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Managing Fungicide Resistance

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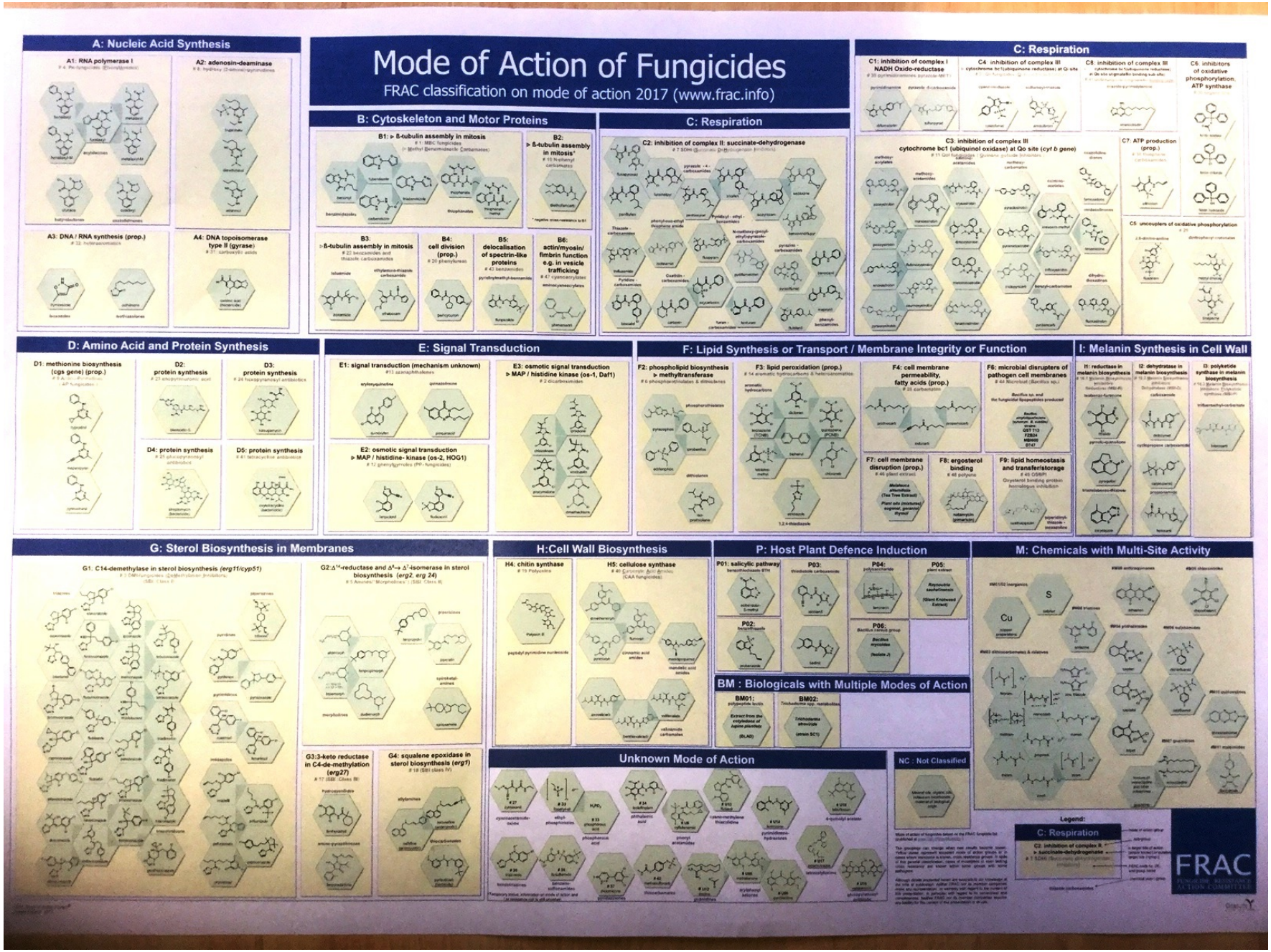
What are fungicides?

- Chemicals that block a chemical reaction or cellular process in a fungus (or Oomycete)
- In a few cases fungicides can also stimulate plant chemical and physical defences to pathogens
- Different fungicides are grouped based on their Chemical Class (Family) and their Mode of Action (Activity Group)
- There are currently >45 Activity Groups – most based upon their Chemical Class while two additional groups are arbitrary and consist of chemicals with multi-site or unknown activities

Fungicide activity groups

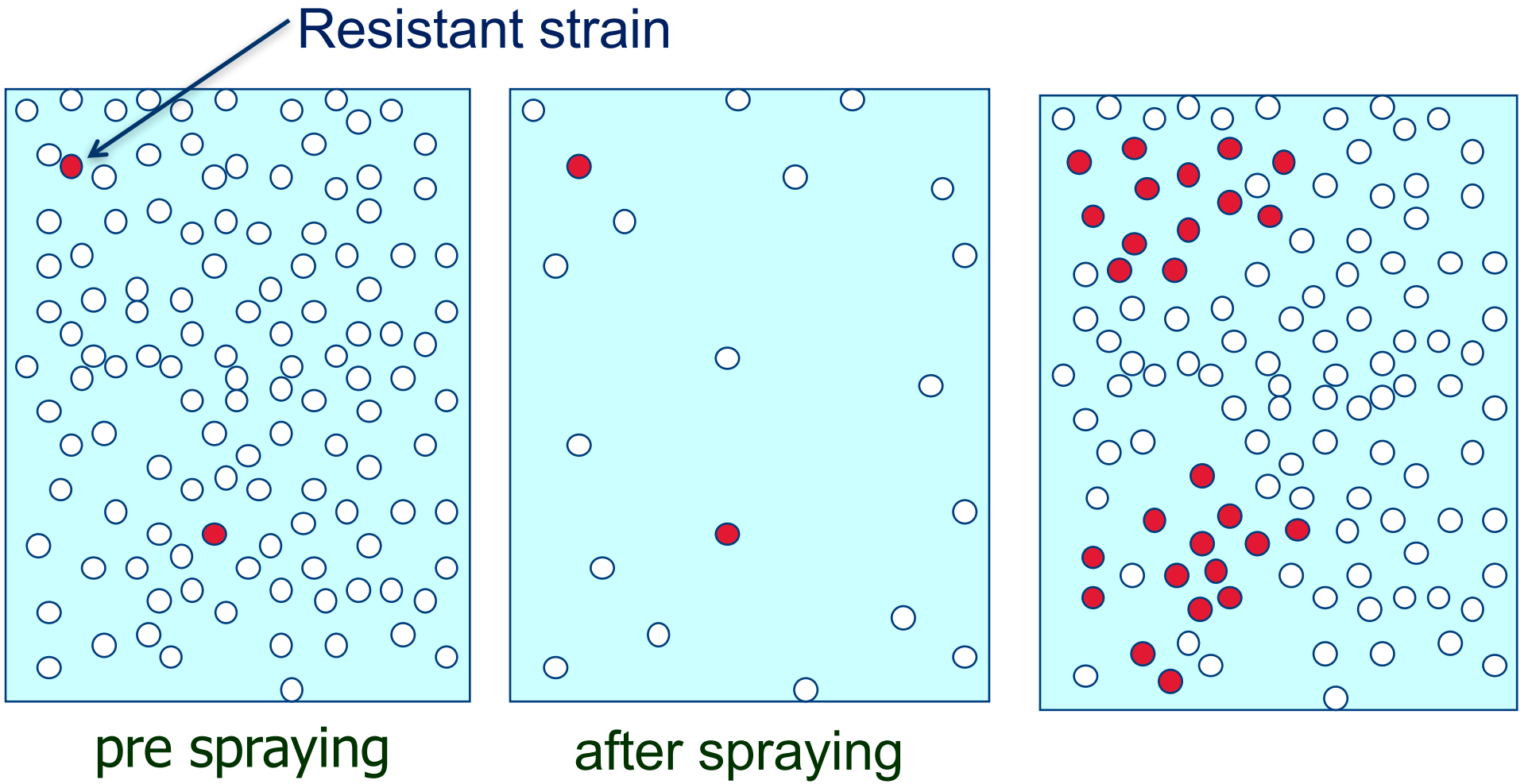


What is fungicide resistance?

- Results from a change in the fungal population that makes the fungicide less effective or ineffective
- Resistant strains of the fungus are *selected* by repeated use of a particular chemical or fungicides with the same mode of action
- Resistant strains can then reproduce and increase in the fungal population
- Resistance can result from a genetic mutation or if a fungal strain can use an alternative biochemical pathway
- Resistant strains probably always exist at low frequencies in a fungal population

Resistance development

Selection of resistant mutants



Shift in resistant population frequency

Caused by increased frequency **(selection)** of resistant individuals in the fungal population

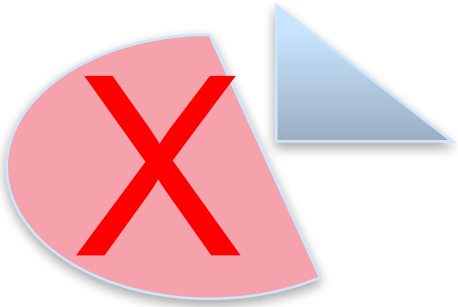
No mutation

GGG GGT TTC

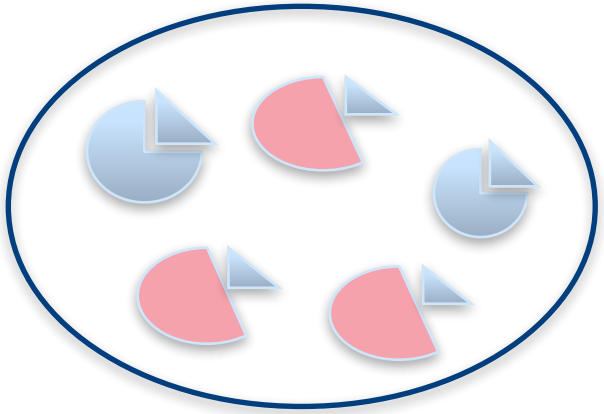
Target site: where fungicide binds

Mutation

G**C**G GGT TTC

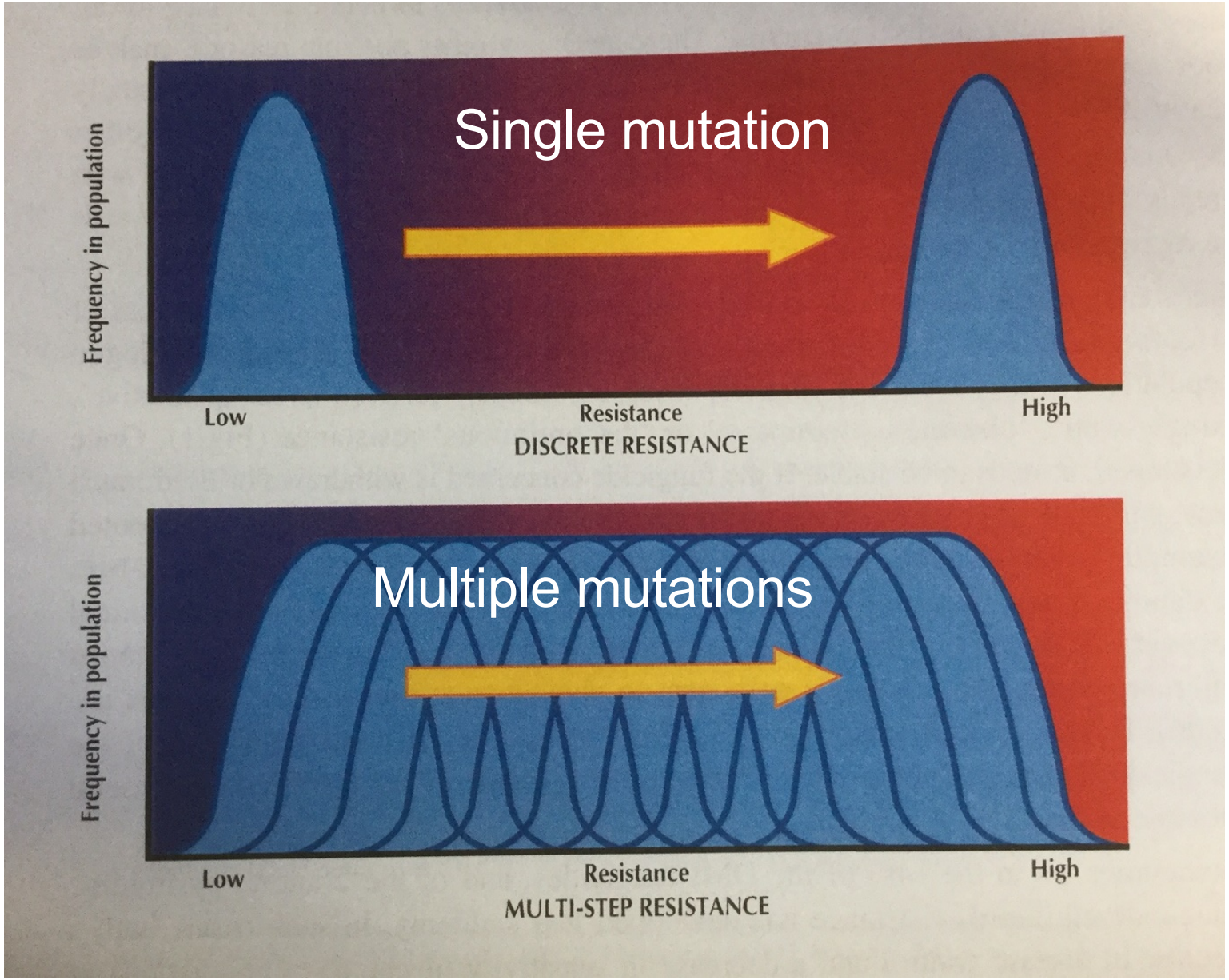


Mixed (mutation/no mutation)



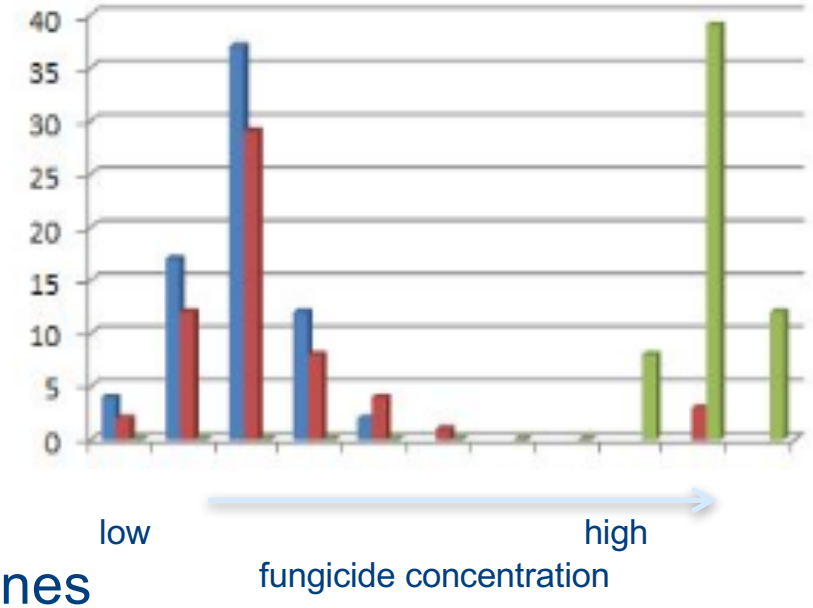
Partial efficacy

Types of resistance

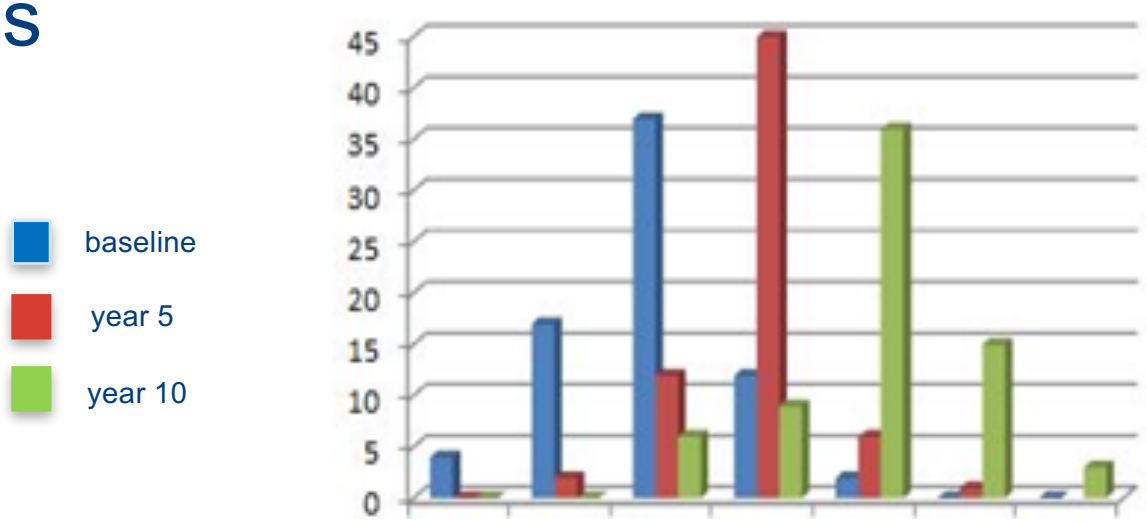


Types of resistance

- Sudden loss of field control
  - major or single gene
  - eg. QoI, metalaxyl



- Gradual loss of control
  - several mutations, interacting genes or multi genes
  - eg. DMI



Estimating the risks

- Some fungicides have an inherently higher risk – binding site predisposed to genetic change &/or chemical persists on/in the plant or environment
- Pathogen produces numerous sexual and/or asexual spores
- Pathogen has multiple cycles per season
- Agronomic risks – many aspects including: chemical application practices; irrigation; fertilisers; variety selection; soil condition; crop scheduling

Detecting decreased sensitivity to fungicides

- In-vitro assays

- Measure suppression of hyphae & spore germination

- Bioassays - biothophs
- Molecular assays
- Decreased sensitivity is not always related to field efficacy

Resistance management practices

- Limit total number of spray applications
- Apply with fungicide from different activity group
- Alternate with fungicide from different activity gp.
- Include fungicides with multi-site activity
- Use microbial biocontrols
- Apply as preventative treatments – before symptoms
- Avoid extended spray intervals
- Use preventative integrated crop management strategies: e.g. resistant varieties; crop scheduling; crop rotation; crop hygiene

Acknowledgements

- DuPont & other agrichemical companies
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Further Reading - FRAC

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