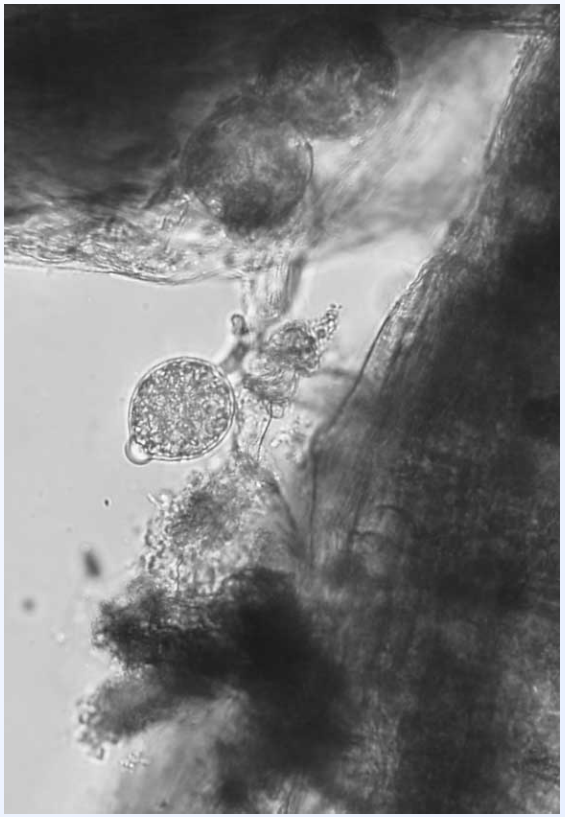
How much of a threat is *Phytophthora idaei* to the raspberry industry?



David Cooke

Alison Dolan

Vanessa Young

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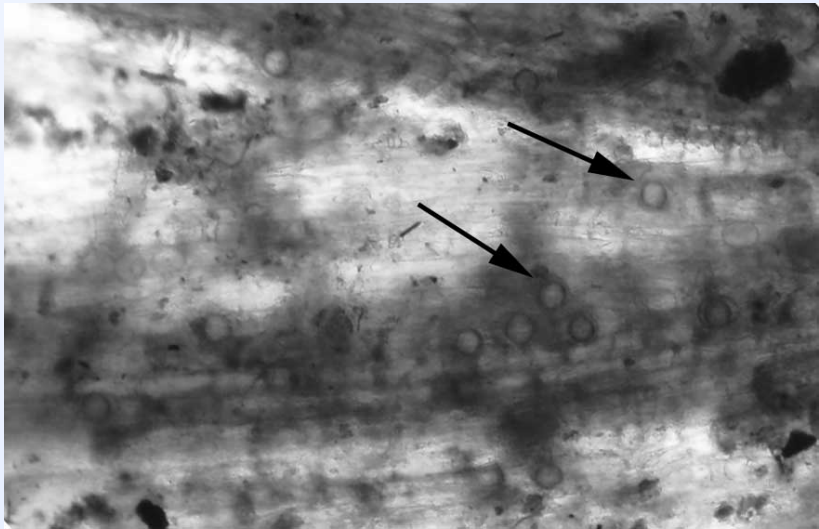
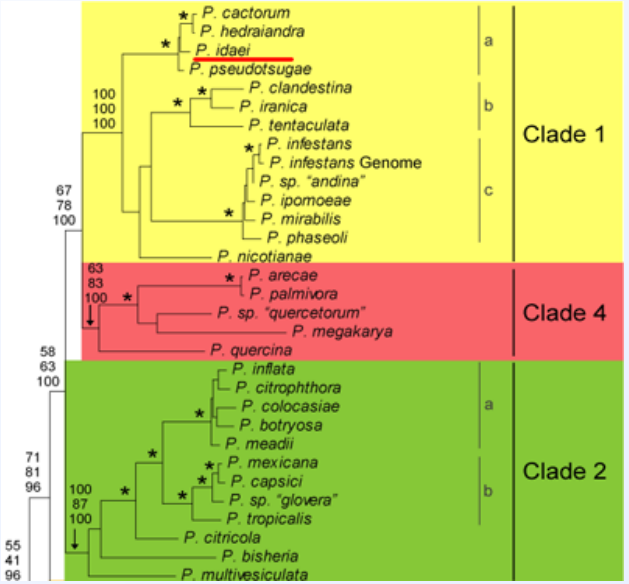
Past history

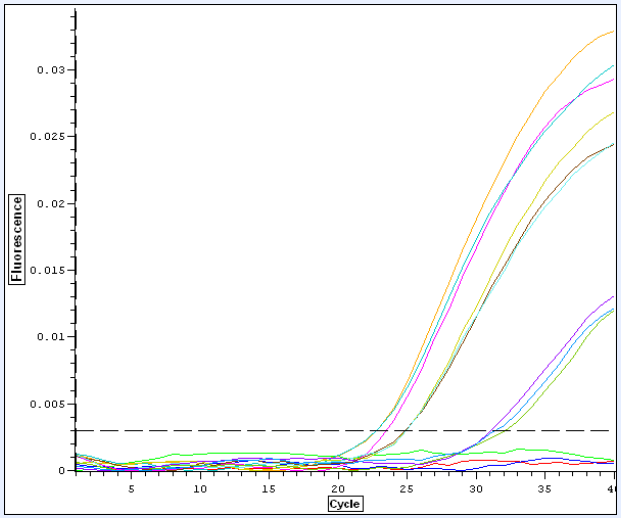
- New *Phytophthora* species discovered in 1985-7 from raspberry crops in England and Scotland
- Formally described as *P. idaei* by Diana Kennedy and Jim Duncan in 1995 on basis of morphology and biology
- Shown to damage roots of pot-grown raspberry (cv Glen Moy)
- Little or no damage to apple fruits and seedlings
- No damage to strawberry
- Origins unknown
- **Note name change** *P. rubi* causes RRR = *P. fragariae* var. *rubi*



Recent history

- Confirmation of relationship to *P. cactorum*
- No new records of *P.idaei* since 1980s
- No effective bait tests
- New DNA-based diagnostics for *P. idaei*
- Found in approx. 50% of 115 raspberry crops sampled in Scotland in 2001-3
- Anecdotal reports of *P. idaei* damaging UK crops
- New cultivars and changing cultivation methods – new concerns





Project aims

- Review diagnostics and sampling methods
- Assess impact of *P. idaei* in field grown and protected crops

  Glasshouse studies

  Field trial

- Best practice guidance to industry
- Advice to Scottish Government on certification scheme

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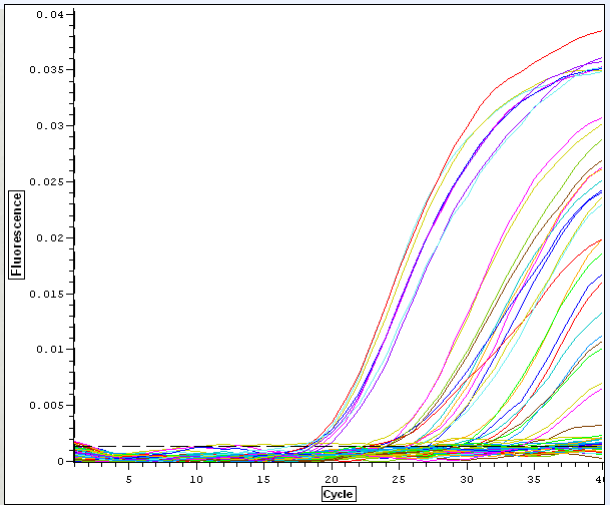
Diagnostics

- Examined new options for diagnostic testing to increase specificity

  Successful but less sensitive - existing real-time assay remains best option

- Novel baiting assays tested

  None of plant materials tested proved effective baits for *P. idaei.* In contrast to Glen Moy baits for raspberry root rot pathogen (*P. rubi*)



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Background to screening

- Five cultivars selected for testing:

Glen Moy	Susceptible to *P. rubi*
Glen Doll	New cultivar
Glen Ample	Current commercial
Tulameen	Current commercial
Latham	Resistant to *P. rubi*

- All material sourced from high-health system at SCRI and tested negative for *Phytophthora*
- Two isolates of *P. idaei* chosen and used throughout

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Glasshouse screening results

- A series of tests were run on 3-9 month old plants
- Pathogen plugs placed around roots
- Cool glasshouse & trickle irrigation used twice per day to create optimal conditions for *Phytophthora* infection
- Visual root health score 1 = healthy to 5 = dead
- Above ground symptoms, plant height etc.

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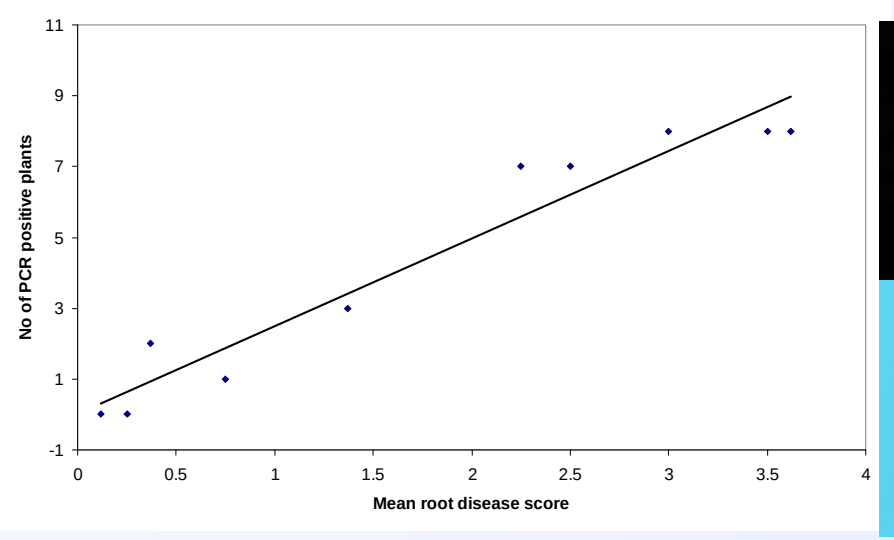
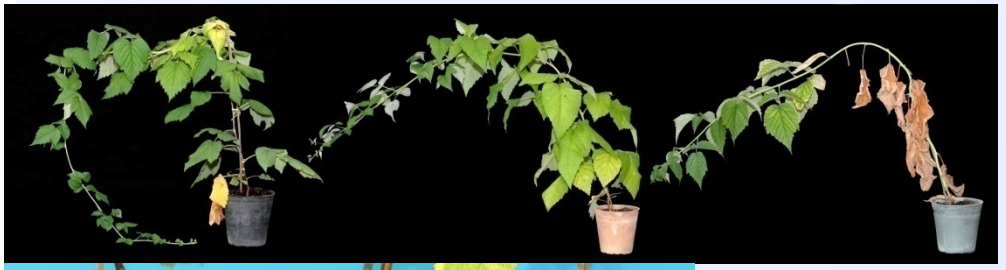
Glasshouse test results

- *P. idaei* resulted in significant amounts of root death
- Root disease and presence of *P. idaei* confirmed by PCR testing
- No affect on above-ground plant parts (cane height, leaf number etc.)
- No affect on bud break the following spring
- Some evidence of pathogen spread
- Less damaging than *P. rubi*





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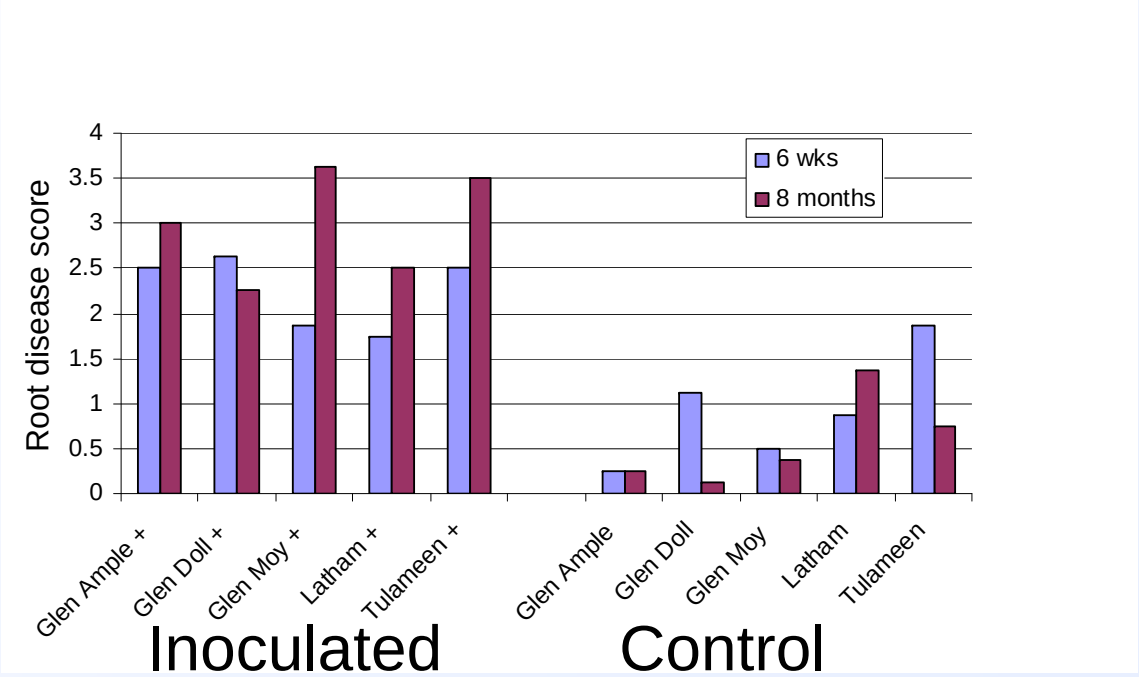
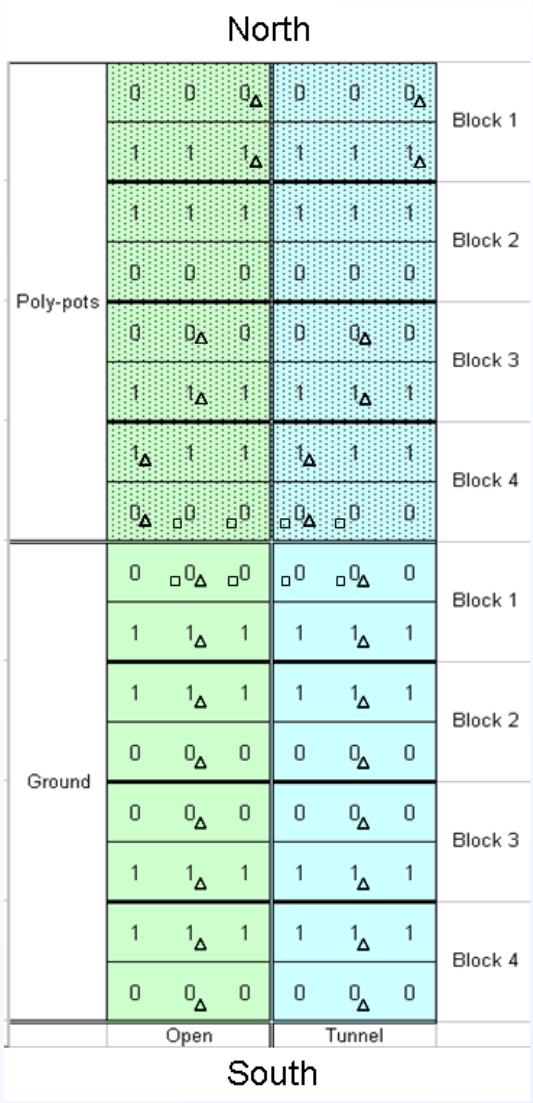
Cultivar resistance?

- No consistent differences between cultivars (three separate glasshouse experiments)
- No correlation between resistance to two *Phytophthora* species (see Moy and Latham results)



Field trial plan



- Cultivars
  - Moy
  - Ample
  - Doll
  - Tulameen
- Tunnel
  - Covered (summer only)
  - No cover
- Substrate
  - Ground-grown on ridges
  - Polypot (on wire above Mypex)
- Inoculum
  - Pre & post-planting treatment with *P. idaei*
  - Uninoculated control

Time-line

Planted	Autumn 2006
First season	2007
Main season	2008
Project end	April 2009

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Field trial

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2007 Primocane height

- Disease symptoms (none)
- Cane height

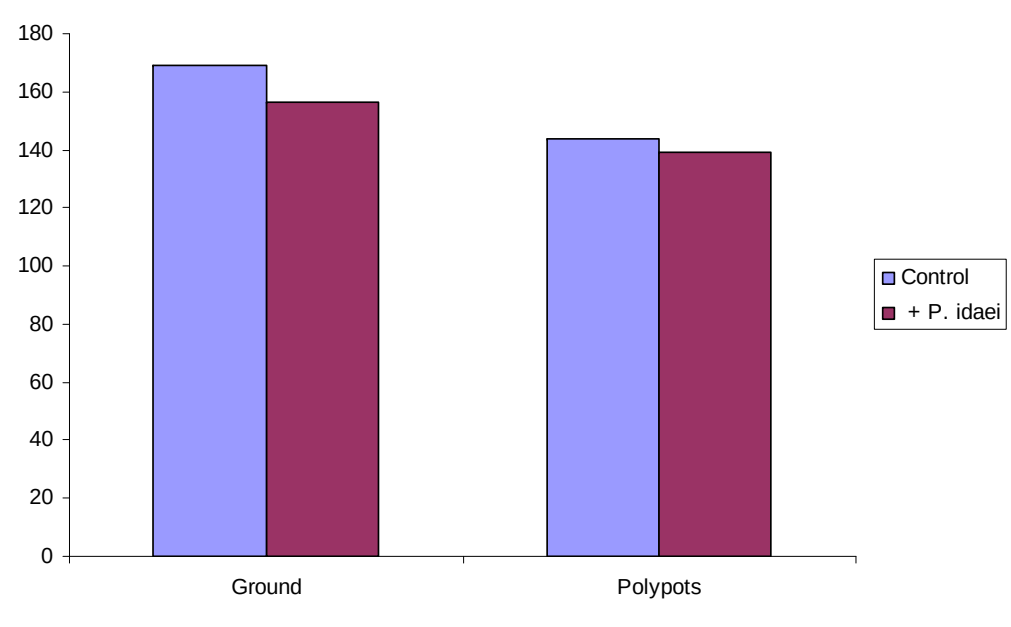

Figure 15. Mean primocane height (2007) of raspberry plants grown in the ground (left) or in Polypots (right) in response to *P. idaei* inoculation. In ground-grown plants the difference was statistically significant (P<0.001, S.E. = 2.21; d.f. = 22) but in the case of plants in polypots it was not (P=0.079, S.E. = 1.72; d.f. = 22).

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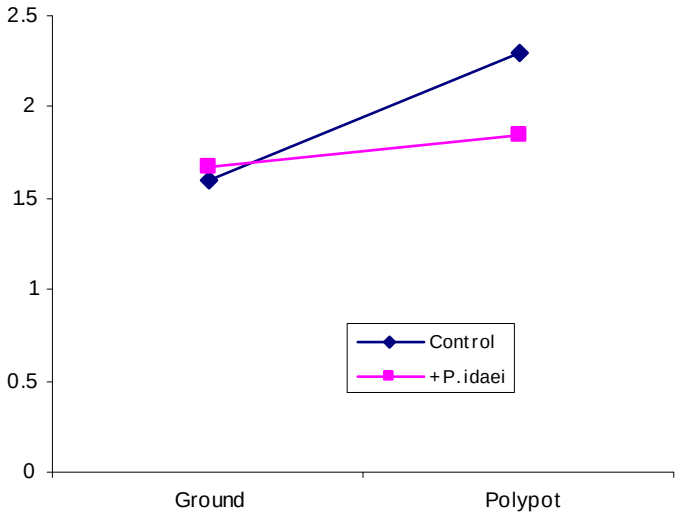
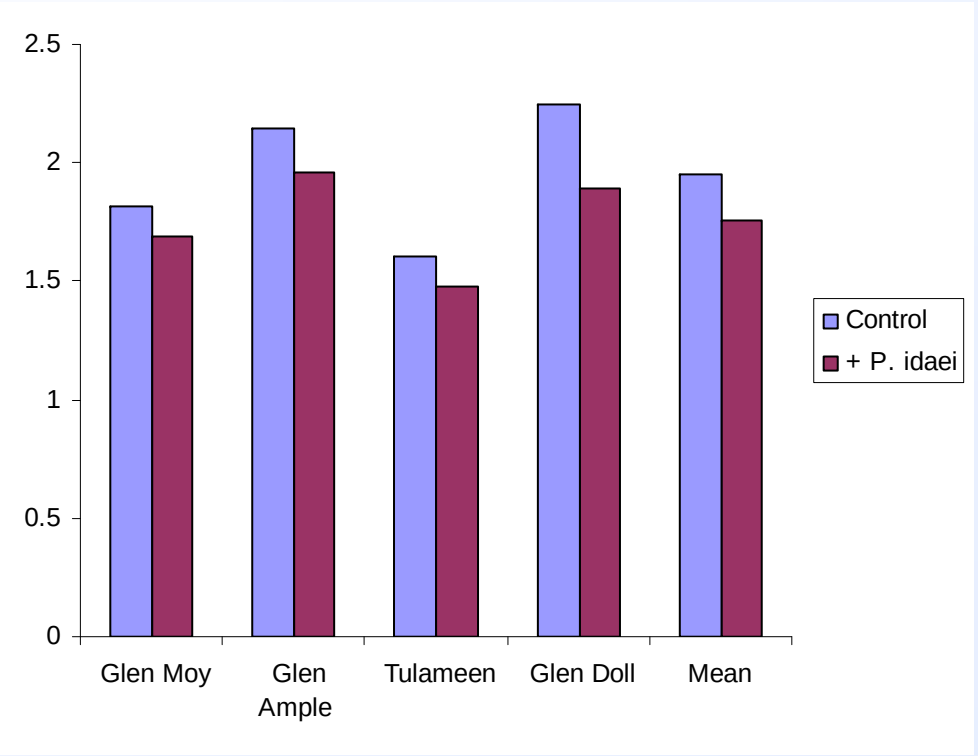
2007 Primocane number

- Slight reduction in primocane number.
- Particularly in poly-pots (restricted root system)





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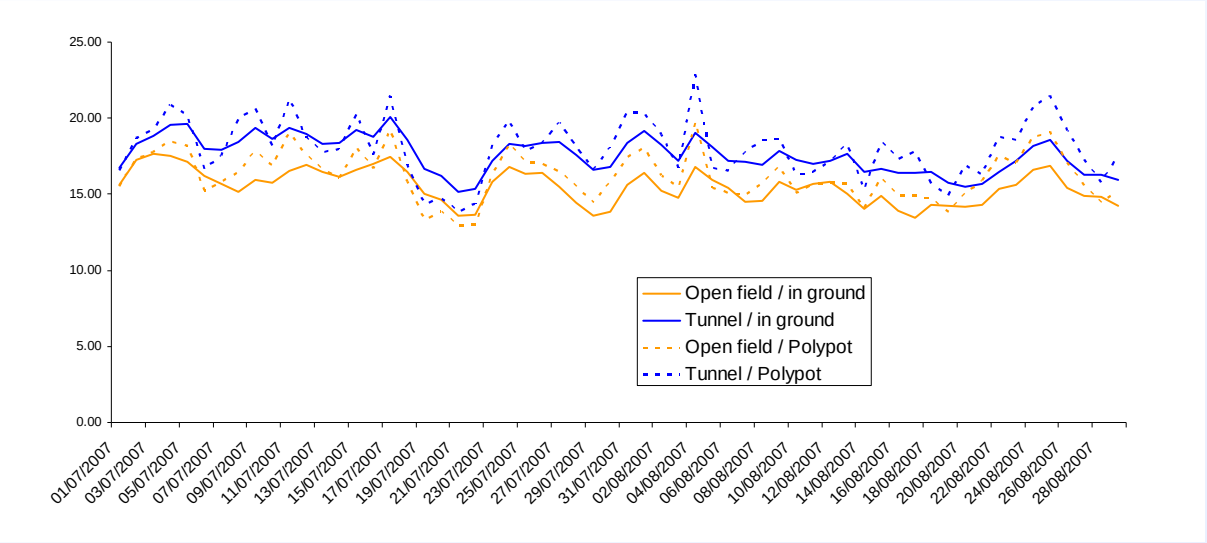
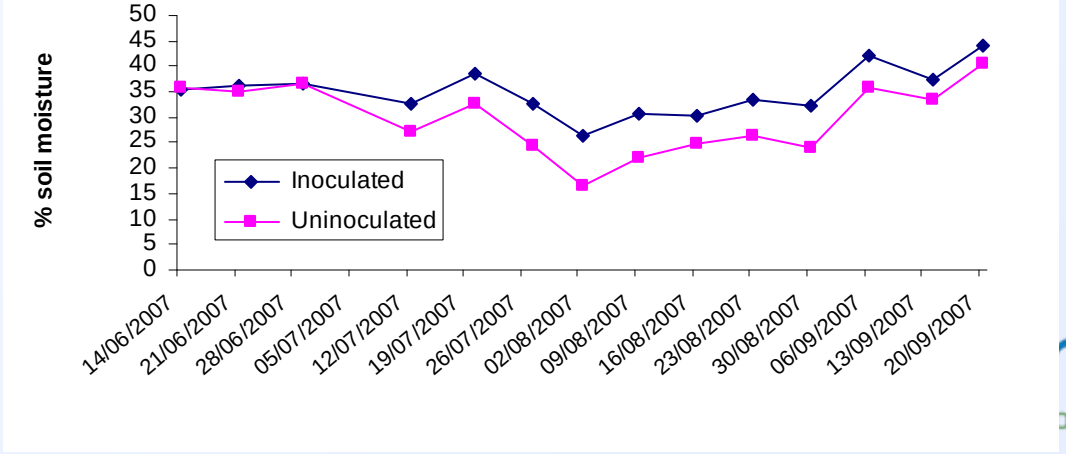
2007 Soil temperature and moisture

- Soil temperature

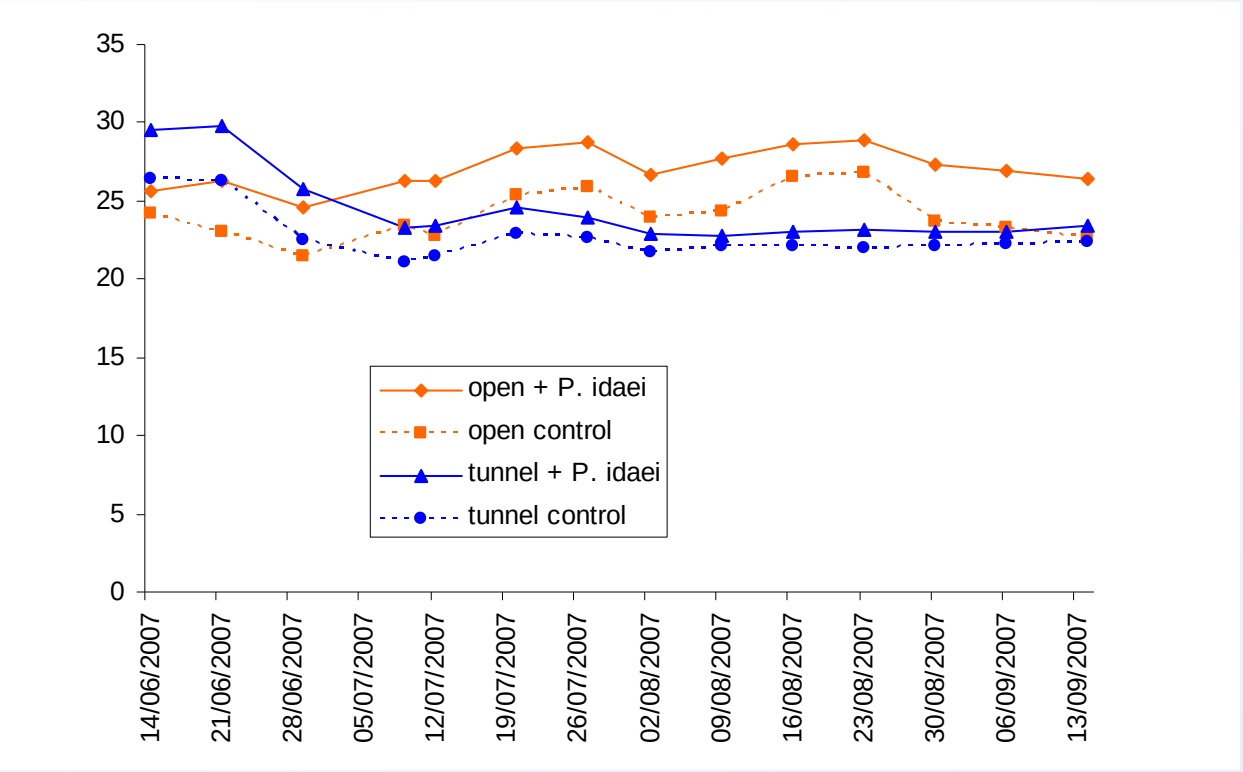


- Soil moisture (Poly-pots)



2007 - Soil moisture

- Ground-grown
- 200mm depth
- Wetter in open
- Wetter beneath inoculated plants



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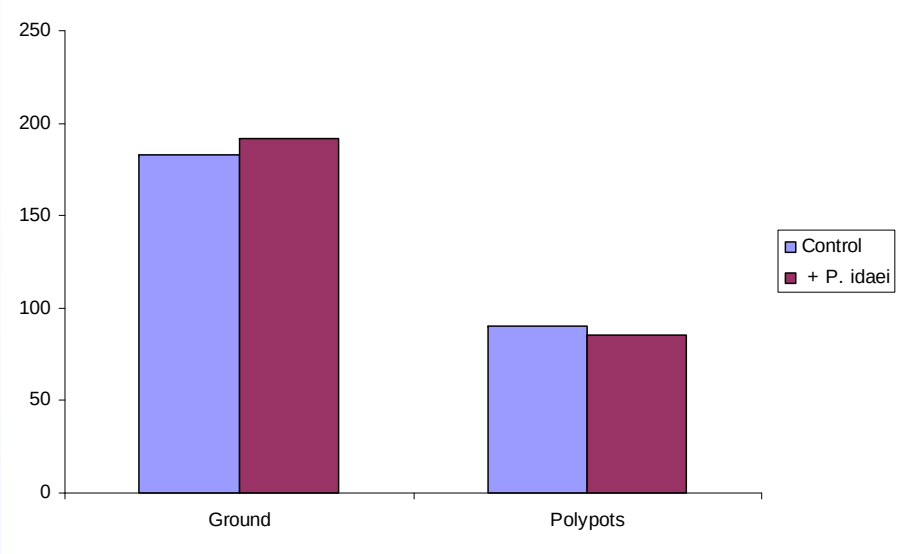
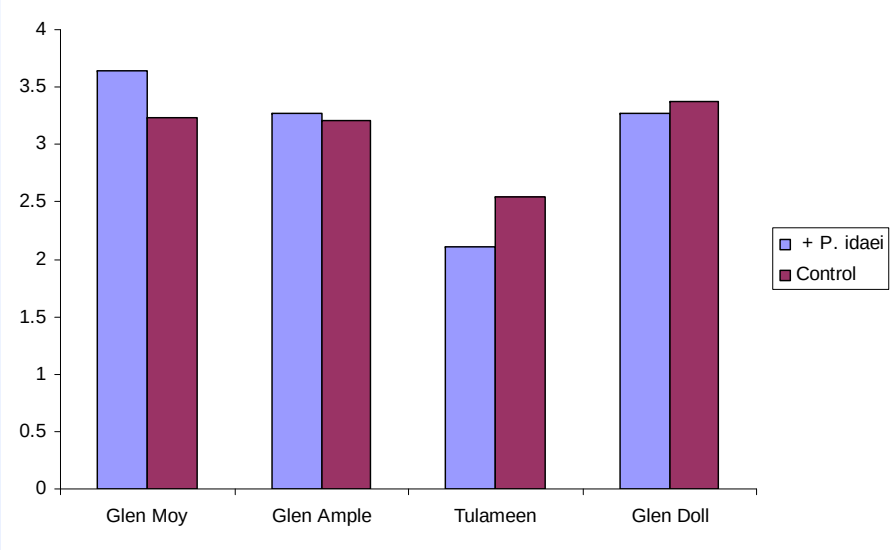
2008 Crop growth

- Bud break unaffected
- Plant height unaffected

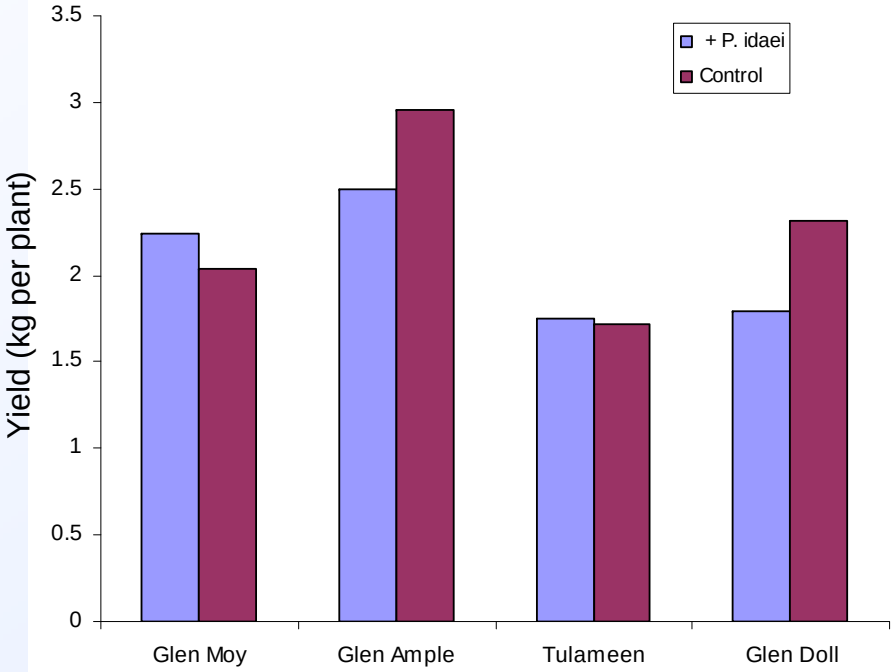


- Primocane number unaffected



2008 Fruit yield

- Hand-picked many times
- Ground better than poly-pots
- Tunnel better than open
- Glen Ample highest yield
- *P. idaei* reduced mean yield in two of four cultivars. Only in Glen Doll was this statistically significant
- Note – single years data only



	+ P. idaei	Control
Glen Moy	2.241 (11.2)	2.043 (10.2)
Glen Ample	2.498 (12.5)	2.953 (14.8)
Tulameen	1.754 (8.8)	1.713 (8.6)
Glen Doll	1.793 (9.0)	2.320 (11.6)
Mean	2.071 (10.4)	2.257 (11.3)

Table Comparison of mean fruit yield given as kg per plant and equivalent tonnes per ha (in brackets) of four cultivars in response to *P. idaei* inoculation.

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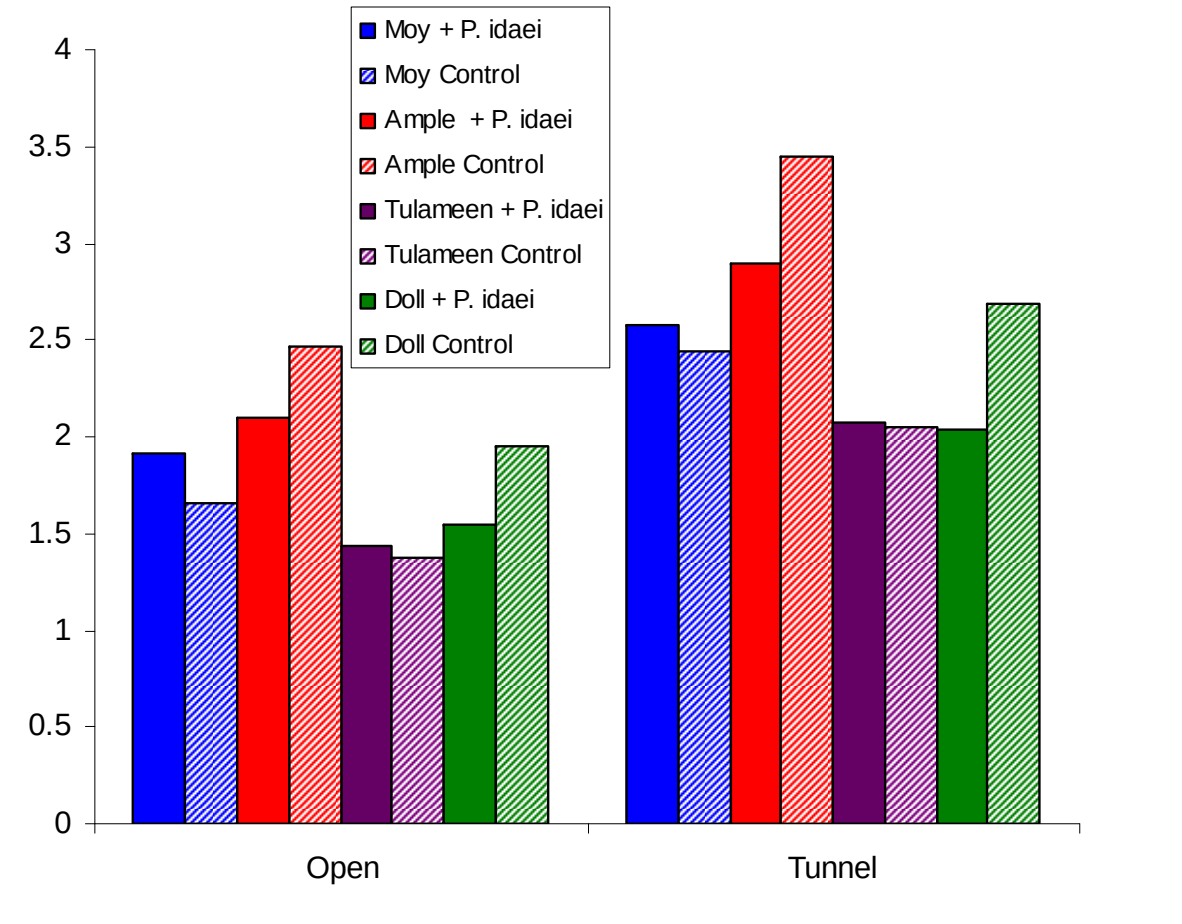
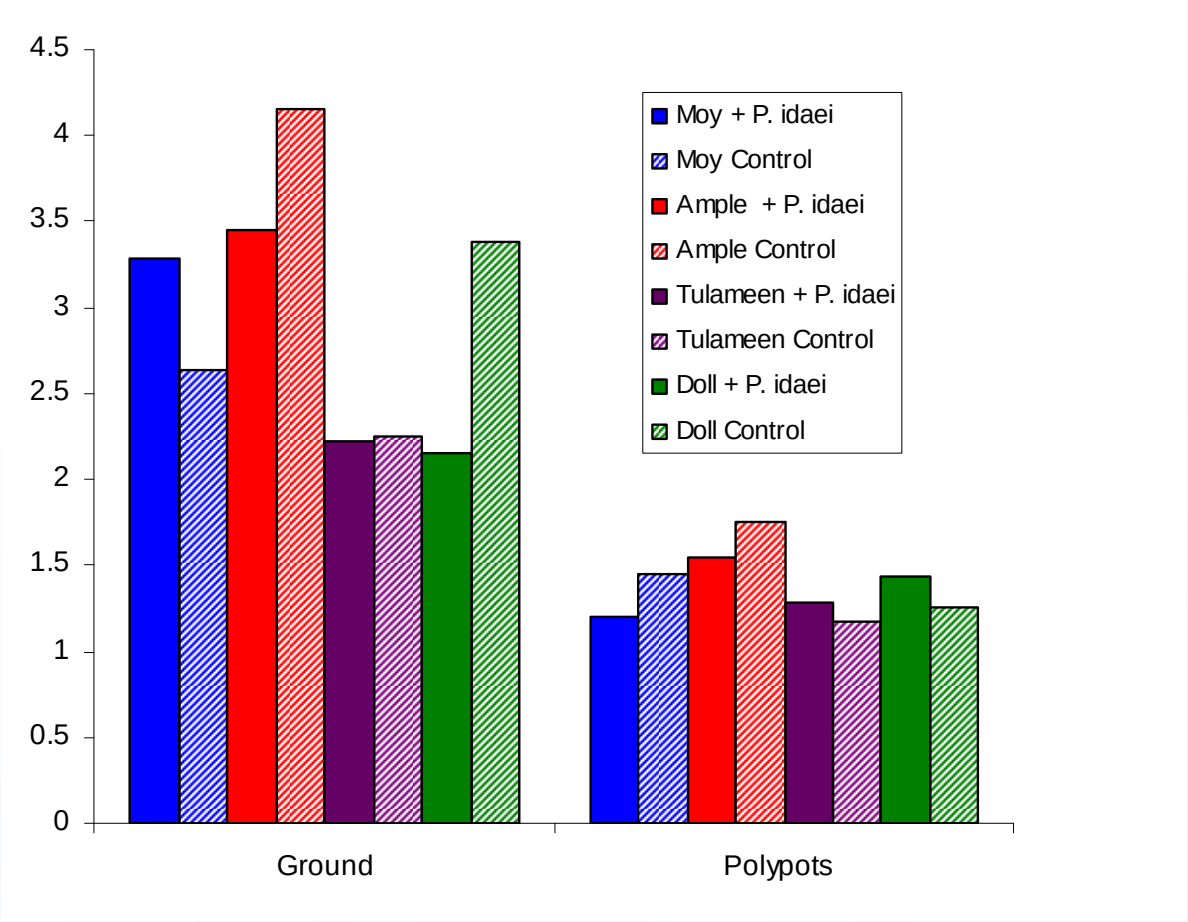
2008 Fruit yield



2008 Fruit yield



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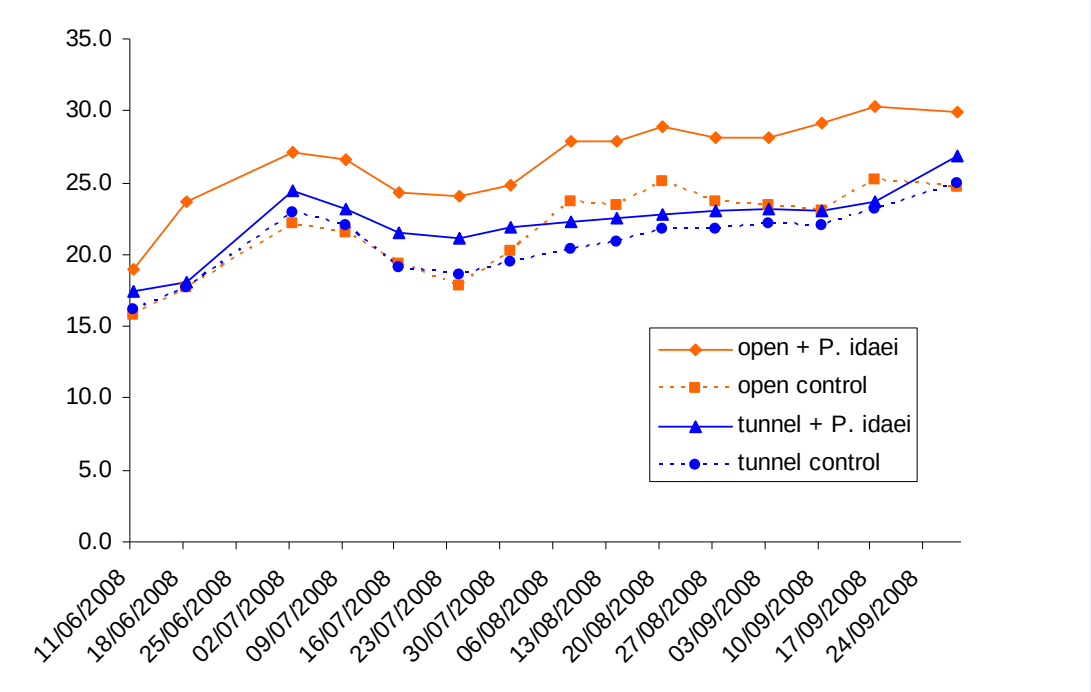
2008 Met. data

- Poly-pot moisture readings in 2008 unaffected by pathogen (data not shown)
- Soil moisture at 200mm depth in ground-grown plants showed soil wetter beneath inoculated plants (as in 2007)



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Conclusions

- *P. idaei* relatively minor impact - not as aggressive as *P. rubi*.
- A different picture may be seen under water or nutrient stress
- No clear differences in resistance amongst the five cvs. tested
- No clear differences in amount of root damage caused under different growing conditions in the field trial
- Pattern of pathogen spread (especially in polypots) unlike that seen in *P. rubi* (air-borne inoculum?)
- The planting of pathogen-free certified planting material is still advisable to minimise the risk of root and crop damage. (Interaction with *P. rubi*?)

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General points and feedback

- Useful to know more about the origins and current distribution
- Urgent need in the industry for more effective fungicides to manage *Phytophthora* diseases in raspberry
- Options for resistance breeding aginst *P. idaei* seem limited.
- Raspberry genotypes resistant to *P. rubi* are not necessarily resistant to *P. idaei*.

- Feedback welcomed on your experiences

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