

Managing concurrent evolution of resistance to fungicides

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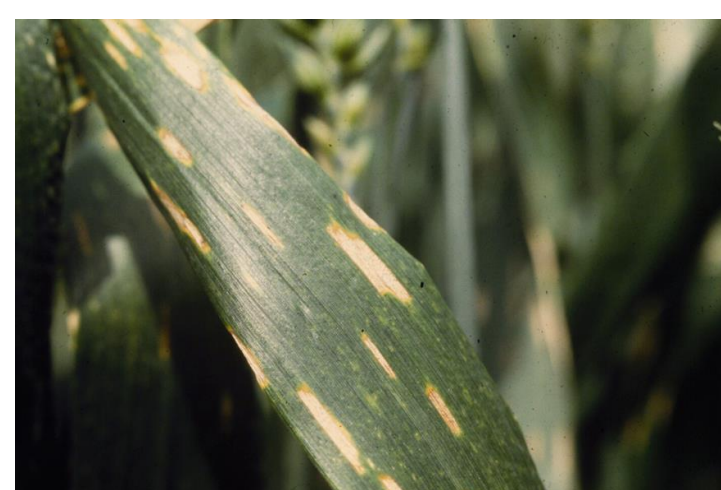
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Fungicides are used to protect wheat crops against pathogens that cause disease, maintaining yield and quality

Septoria leaf blotch causes up to 50% yield loss

Fig. 1: Septoria leaf blotch on a wheat leaf.



What are single-site fungicides?
Single-site fungicides, such as azoles and SDHIs, target only one part of the pathogen's biology, e.g. an enzyme. This slows down the pathogen's growth.

What causes fungicide resistance?
A mutation in the pathogen target-site gene can lead to pathogen strains with resistance to a single-site fungicide.

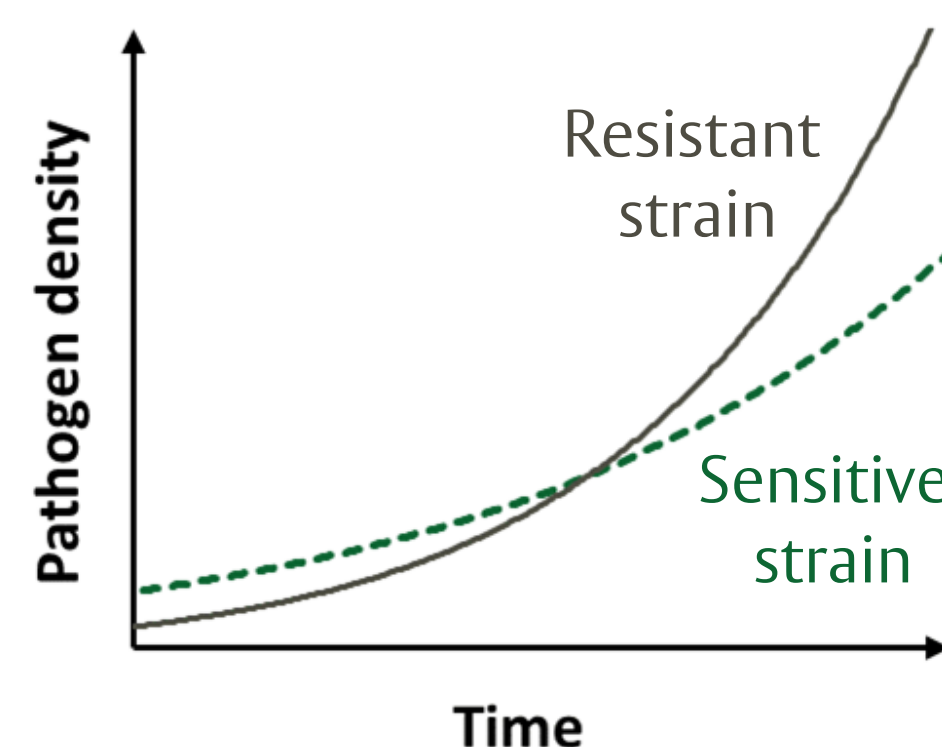


Fig. 3: When fungicide is applied, resistant strains outcompete sensitive strains.

Why does resistance spread?
When the fungicide is applied, the percentage of the pathogen population that is resistant increases, as resistant strains grow faster.

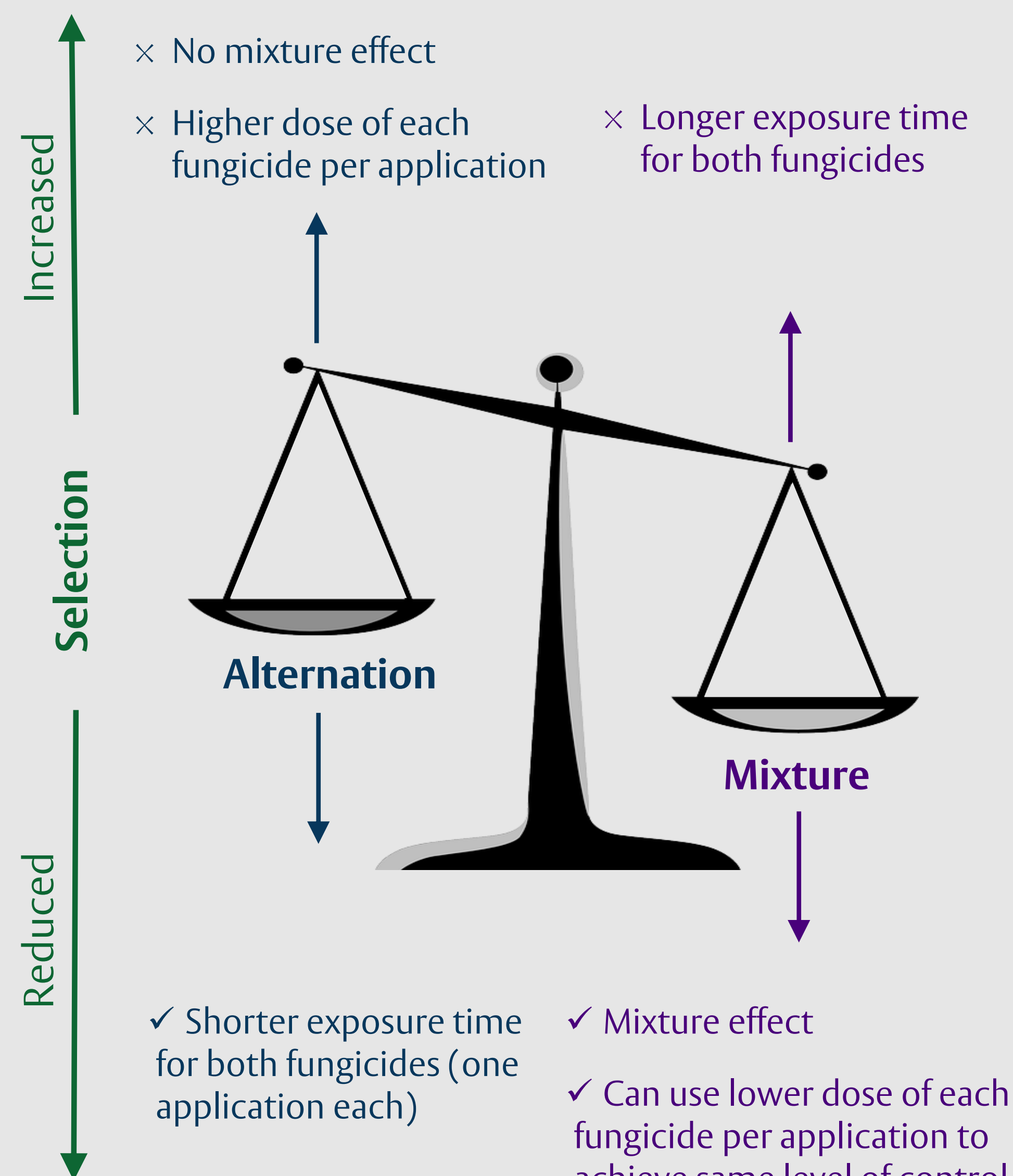
What is concurrent evolution of resistance?

Septoria is currently evolving resistance to both SDHI and azole fungicides at the same time. This is known as 'concurrent evolution of resistance'. Can this process be slowed down?



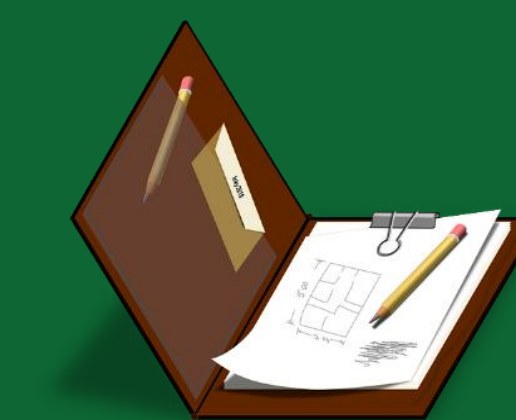
A balancing act

What is the best way to combine two single-site fungicides in a programme? Strategies include alternation or applying fungicides in mixture. Each option introduces trade-offs, and so could either increase or reduce the selection pressure overall.

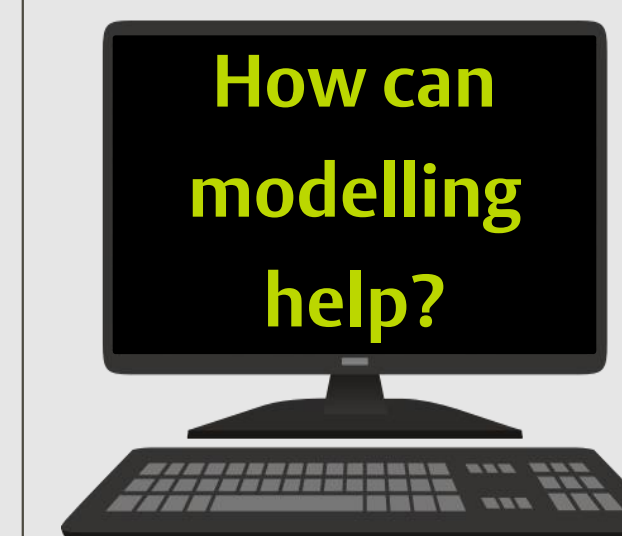


What is 'resistance management'?

Choosing fungicide programmes that aim to keep selection for resistant strains as low as possible, whilst maintaining control of disease.

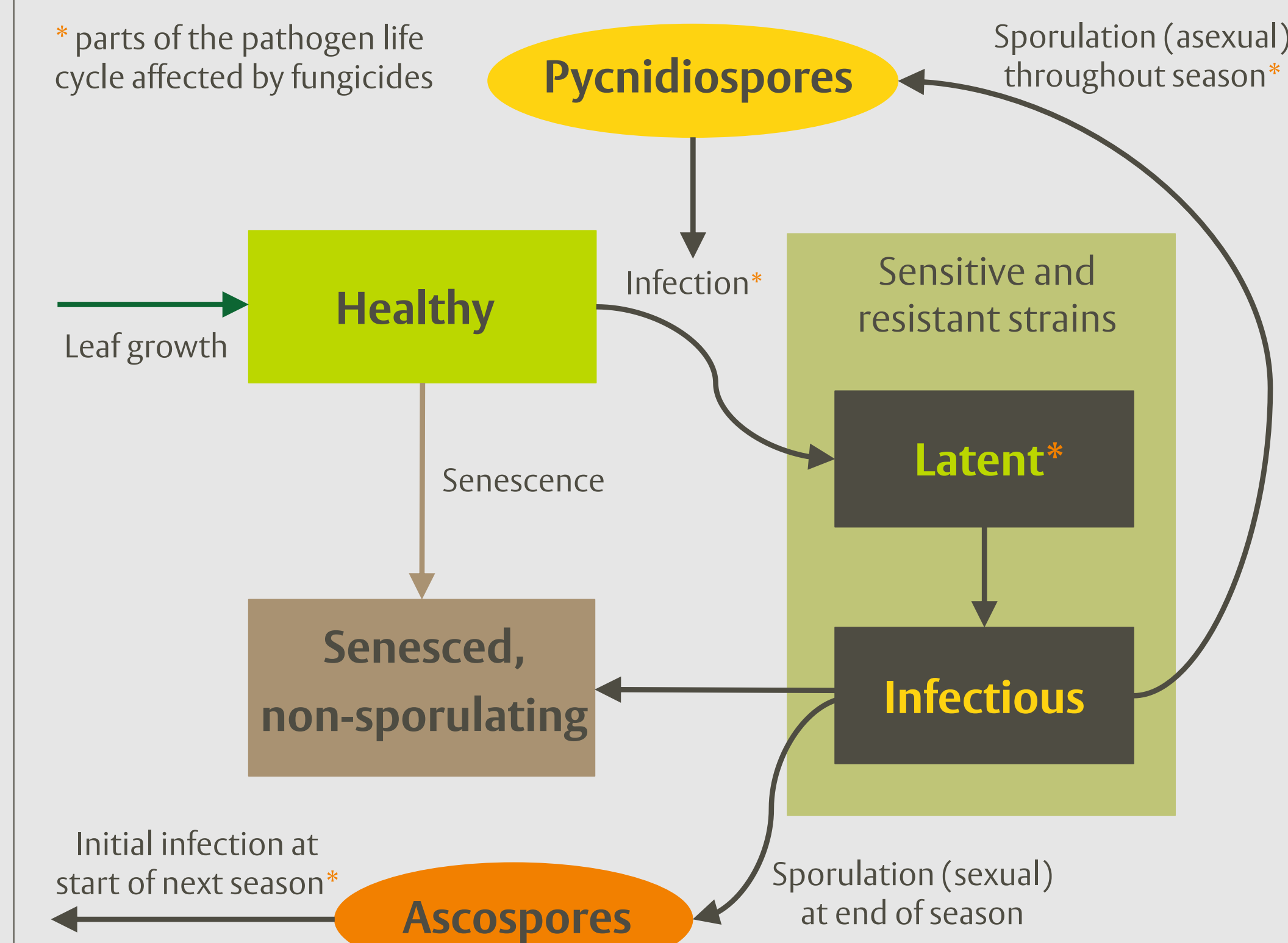


How can modelling help?



I will use models to run 'what-if' scenarios, testing a large number of possible strategies with the aim of informing and improving resistance management tactics.

Fig. 4: A schematic diagram of a fungicide resistance model for septoria.



References

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- van den Bosch, F. et al. (2011). The dose rate debate: does the risk of fungicide resistance increase or decrease with dose? *Plant Pathol.* **60**: 597-606.
- van den Bosch, F. et al. (2014). Governing principles can guide fungicide-resistance management tactics. *Annu. Rev. Phytopathol.* **52**: 175-195

Acknowledgements

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- Fig. 1 M. Shaw; Fig. 4 adapted from van den Bosch et al.²; Graphics CC BY-NC.