Effects of model parameter uncertainty in predicting severity of phoma stem canker epidemics in UK winter oilseed rape crops

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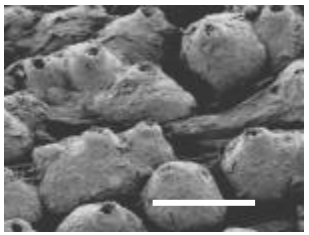
Phoma leaf spot

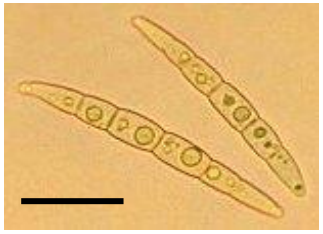
© Fay Newbery

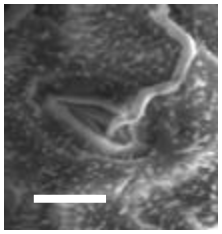
Phoma stem canker

© Fay Newbery

The phoma stem canker 3-stage model in the UK







Stage 1 Ascospore maturation and release; infection of leaves in autumn

Predict date 1st leaf spotting

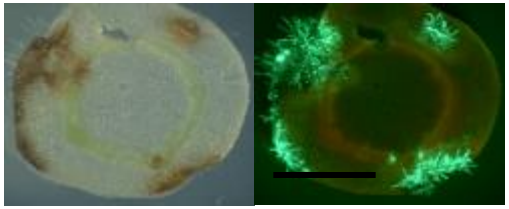
Summer | Autumn

Spring | Winter

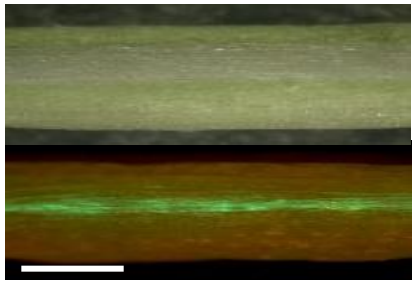
Stage 2 Growth along leaf petiole to produce stem base canker in spring

Stage 3
Predict canker severity

Increase in severity of phoma stem canker until harvest (summer)



Predict date 1st canker



Pseudothecia on stubble

© Ralph Lange, CC

Prevent pseudothecia maturation

Control leaf spot formation

Phoma stem cankers

© Peter Gladders

Phoma leaf spots

© Rothamsted

Spray threshold date

10% of plants with at least one leaf spot

Fungicide efficacy timespan

approximately 21 days

UK phoma stem canker model

by Evans *et al.* (2008)

$$Dl_p = 216.5 - 0.24R_{sum} - 4.55T_{\max}$$

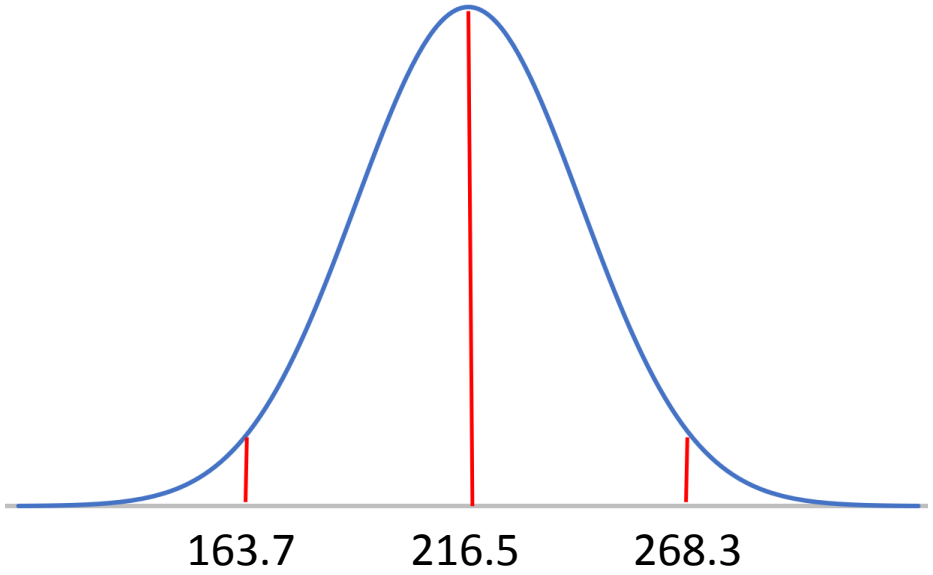
R_{sum} = Total rainfall from 15 July - 29 Sept

T_{max} = Mean maximum daily temperature from 15 July - 29 Sept

$$Dl_p = 216.5 - 0.24R_{sum} - 4.55T_{\max}$$

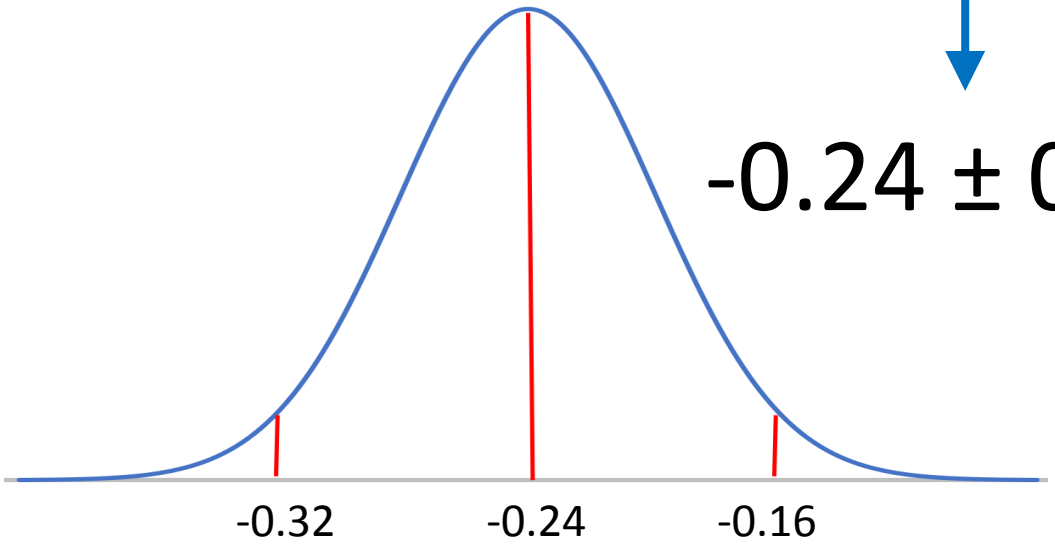
216.5 ± 52.84

163.66 → 268.34

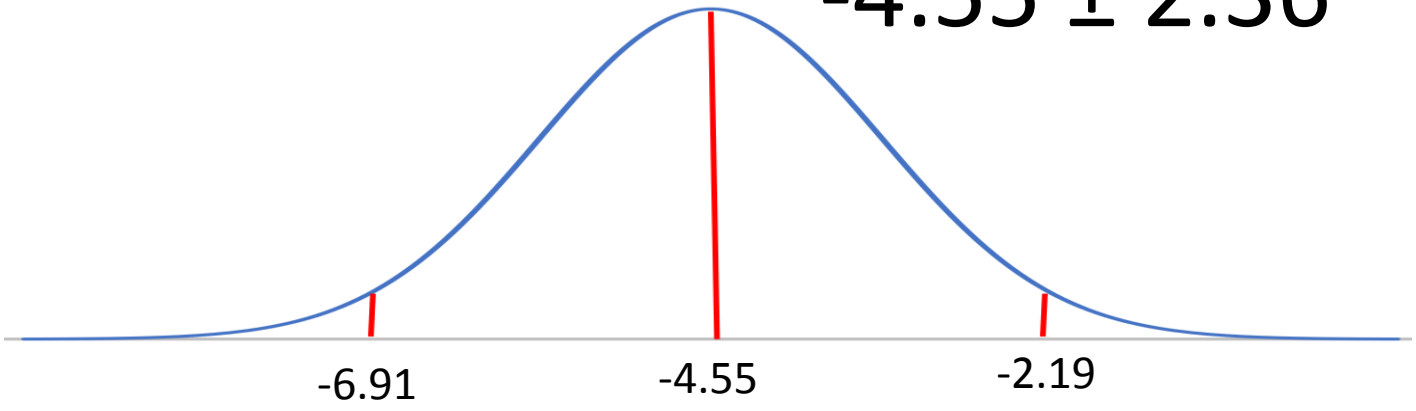


$$Dl_p = 216.5 - 0.24 R_{sum} - 4.55 T_{\max}$$

-0.24 ± 0.08

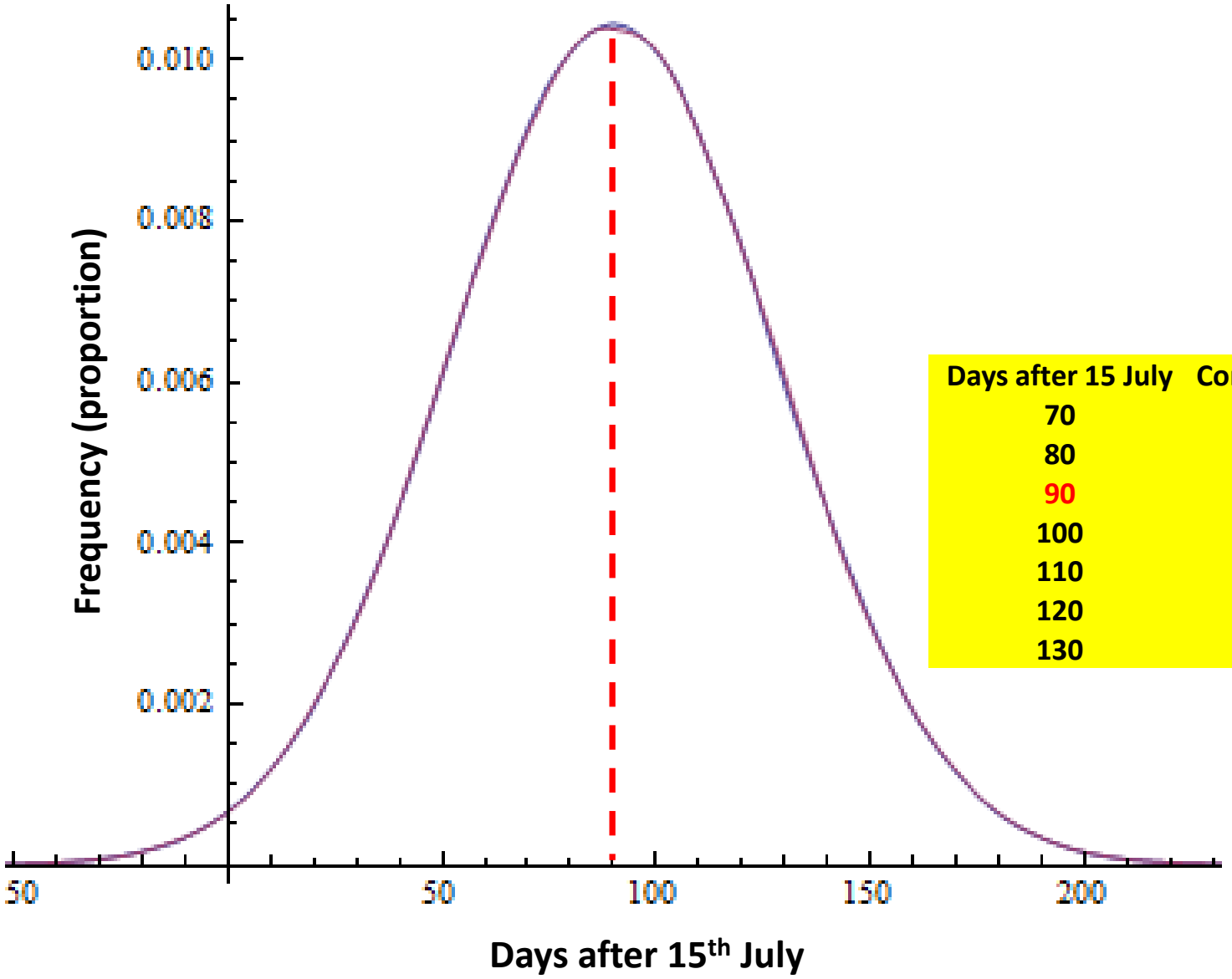


-4.55 ± 2.36



Monte Carlo simulations

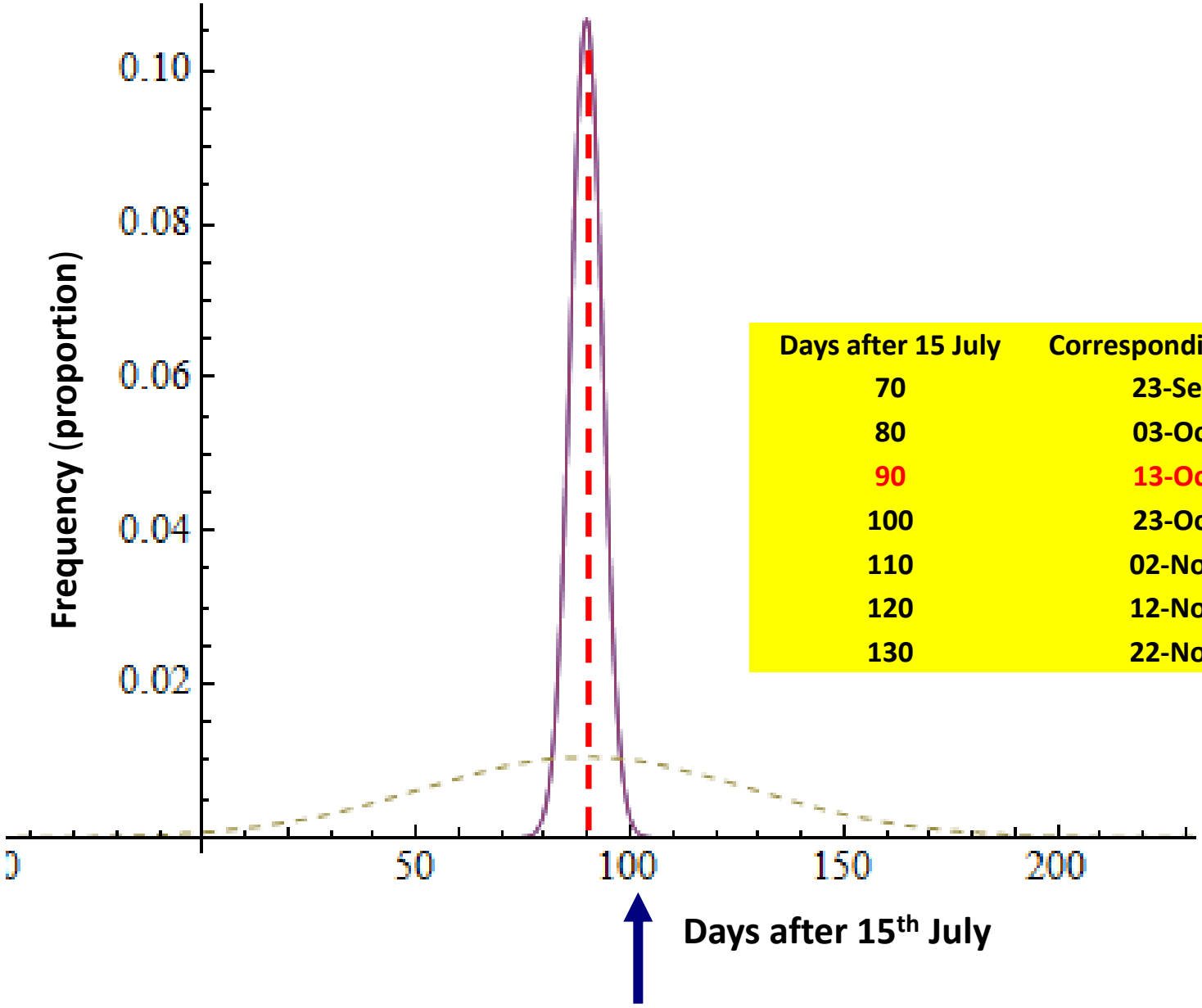
- **Fixed values used for R_{sum} and T_{max} (e.g. 2013/2014 at Bedford)**
- **Random values selected for each parameter**
- **Date for spray threshold calculated using stage 1 of the Evans *et al.* model**
- **Repeated 1 000 000 times**
- **1 000 000 predicted dates investigated**



Days after 15 July	Corresponding Date
70	23-Sep
80	03-Oct
90	13-Oct
100	23-Oct
110	02-Nov
120	12-Nov
130	22-Nov

$$Dl_p = 216.5 - 0.24R_{sum} - 4.55T_{\max}$$

Correlation coefficient matrix			
Constant	1		
Rain parameter	-0.58	1	
Temperature parameter	-0.97	0.37	1



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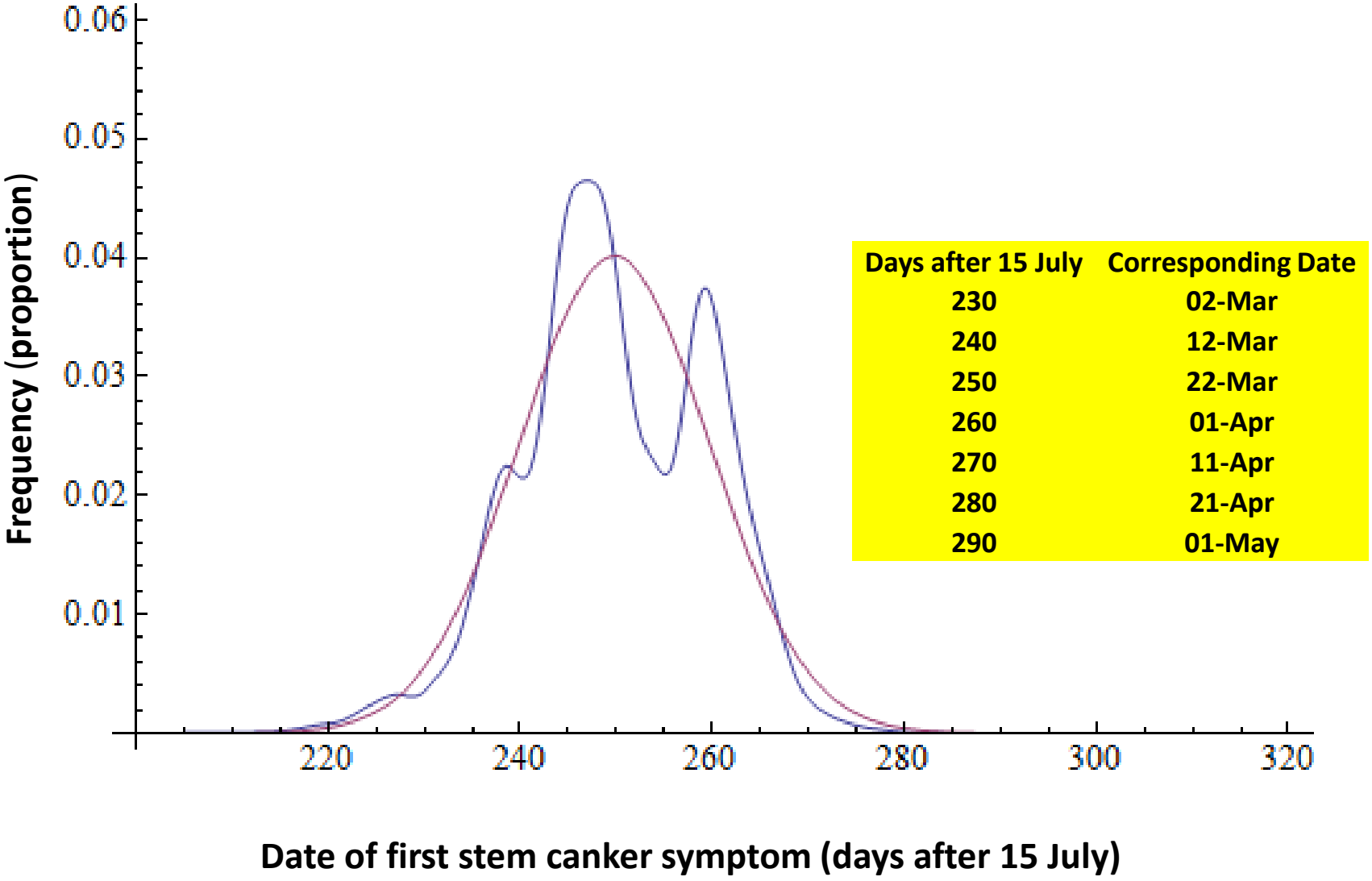

Days after 15 July	Corresponding Date
230	02-Mar
240	12-Mar
250	22-Mar
260	01-Apr
270	11-Apr
280	21-Apr
290	01-May

Conclusion

Monte Carlo simulations -

a plausible method for investigating the effects of uncertainties in model parameters.

References

- **Evans, N., A. Baierl, *et al.* (2008).** "Range and severity of a plant disease increased by global warming." Journal of The Royal Society Interface **5(22):** 525-531.

- **Newbery, F. (2016)** Temperature relations of Leptosphaeria species on oilseed rape and their implications for forecasting. ***PhD thesis***. University of Reading.

Thank you

BBSRC bioscience for the future

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