Brassica Growers Association
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CP191 Bacterial diseases

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Outline

- Background thinking:
  - CP174 AHDB Review of bacterial diseases
- CP191:
  - Black rot summary/plans
  - Spear rot summary/plans

CP191 Bacterial diseases

- Response to tender call.
- Main aim:
  - Improve the management of bacterial diseases of horticultural crops
  - Priority targets:
    - Brassicas/Xcc
    - Broccoli/Pf
    - Herbs/Pss
    - Cherry laurel/Pss
    - Ivy/Xhf
    - Geraniums/Xhp

CP174 AHDB Review (2017)

- List of bacterial pathogens known to affect or could potentially affect UK crops.
- Industry consultation to identify priority pathogens/diseases.
- Review control options for priority pathosystems.
- Summarise AHDB bacterial disease control trials.
- 115 page report
- Link:

  https://horticulture.ahdb.org.uk/sites/default/files/research_papers/CP%20174_Report_Final_2017_0.pdf

CP191

- Common themes:
  - 'clean' starting material
  - setting health standards based on epidemiological data

CP174 AHDB Review (2017)

- ~ 110 bacterial pathogens of concern (pathogen = distinct species / sub-species / pathovar)
- Top priority bacterial diseases:
  - Onions/storage rots
  - Broccoli/spear rot
  - Prunus/bacterial canker
  - Tomato/root mat
  - Potato/black leg
  - Mushrooms/bacterial blotch

CP174 AHDB Review (2017)

- Control of bacterial diseases seen as difficult
  - mainly due to lack of chemicals
- ~30 AHDB/HDC projects on bacterial diseases
  - 23 spray trials: chemicals, biologicals, elicitors
  - 3 seed treatments
- Most products ineffective, inconsistent, not cost-effective.
- The only consistently effective PPP in the last 30 yrs has been copper oxychloride

Bacterial pathogens

- Why are they difficult to control?
- If conditions are right:
  - Bacterial pathogens multiply and spread much more rapidly than fungal pathogens
  - Unlike most fungi, there is no gap between initial infection and further inoculum production and dissemination
  - By the time symptoms are first observed, the pathogen has already multiplied and spread (just like *Coronavirus*!?)

Why don't we have any PPPs ?

- Money, markets, cost of development...
- Potentially some highly effective chemicals and natural products could be used to control bacterial plant diseases...
  - curative, systemic
- BUT .....
- They are called antibiotics !
- Generally reserved for humans and animals
- Where they have been used → resistance

Bacterial disease control

- The most effective strategy to control most bacterial plant diseases:

Disease avoidance
(Clean start)

- If you don't introduce the pathogen into the crop (or farm or country), it can't cause disease
- No need for secondary control measures

Why no PPPs ?

- If someone was to discover some novel broad spectrum antibacterial compound today...
  - low toxicity to humans, animals
  - safe in the environment
- Where are they going to make the most return on investment?
- Conclusion:
  - The likelihood of a novel effective PPP being developed for bacterial diseases of horticultural crops is low...

Disease avoidance

- What do we mean ?
- Biosecurity – prevention is better than cure
- Quarantine at national level
  - exclude, restrict entry of potential host plant material
  - testing, indexing, certification
- Quarantine at farm level
  - use of clean (= pathogen-free) propagation material (i.e. seed, transplants, tubers, cuttings)
  - testing, indexing, certification

How clean is 'clean'?

- The problem with testing
  - We only ever test a sample
  - No test is 100% reliable
- To be effective:
  - need to understand the epidemiology
    - Primary sources of infection
    - What material do we need to test ?
  - define the standards for testing/certification
    - How many units do we need to test?
    - How sensitive does the test need to be?
  - consistent application of standards

Black rot

- *Xanthomonas campestris* pv *campestris* (*Xcc*)
- V-shaped chlorotic, yellow lesions with blackened veins
- Systemic infection - stunted or dead plants
- Premature defoliation, secondary soft rots
- Primary source: seed

Disease avoidance

- For some pathogens
  - we know the primary source, we have effective test methods, and defined standards
  - but not applied?
- For others
  - sources not so well defined, and/or standards are not defined.

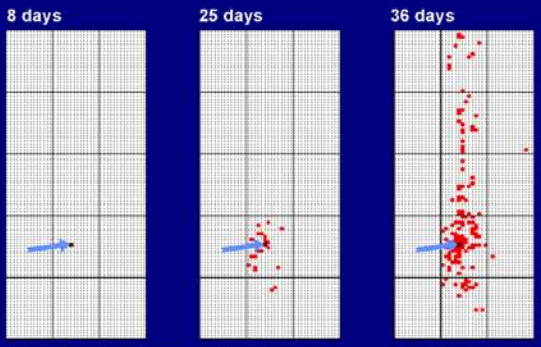
Black rot

- Studies on epidemiology in the 1990s:
  - MAFF and HDC funded
  - Some seed not tested
    - Often infested
  - Tested seed
    - Variable standards applied
    - Some 'tested' seed was infested at low levels
  - Rapid spread during plant raising from low levels of seed inf. can result in almost 100% contamination of transplants

Black rot

Infected seedlings are hard to spot

Spread in transplants



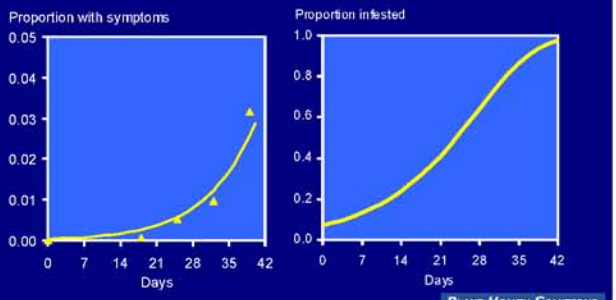
Symptoms, single primary infector, ~ 4,500 plants

Black rot

- If we have a standard, why is Xcc still a problem?
- Project aims:
  - Case study to determine role of different potential sources
    - farm with current problems
    - testing seed and transplants
  - Demonstrate value (or not) of high-health transplants

Spread in transplants

- Symptoms only half the story !



Spear rot

- Caused by specific biosurfacant producing strains of *Pseudomonas fluorescens* GpIV
- *Pectobacterium* often isolated, but does not cause disease on intact heads

Models used to set the standards

- Transmission model (seed to seedling):

$$P = 1 - \exp\{-w.ds\}$$

  - P is the proportion of seedlings infested, w is the one-hit probability (0.014), d is the dose, x is a proportionality factor
- Spread model:

$$\ln\{p_e/(1-p_e)\} = \ln(a_e) + b_e\ln\{c_e + \sqrt{(k_e.x^2 + y^2)}\} + r.t$$

- Seed test model (simplified):

$$p_+ = p_s \times \{1 - (1-\theta)^n\}$$

- Combined results indicate a seed health standard of 0.005% is appropriate (means testing ~60,000 seeds)

Spear rot resistance

- Lot of work at Wellesbourne in 1990s
  - Demonstrated differences in susceptibility amongst cultivars
  - Never been any further work to look at this
- Project aim:
  - to determine availability of resistance in current varieties

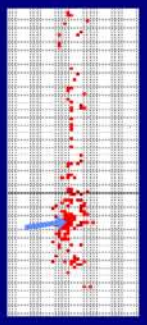
Spear rot epidemiology

- Work at Wellesbourne in 1990s:
  - BSP strains can be seed-borne
  - be transmitted from seed to seedling
  - survive on transplants/plants to maturity
- Project aims:
  - Determine prevalence in commercial seed
  - Determine relative importance of seed and non-seed sources of infection
  - Determine rate of spread in transplants so we can set seed health standards

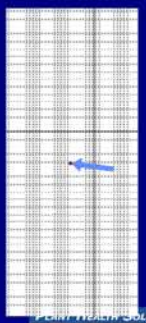
Spread in transplants

Symptoms 5½ weeks after sowing

Overhead gantry



Capillary matting



Novel high-health transplant production

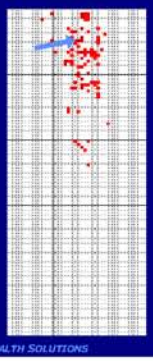
- Can we produce guaranteed 'high-health' transplants
- Previous work has shown that using a sub-irrigation system can give control equivalent to repeated copper sprays....

Novel transplant production

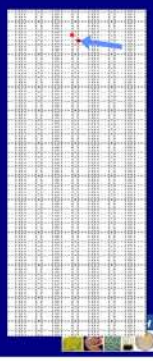
- Successfully for research purposes:
  - Non-destructively tested seed
  - Sub-irrigation on capillary matting to prevent secondary spread
  - Capillary matting covered with treated fabric (Tex-R) to prevent rooting through
  - Transplants tested pre-planting
- Project aim:
  - Can we adapt/develop this on a commercial scale?

Effect of copper (weekly sprays) on spread of Xcc in transplants (6 weeks)

- Cu 2%



+ Cu 0.02%



The End

Thank you for listening

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