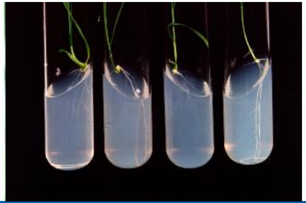
Department for Environment Food & Rural Affairs

ADAS


Integrated Pest Management: Science and Practice
Disease control in cereals

Neil Paveley and Frank van den Bosch

A video series funded by Defra and produced by ADAS

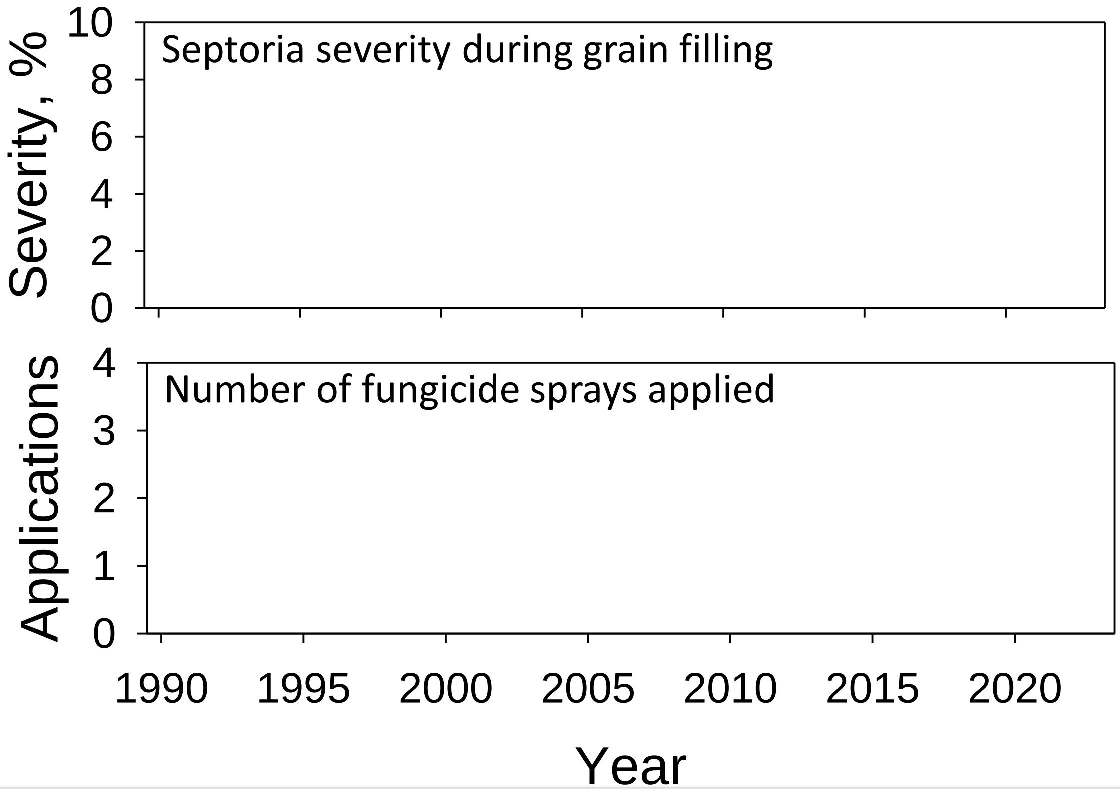
www.adas.co.uk

How to predict epidemic severity?

Septoria tritici blotch

Source: AHDB

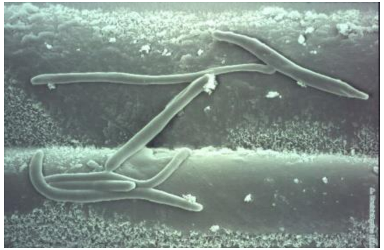
Treatment according to need?



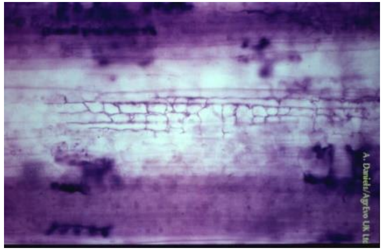
Source: DEFRA Pest and Disease survey, winter wheat

What does the future hold?

Pathogen life cycle: Septoria tritici

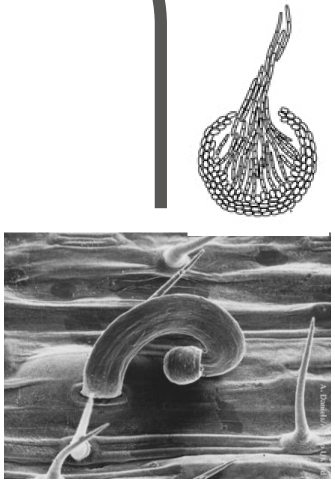


Infection



Symptomless growth
(latent period)

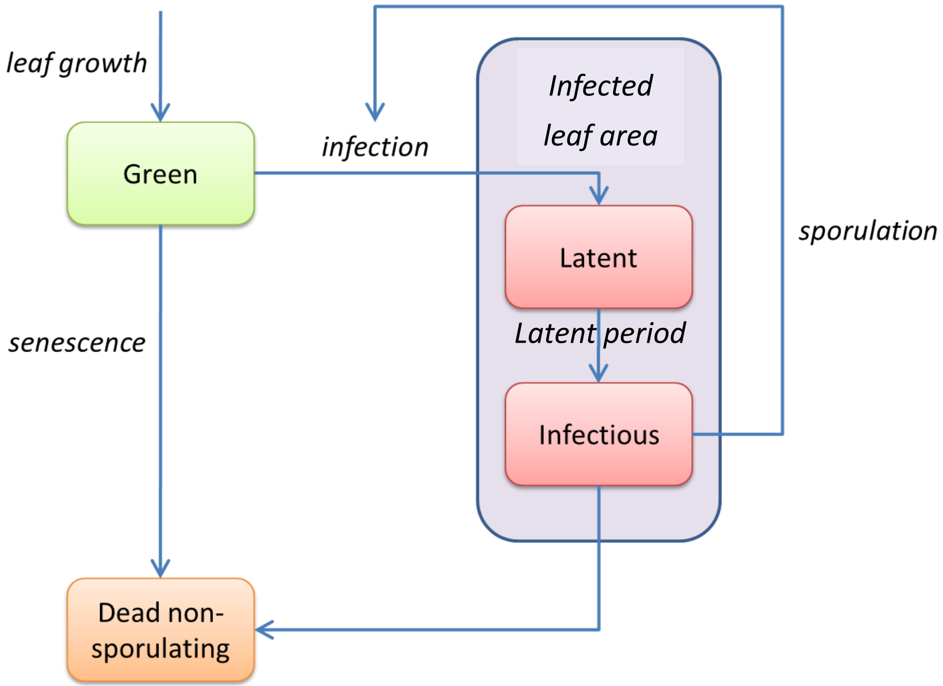
Symptom
expression



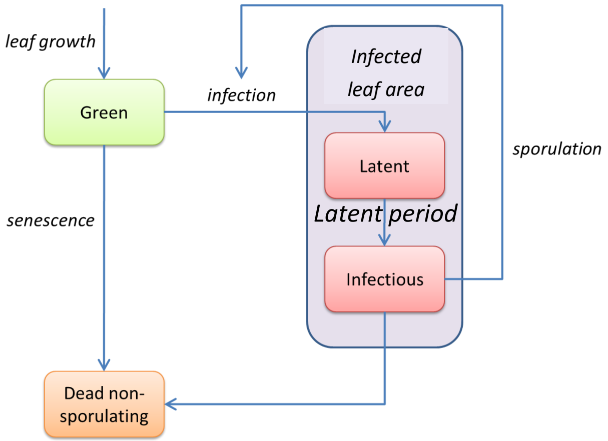
Sporulation

Source: Images by Alison Daniels

Pathogen lifecycle



Pathogen life cycle



***R*0: basic reproductive number:**

Number of daughter lesions produced by 1 latent lesion (when not competing for leaf area)

Generation time:

Time for infection cycle from lesion to lesion

$$\boldsymbol{R_0} = \begin{bmatrix} probability\ to \\ survive\ to\ the \\ infectious\ stage \end{bmatrix} \begin{bmatrix} number\ of \\ spores \\ produced \end{bmatrix} \begin{bmatrix} probability\ that \\ a\ spore\ lands \\ on\ a\ leaf \end{bmatrix} \begin{bmatrix} Infection \\ efficiency \end{bmatrix}$$

What affects pathogen life cycle?

Weather affects:

R_0 and generation time

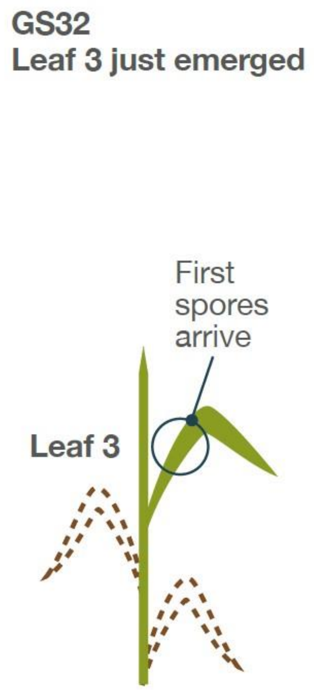
Variety affects:

R_0 and generation time

Fungicide affects:

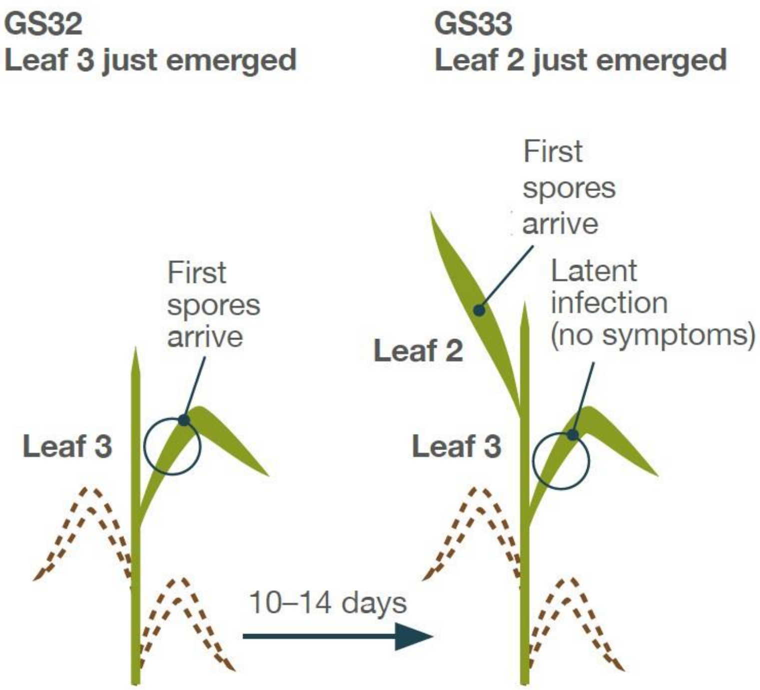
R_0 and generation time

Canopy growth vs. Septoria tritici growth



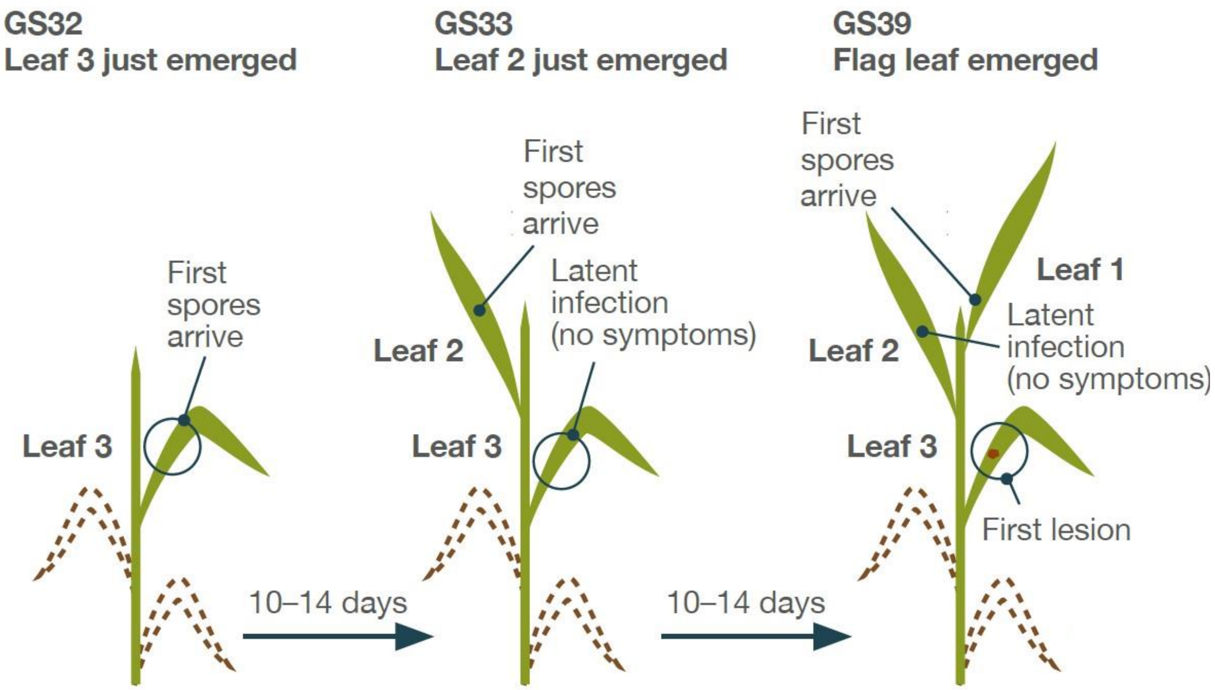
Source: AHDB wheat and barley disease management guide

Canopy growth vs. Septoria tritici growth



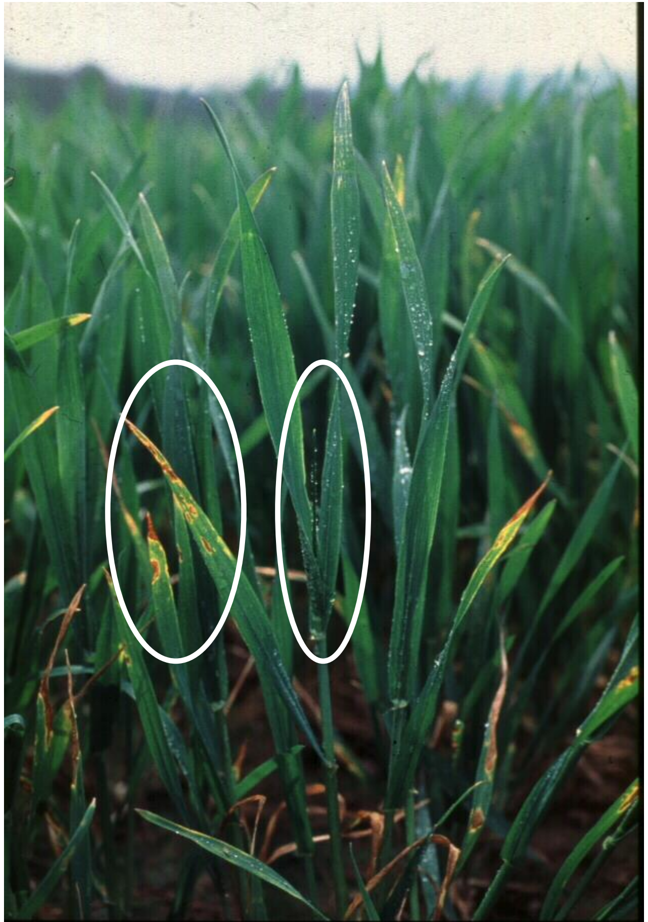
Source: AHDB wheat and barley disease management guide

Canopy growth vs. Septoria tritici growth



Source: AHDB wheat and barley disease management guide

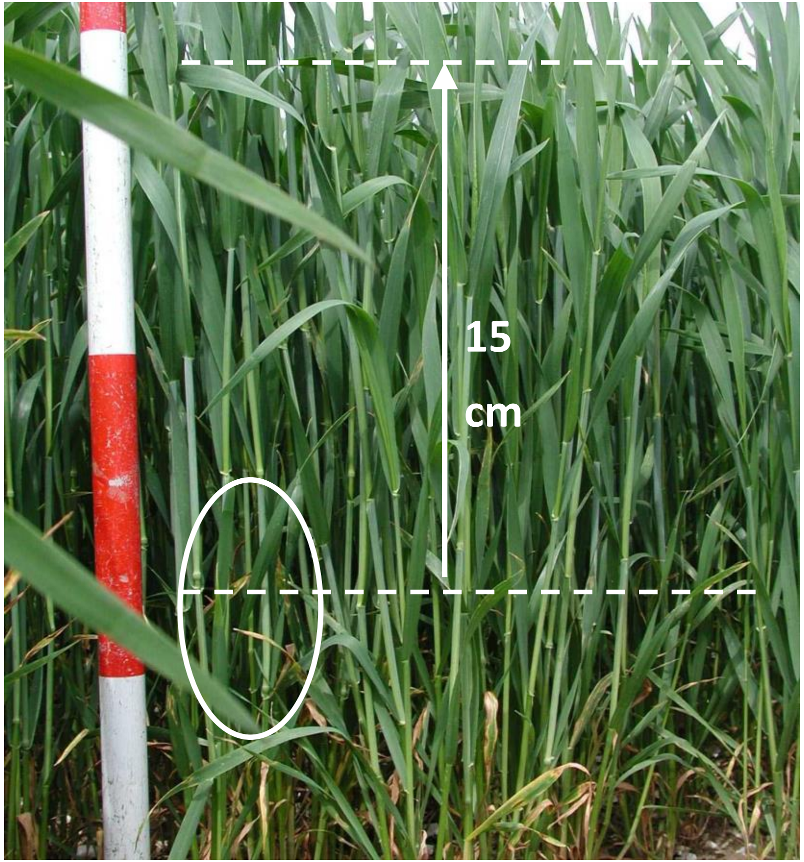
Canopy growth vs. epidemic growth



Source: Lovell et al. (2004a)

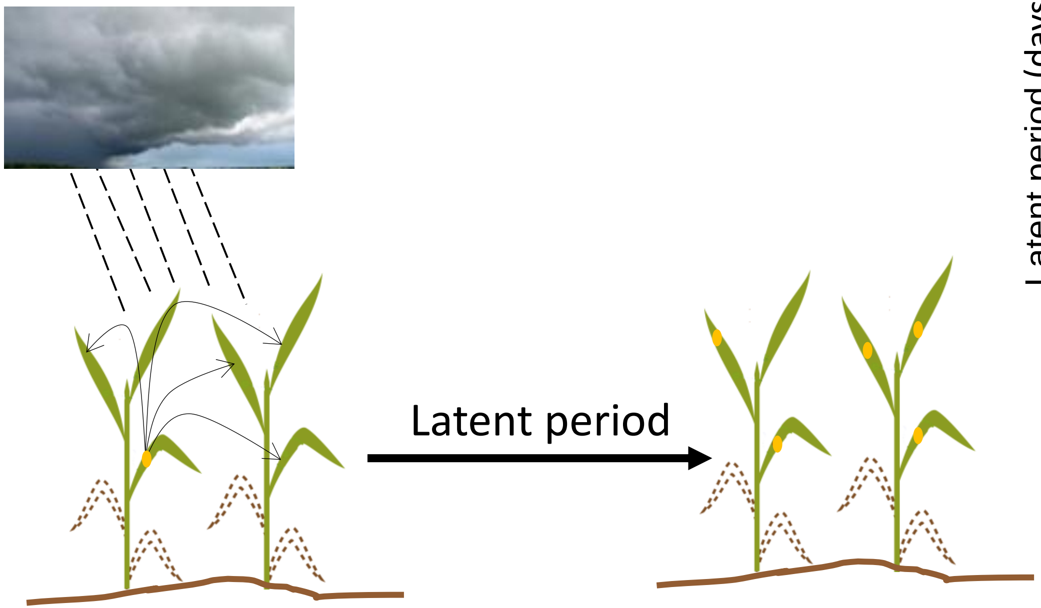
Plant Pathology

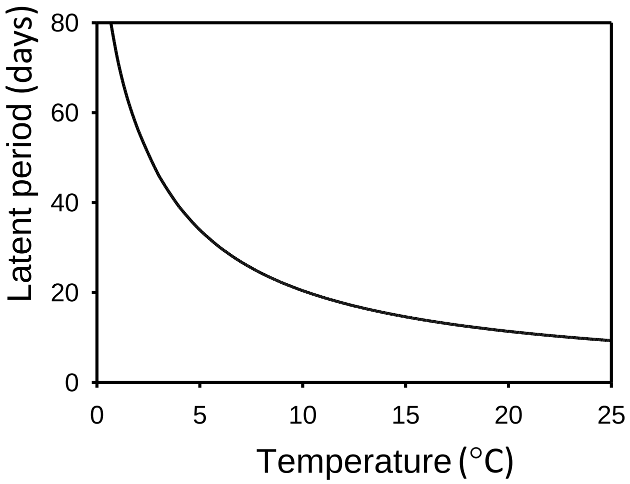
Canopy growth vs. epidemic growth



Short term disease prediction

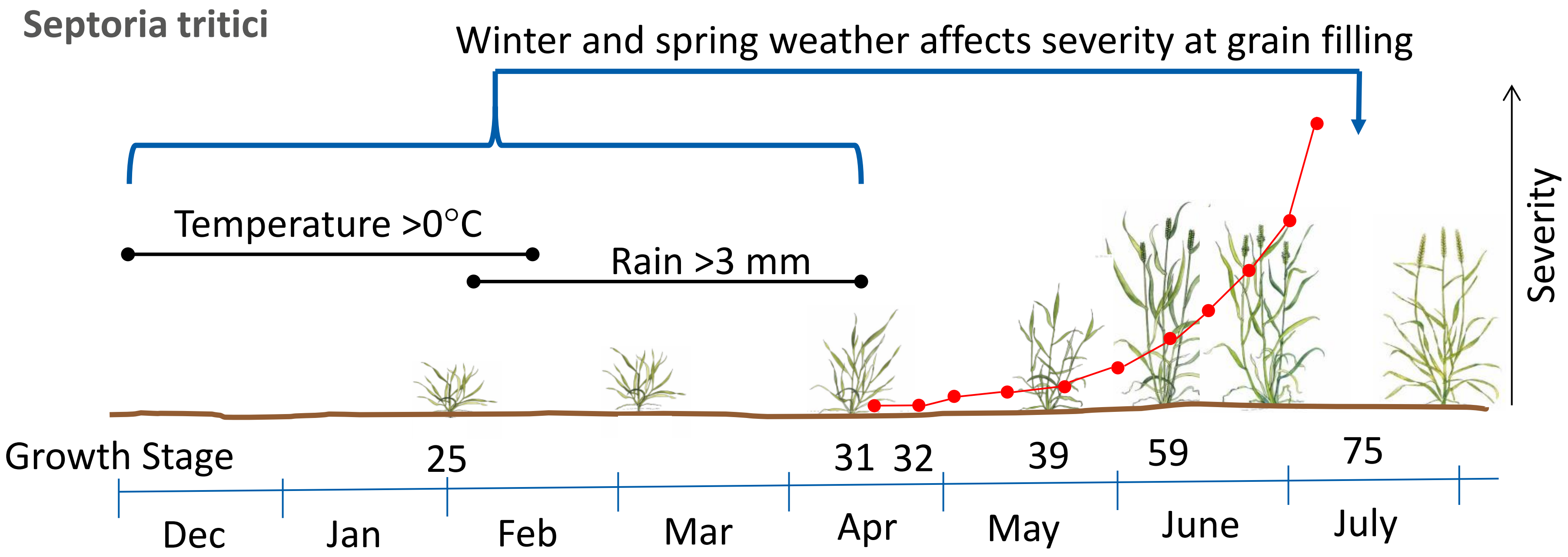
Septoria tritici





Source: Lovell et al. (2004b) Plant Pathology

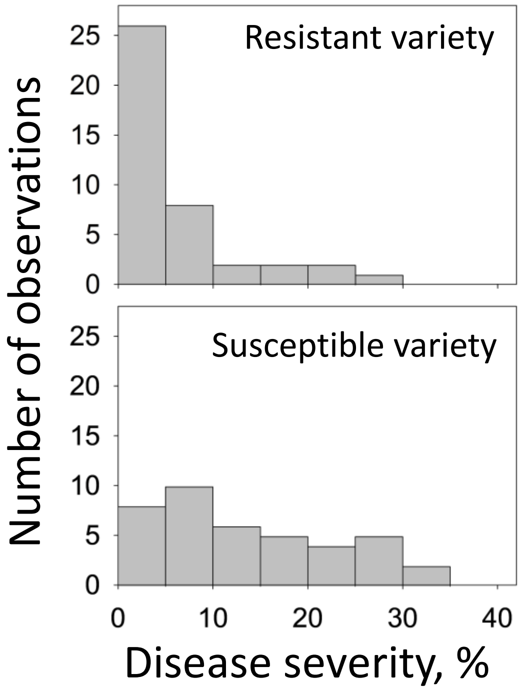
Long term disease prediction



Source: te Beest et al. (2009) European Journal of Plant Pathology

Managing disease risk

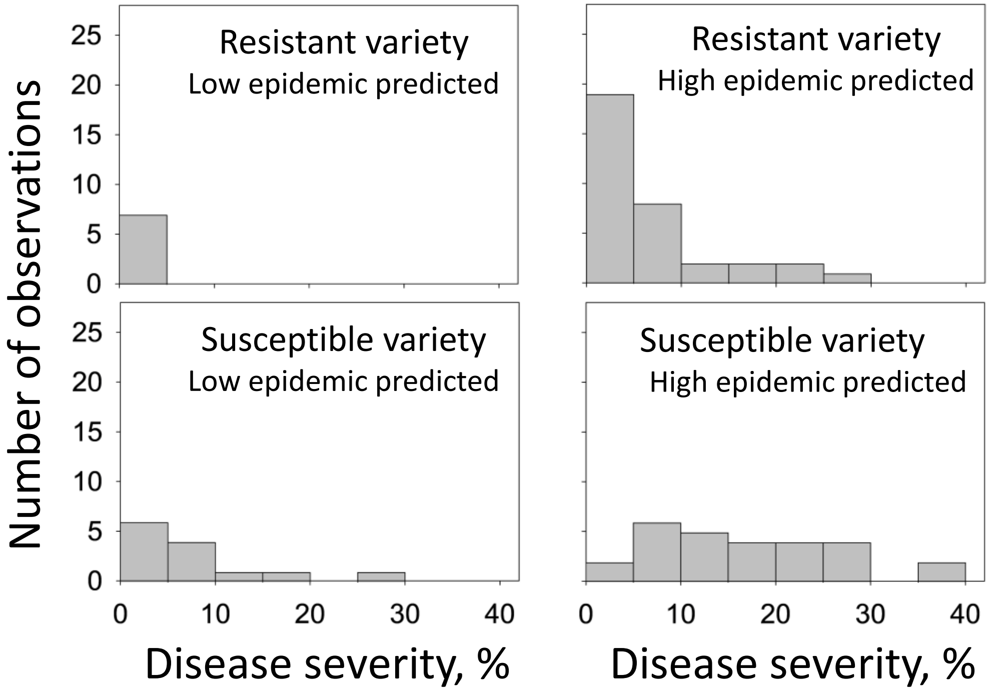
Untreated septoria mid grain filling, 44 field experiments



Source: te Beest et al. (2009) Plant Pathology and European J. Plant Pathology

Managing disease risk

Untreated septoria mid grain filling, 44 field experiments



Source: te Beest et al. (2009) Plant Pathology and European J. Plant Pathology

How to predict epidemic severity?

- Disease control decisions need to be made before control is needed
- The aim is to foresee what the future holds
- Epidemics are determined mainly by R_0 and latent period
  - Weather, agronomy, crop genetics and fungicides affect number of progeny and latent period
  - Hence, disease risk and disease control variables are ‘interchangeable’
  - More control from agronomy and genetics (or unconducive weather) mean less fungicide is needed
- For septoria, separation distance between lesions and emerging leaves is a good risk indicator
- Disease resistant varieties, combined with weather-based disease forecasting, limit the range of future disease severities - and hence risk

Further reading

Guides

AHDB Wheat and barley disease management guide. https://ahdb.org.uk/knowledge-library/integrated-pest-management-ipm-of-cereal-diseases

Books

Madden, L.V., Hughes, G. & van den Bosch, F. (2007). The Study of Plant Disease Epidemics APS Press.

Parker, S R, Lovell, D J, Royle, D J and Paveley, N D (1999). Analysing epidemics of *Septoria tritici* for improved estimates of disease risk. In: *Septoria on cereals: a study of pathosystems.* Eds. Lucas J.A., Bowyer P. and Anderson H.M., 96-107.

Research papers by the authors on the theme of this video.

te Beest, D E, Paveley, N D, Shaw, M W, van den Bosch, F. (2013). Accounting for the economic risk caused by variation in disease severity, in fungicide dose decisions: exemplified for *Mycosphaerella graminicola* on winter wheat. Phytopathology 103, 666-672.

te Beest, D E, Shaw, M W, Paveley, N D, van den Bosch, F. (2009). Evaluation of a predictive model for *Mycosphaerella graminicola* for economic and environmental benefits. *Plant Pathology* **58**, 1001-1009

Gladders, P, Langton, S D, Barrie, I A, Hardwick, N V, Taylor, M C, Paveley, N D (2007). The importance of weather and agronomic factors for the over-winter survival of yellow rust and subsequent disease risk in commercial wheat crops in England. *Annals of Applied Biology* **150,** 371-382

Audsley, E, Milne, A, Paveley, N D (2005). A foliar disease model for use in wheat disease management decision support systems. *Annals of Applied Biology.* **147**, 161-172

Young, C S, Paveley, N D, Vaughan, T B., Thomas, J M and Lockley, K D. (2003). Predicting epidemics of yellow rust (*Puccinia striiformis*) on the upper canopy of wheat from disease observations on lower leaves. *Plant Pathology* **52**, 338-349

Gladders, P, Paveley, N D , Barrie, I A, Hardwick, N V, Hims, M J, Langton, S, Taylor, M C (2001). Agronomic and meteorological factors affecting the severity of leaf blotch caused by *Mycosphaerella graminicola* in commercial wheat crops in England. *Annals of Applied Biology* **138**, 301-311.

Paveley, N D, Lockley, K D, Sylvester-Bradley, R. and Thomas, J.(1997). Determinants of fungicide spraying decisions for wheat. *Pesticide Science* **49**, 379-388.

Lovell, D J, Hunter, T, Powers, S J, Parker, S R, van den Bosch, F. (2004). Effect of temperature on latent period of septoria leaf blotch on winter wheat under outdoor conditions. Plant Pathology **53**, 170-181.

Many excellent papers are available by other authors – search online.

If a research paper is not open-access you can request a copy by contacting authors directly or through www.researchgate.net