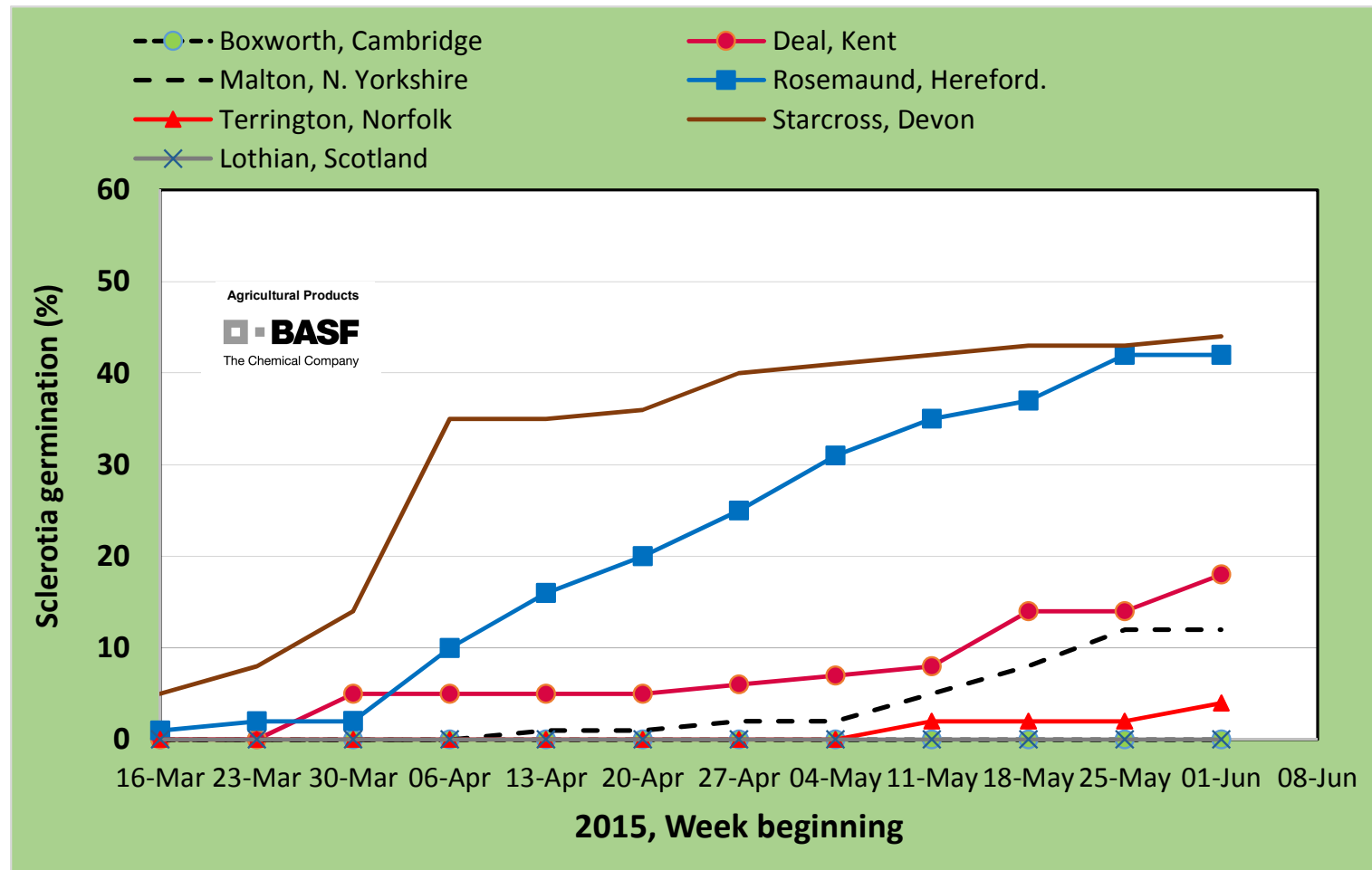Weather conditions for infection

host

disease

pathogen   environment

Predictions

Date of first sclerotial germination
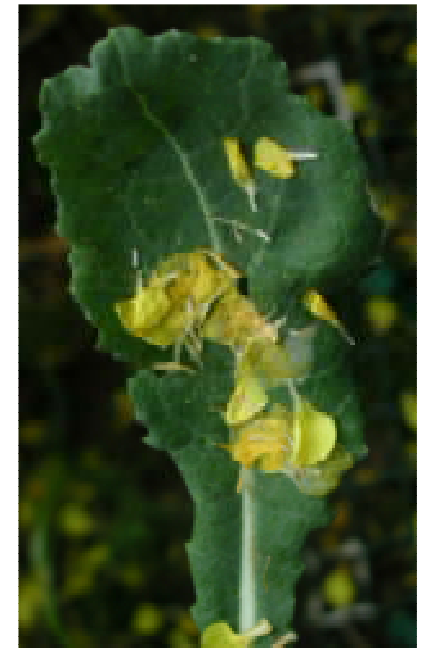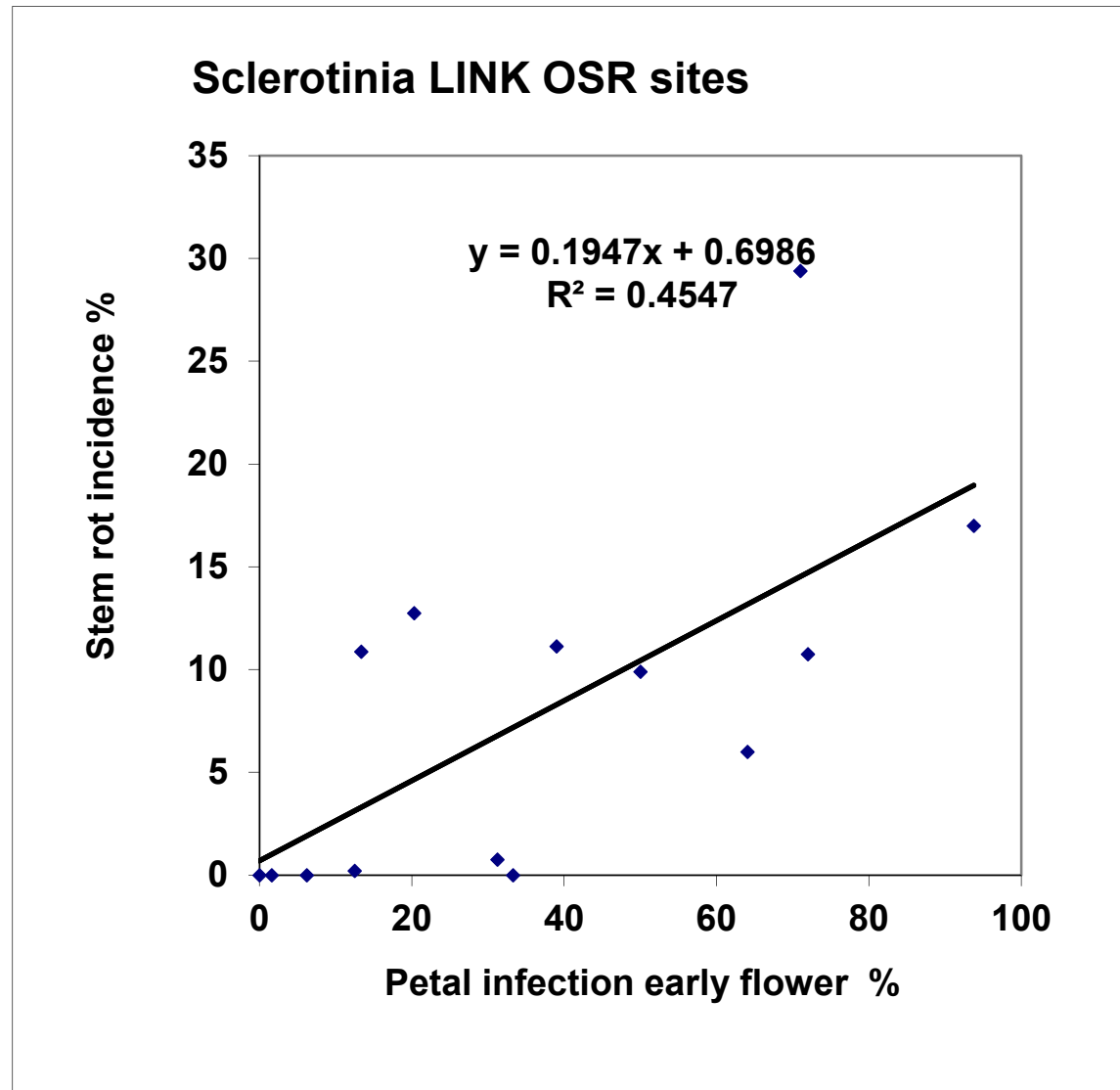
Forecast weather
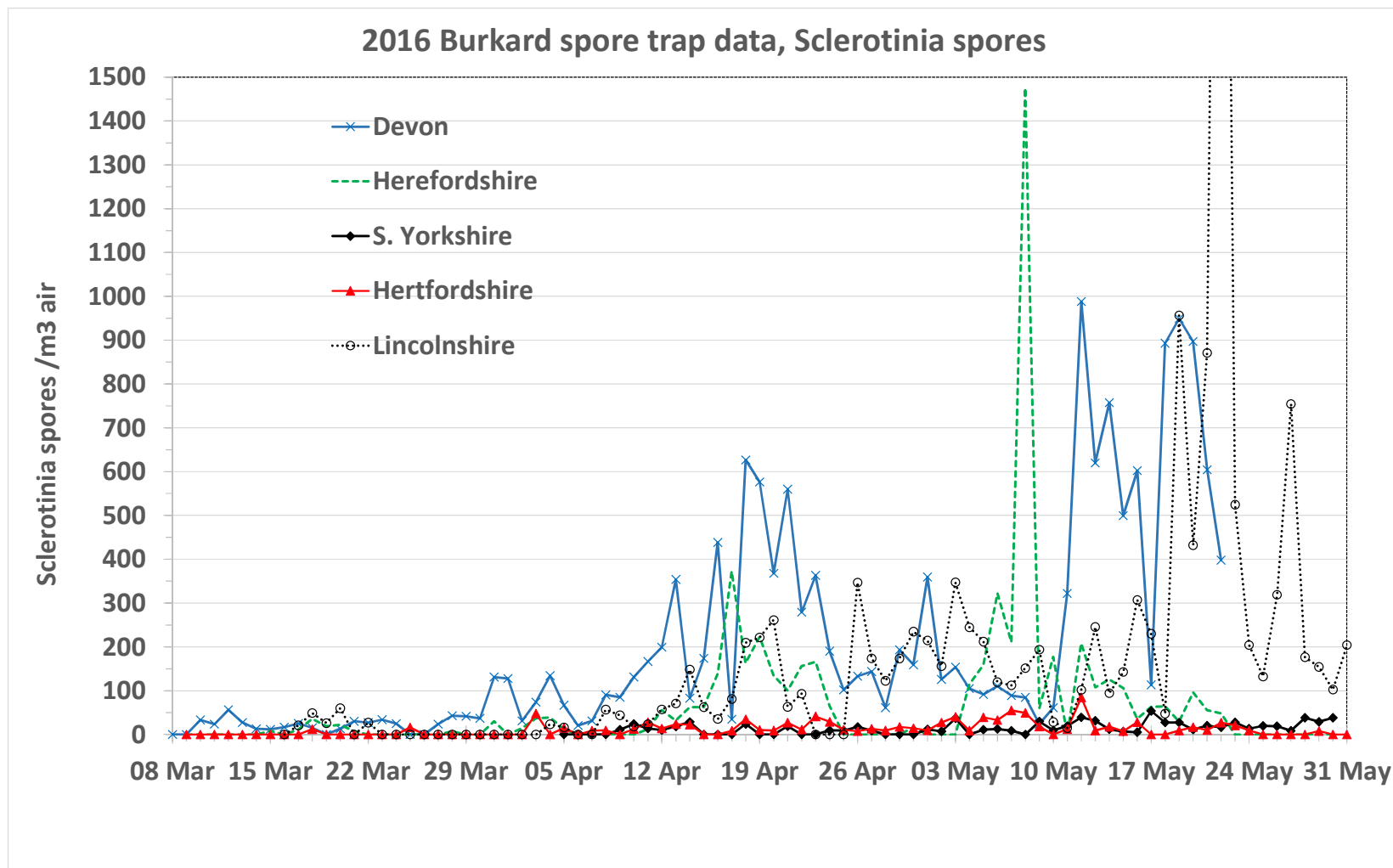
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Sclerotial germination: observed

- 12 years of data, continuing 2017, weekly BASF/ADAS updates
- Shows onset of germination by region = first ascospores

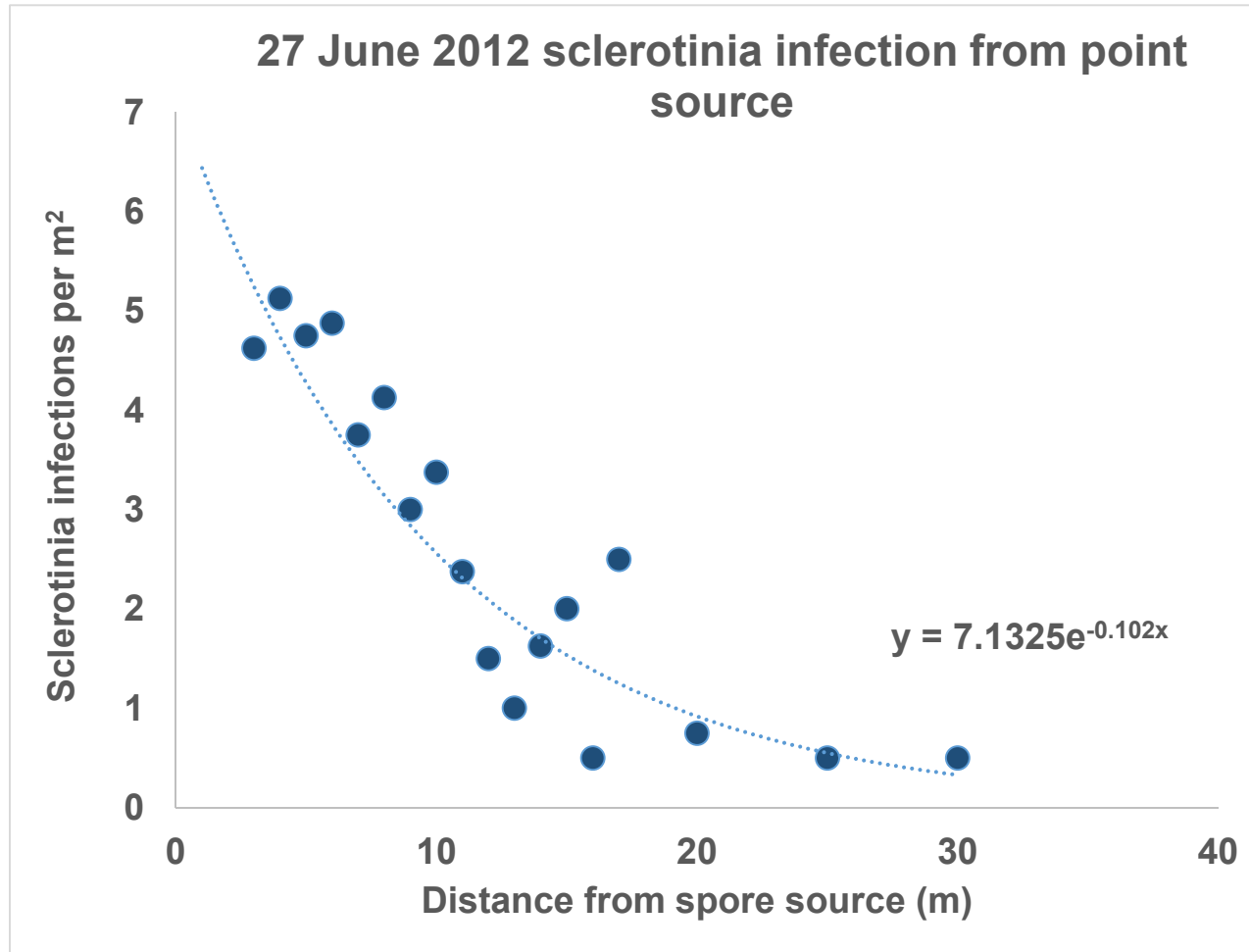# Airborne spores: petal tests

Sclerotinia LINK OSR sites

$y = 0.1947x + 0.6986$
$R^2 = 0.4547$

Stem rot incidence % (y-axis)

Petal infection early flower % (x-axis)

Sclerotinia spores at UK sites

2016 Burkard spore trap data, Sclerotinia spores

Sclerotinia infection decline from point source

27 June 2012 sclerotinia infection from point source

$y = 7.1325e^{-0.102x}$

ROTHAMSTED
RESEARCH

Airborne spore levels, East

Sclerotinia DNA at Rothamsted and ADAS Boxworth
(East of England) Defra-AHDB-LINK 2011

RRes NZ1
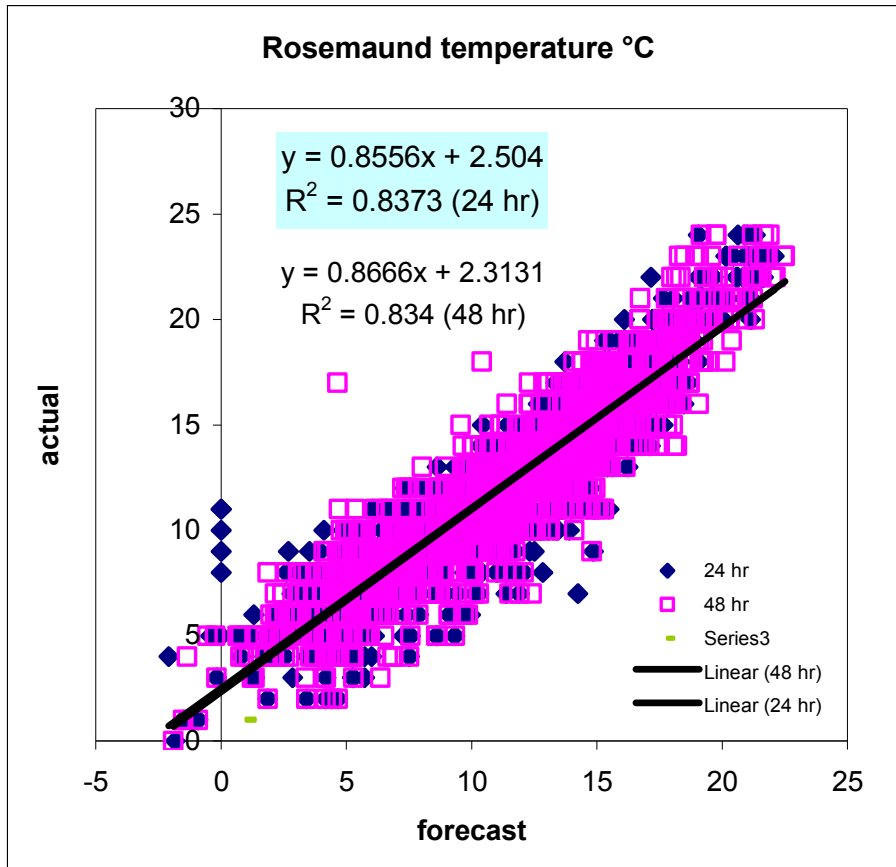
Boxworth
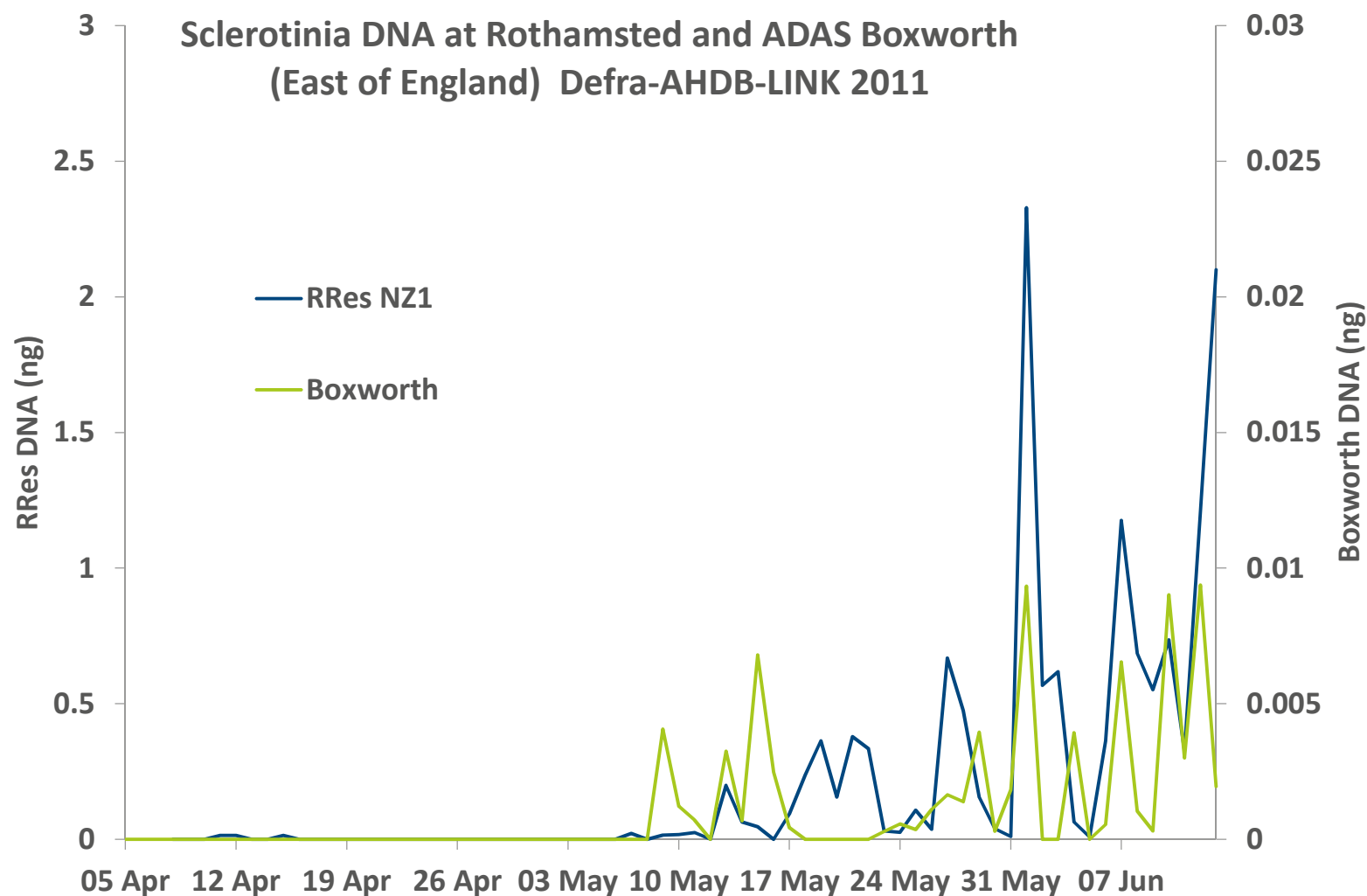
Forecast weather and infection criteria

- Previous LINK project weather analysis

- Temperature 48 hr prediction is good

- RH% prediction variable

- Use 48 hr forecast weather for alerts

- Infection criteria from SkleroPro (Koch *et al* 2006)

- **At least 23 hr $\geq$ 7ºC**

   and 80% RH

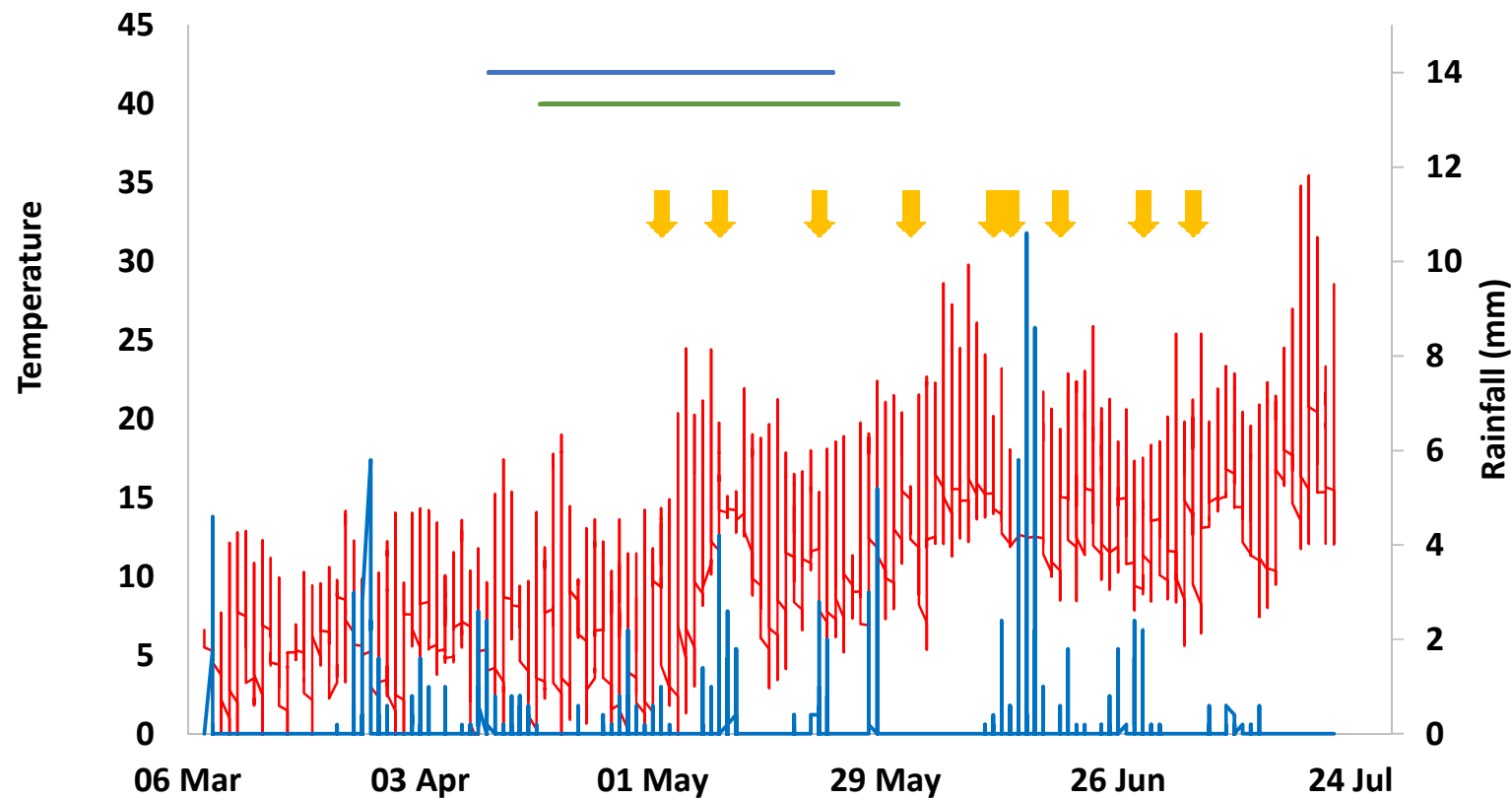# Predictors for sclerotinia stem rot in oilseed rape

Risk score for crop in flower is calculated from weighted scores for :

- weather based alert - positive (increases infection risk)

- % of petals with sclerotinia - positive

- Light rain - positive

- Heavy rain – negative (reduces infection risk)

Weather-based alerts Herefordshire 2016

Sclerotinia risk reporting system for oilseed rape

01/02/2015 to 31/01/2018

Dr Caroline Young

Agricultural Products

www.adas.uk

In-field and regional inputs

Objectives

Provide a sclerotinia disease risk reporting system for oilseed rape, to guide fungicide timing and improve control

In-field

Weather data, infection risk forecasts, flowering stage, petal tests, sclerotial germination, sclerotinia stem rot

Regional

Sclerotial germination, Burkard spore traps

	Number of sites
Field experiments	2 ADAS, 1 Velcourt
AHDB monitor farms	6
BASF sclerotia depots	7
Burkard spore traps	5

Weekly reports on AHDB website, 15 sites

Risk forecasts in AHDB reports

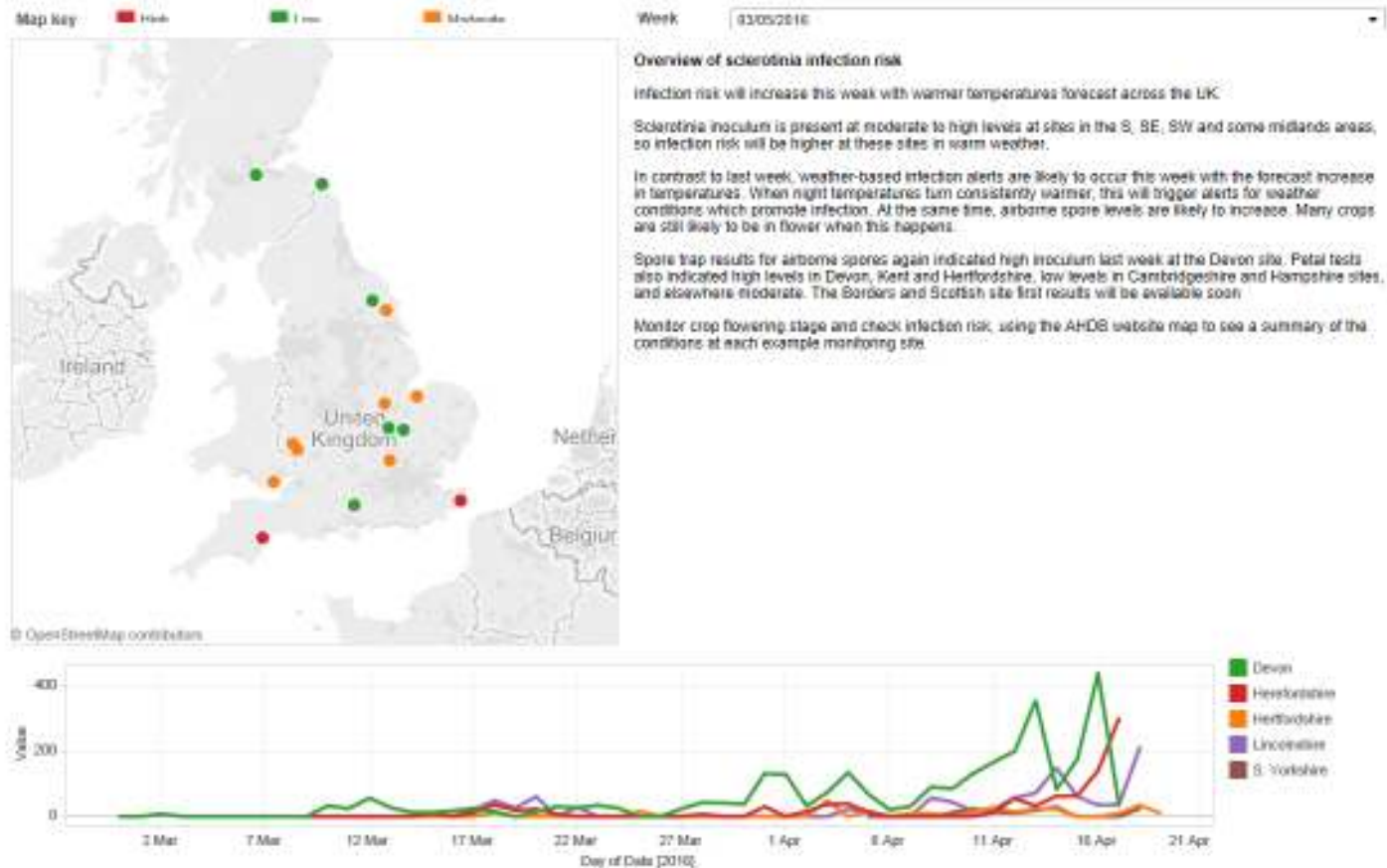|	**Weather based infection alert**	**Petals testing positive**	**Spore trap positive**
Crop not in flower	low	low	low
Crop flowering	moderate	high	high

15 sites (click on AHDB map)
- Data updated weekly: growth stage, petal test result, infection alert
- Added comments: wet/dry soil, frosts, heavy rain showers, petal stick

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Example AHDB weekly report 2016

Sclerotinia risk monitoring: key results 2015

Forecasting

- Where low risk for whole duration: all correct, no sclerotinia

- Where moderate risk: no stem rot

- Where high risk: 2 out of 5 sites had stem rot

- Assessment is risk-averse

Monitoring

- Locally, infection alerts (weather-based model) and petal tests are useful for spray guidance

- Regionally, spore trap & germination data are helpful

- Moderate risk can change quickly to high risk

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Impact of sclerotinia risk monitoring and forecasting

- Provides evidence for the onset of the key risk-phases by region

- Information on progress of infection conditions and risk at monitor sites

- Justify no fungicide treatments on low-risk crops

- Improved targeting or timing of the first spray

- If first spray can be delayed beyond early flower, a second spray may be unnecessary

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Thank you

Thanks to staff involved:

ADAS
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