THE JOINT FORCES OF CSIRO & SCION

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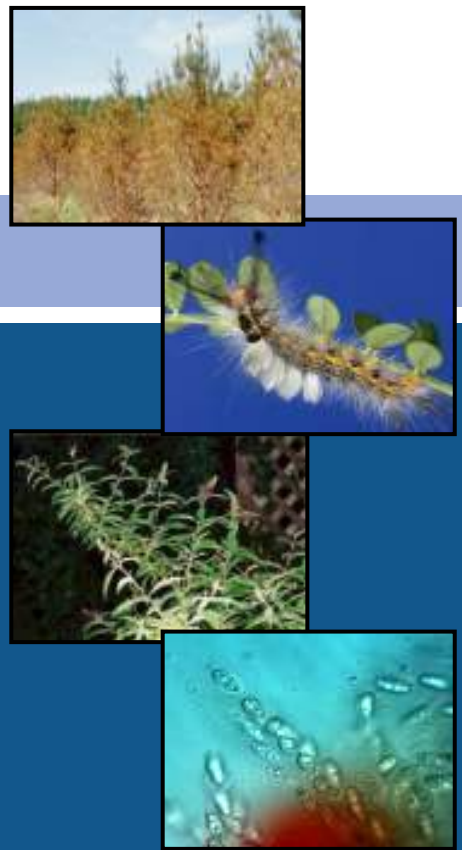
Group Leader



Forest Biosecurity and Protection

FBRC/FIDA RESEARCH ~ Ensis Forest Biosecurity and Protection Unit

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Pitch Canker – *Fusarium circinatum*

- Can be a severe nursery and plantation disease of pine and Douglas fir
- Present in USA (SE and California), South Africa, Spain, Chile, Haiti, Korea, Japan and Mexico
- Needs wound, vector, suitable environmental conditions, and other factors to cause severe disease

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Chile: nursery-based case study for New Zealand

- Some parts of Chile and NZ have similar growing climate
- First observed in Chile in 2001 but probably introduced during 1990s in seed from Mexico
- Present in 9 nurseries
  - central region only
- Has not spread into the plantations

PC situation: nursery

- Maximum losses since 2001
  - Container cuttings – 14.6% (2004)
  - Bare-root cuttings – 0.14% (2004)
  - Container seedlings – 4.7% (2002)
  - Bare-root seedlings – 7.7% (2003)
  - Stool beds – 46.0% (2003)

- Thought to be transmitted via contaminated soil

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PC situation: plantations

- Some “healthy” outplanted seedlings from infected nurseries develop PC in the field
- These seedlings were likely infected in the nursery but the disease has gone undetected or the pathogen has a “latent” stage of infection.
- The disease is not spreading from tree to tree = not establishing
- Central Chile – very dry, hot climate

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Pitch canker - future outlook

- Increased moisture in the central region, or spread of infected material to more southern areas of Chile, would probably result in a major outbreak of pitch canker in the plantations
- In Chile, *F. circinatum* could be eradicated from the nurseries
  - current practice is to ‘maintain’ - happy to accept current plant loss
- For NZ, swift action and stringent sanitation procedures could prevent spread between nurseries and to adjacent forest lands.

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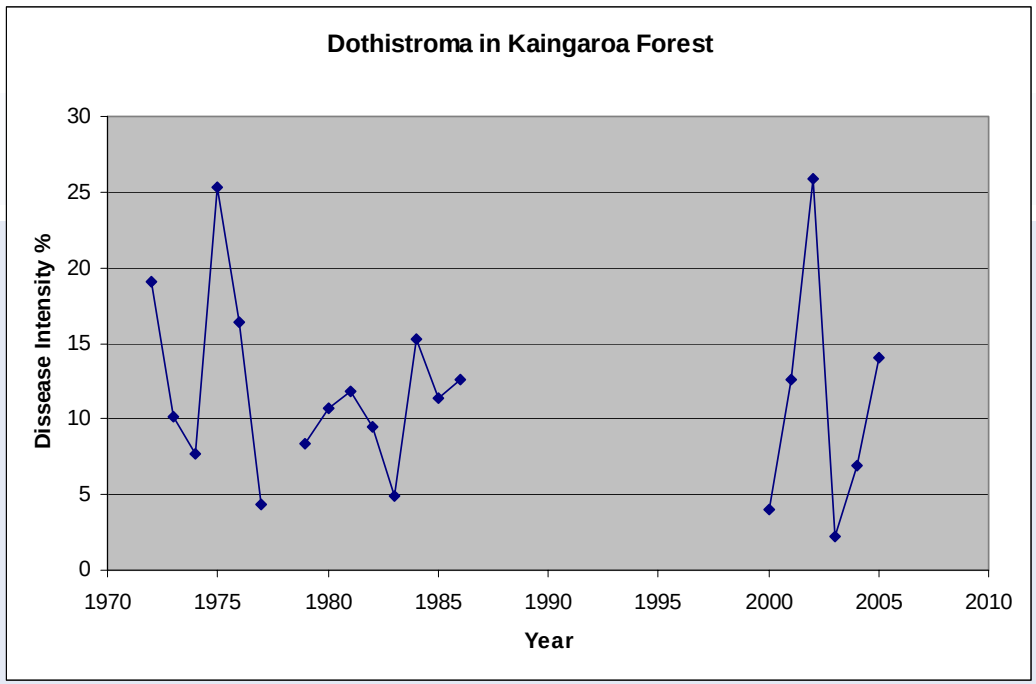
Sampling Efficiency for Forest Health Assessment and Pest Detection

Aims

- Assess the impact of different sampling intensities upon confidence/variance in estimates of forest health assessments
- Assess the impact of sampling intensities upon the ability to detect newly arrived pests

Sampling efficiency - Aerial Survey for Dothistroma in Kaingaroa



- Significant inter-annual variation in disease intensity

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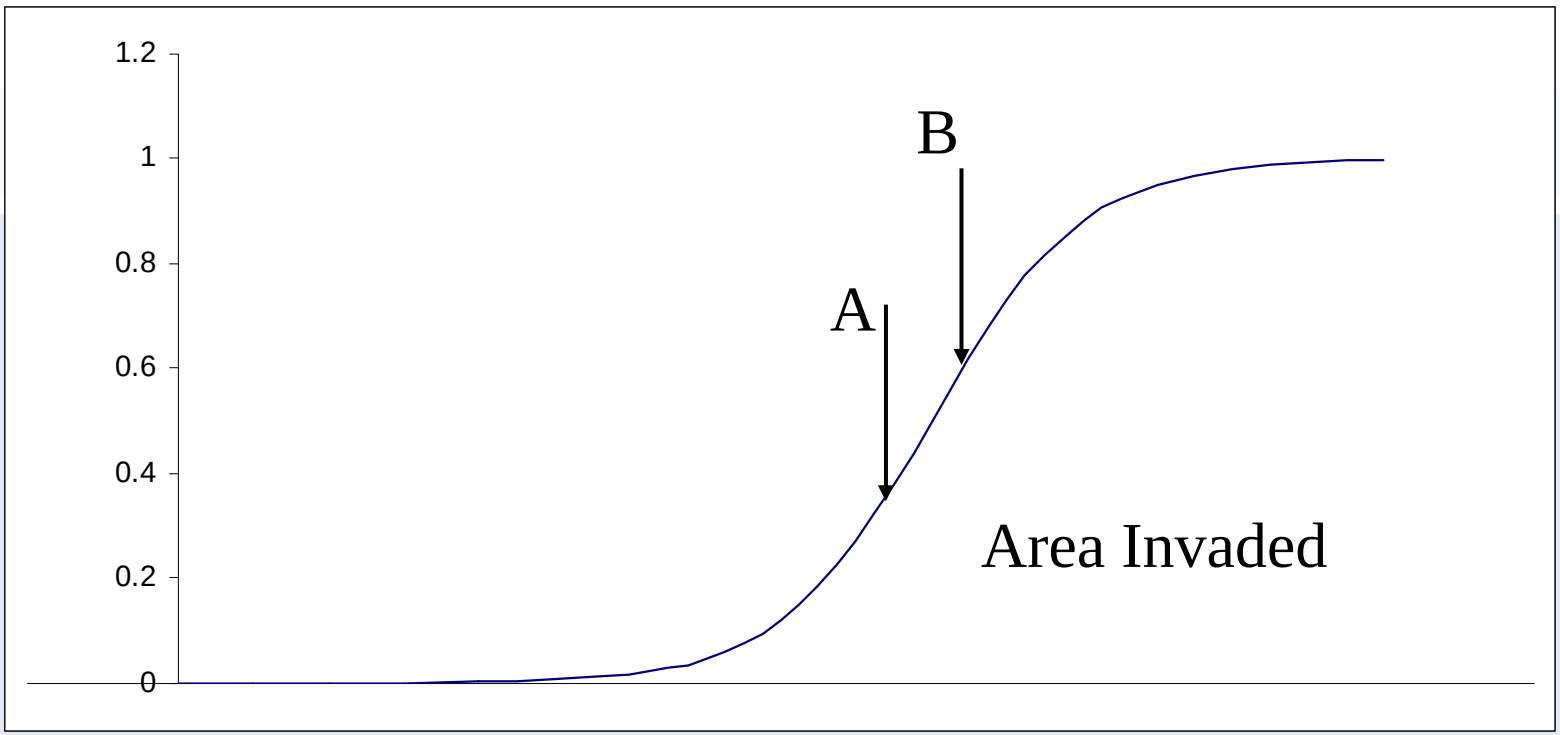
Sampling efficiency - Methods

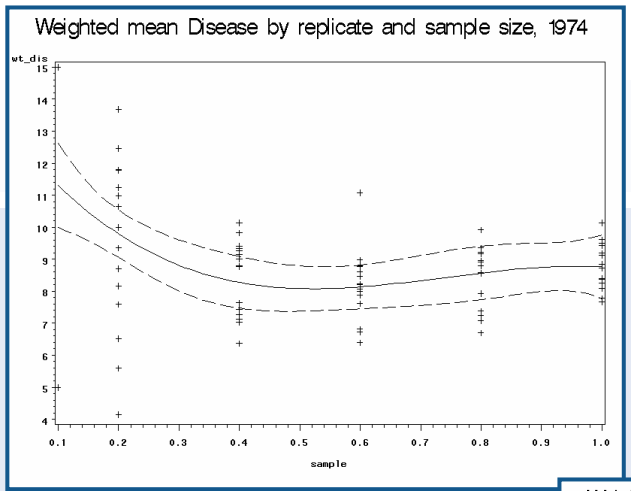
- Using aerial survey data for Dothistroma in Kaingaroa forest from 1972 to 2005 (some gaps), estimate overall forest disease severity by randomly sampling stands at different intensities
- For a single year, test the effect of overall forest size on the relationship between variance and survey intensity
- Apply that framework using Cyclaneusma and physiological needle blight data over two years
- Use pest spread models and see how far various pests spread before being detected, using varying sampling intensities

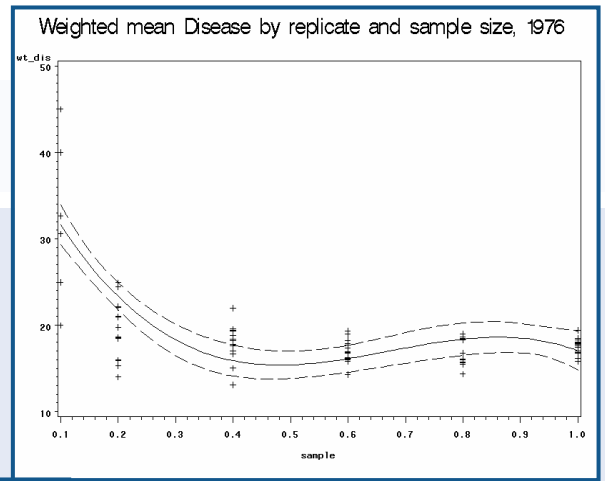
Later detection = more area invaded before a response is considered = poor eradication chances

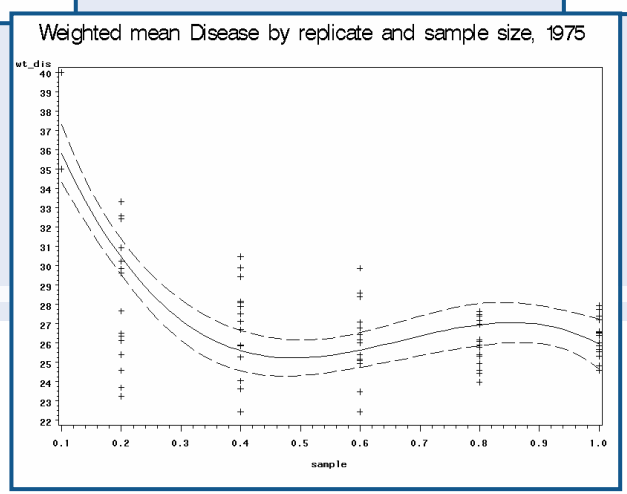


Sampling intensity and error

- Effect of sampling intensity on variance of estimates completed for fixed forest size







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Sampling efficiency - Progress

- Error terms calculated for a large forest
- Forest sub-units sampled, data partly analysed
- Dothistroma data explored for suitability to build a weather-based model of dynamics
- Arranged data for use in a PestSpread model
- Cyclaneusma and PNB datasets compiled

Nursery surveillance

Method

- Review historical pest incursions and findings
- Carry out monthly assessments – record pest damage and test repeatability and efficacy of inspections

Nursery surveillance

Pathway risk

- Nurseries have been implicated in the introduction and spread of pests – i.e. seed, scion, whole plants, growing medium
- In North America and Europe, devastating introductions – white pine blister rust, chestnut blight, SOD, etc.
- New Zealand - pitch canker fungus in asymptomatic Douglas fir scion material. Its discovery is an example of effective biosecurity
- The systems in New Zealand that restrict or monitor plant material appear to be working well. However there is clearly a need to maintain stringent control

Nursery surveillance

Biosecurity Risk

- An incursion of pitch canker is likely to show early in the growing season. Therefore one pre-lift survey for detection of new introductions may be too late to prevent spread
- There is a high level of awareness among nursery growers of pitch canker and of other nursery problems. It is expected that growers will recognise uncharacteristic symptoms and send them in for diagnosis
- Therefore biosecurity risk is low

Nursery surveillance

Plant Health

- Some early season pests and disorders may be missed by a pre-lift survey but this is unimportant. Disorders such as Phytophthora root rot and Dothistroma are relevant to forest growers and the focus should be on these.
- Altering the timing or the frequency of nursery inspections would not provide additional knowledge of disorders that might affect selection for planting out
- **Summary:** The focus of surveys should be on plant health, not new incursions

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Nectria research

Research areas

- Surveys
- Control and mitigation
- Infection process and ecology
- Host susceptibility and response

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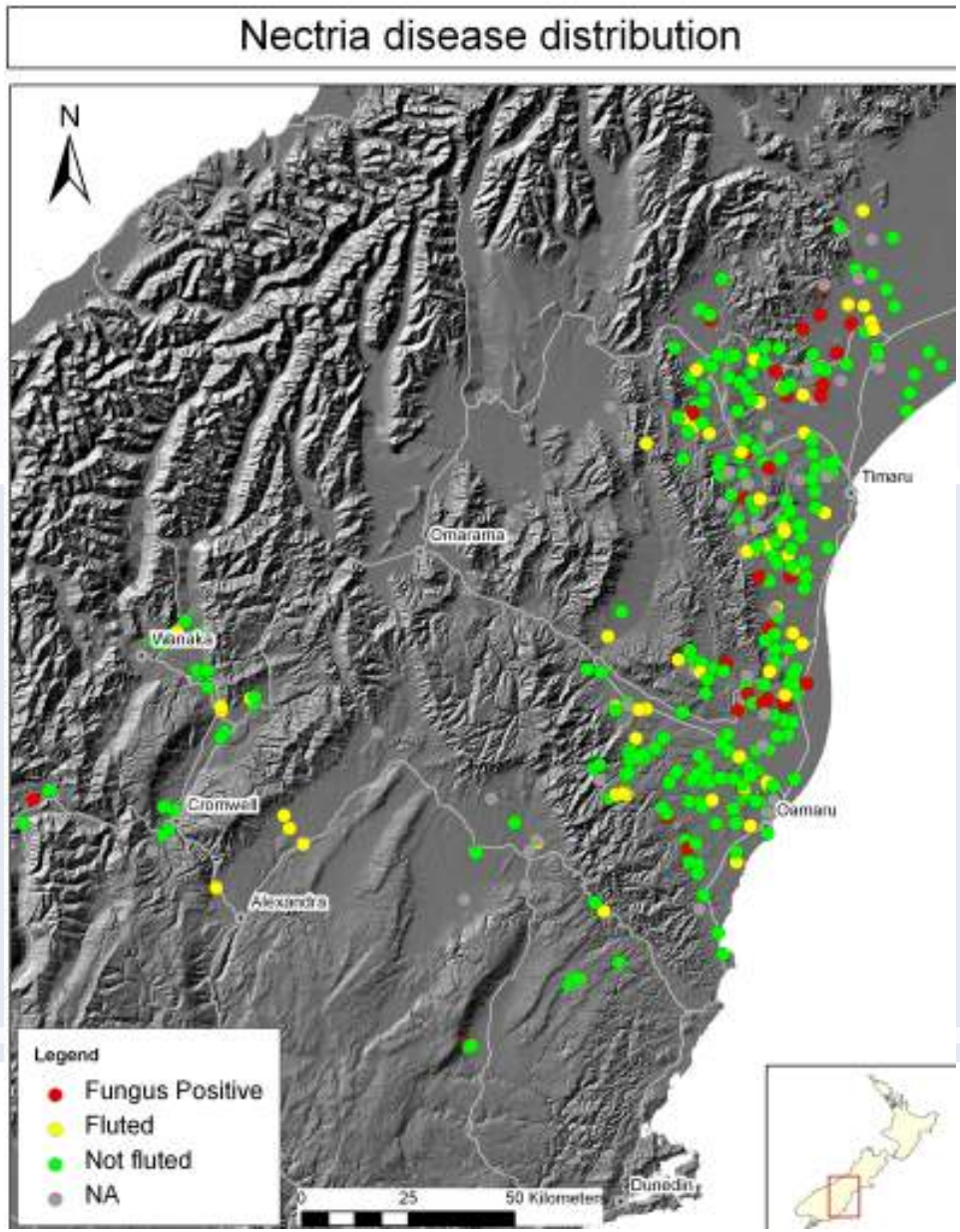
Nectria research

Delimiting Survey

- Initial survey completed 26 February 2006
- Fluting and Nectria distributed throughout inspection zone, but less common in Central Otago
- The survey was extended northwards in November 2006
- Further extensions will be made in April 2007



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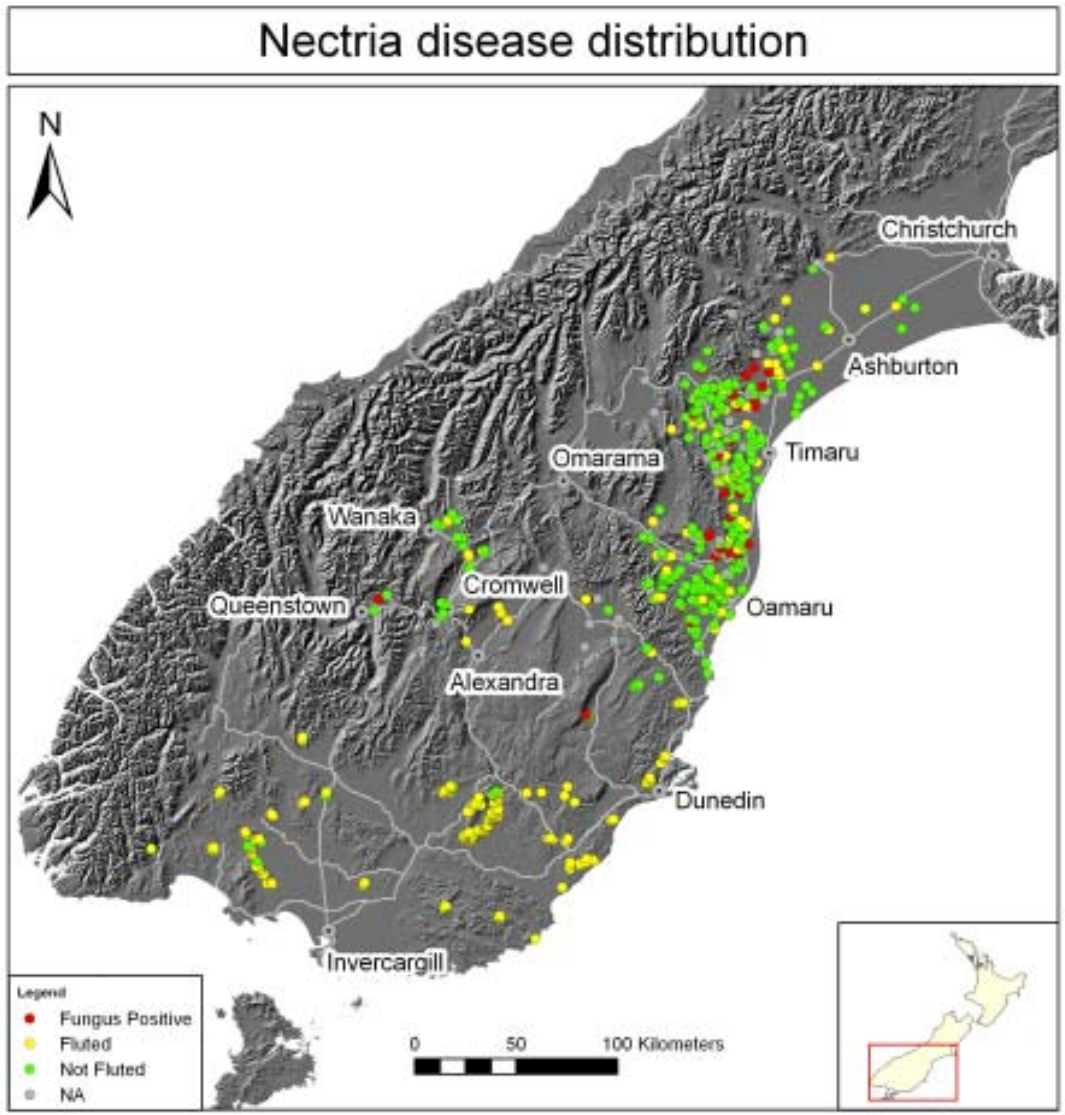
Nectria research

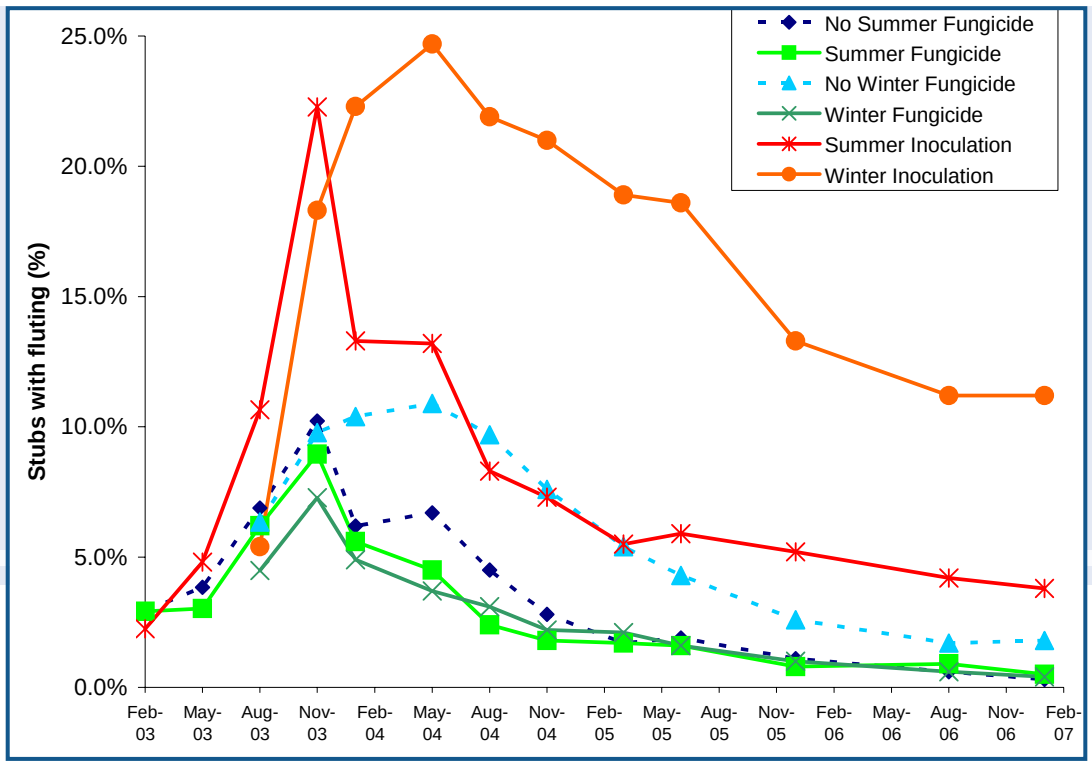
Regional incidence Survey

- Ongoing, due for completion March 2007
- Samples not sent in for confirmation
- Fluting much more common in Otago/Southland than South Canterbury.
- Data will be used for habitat preference, ecology, and economic impact work



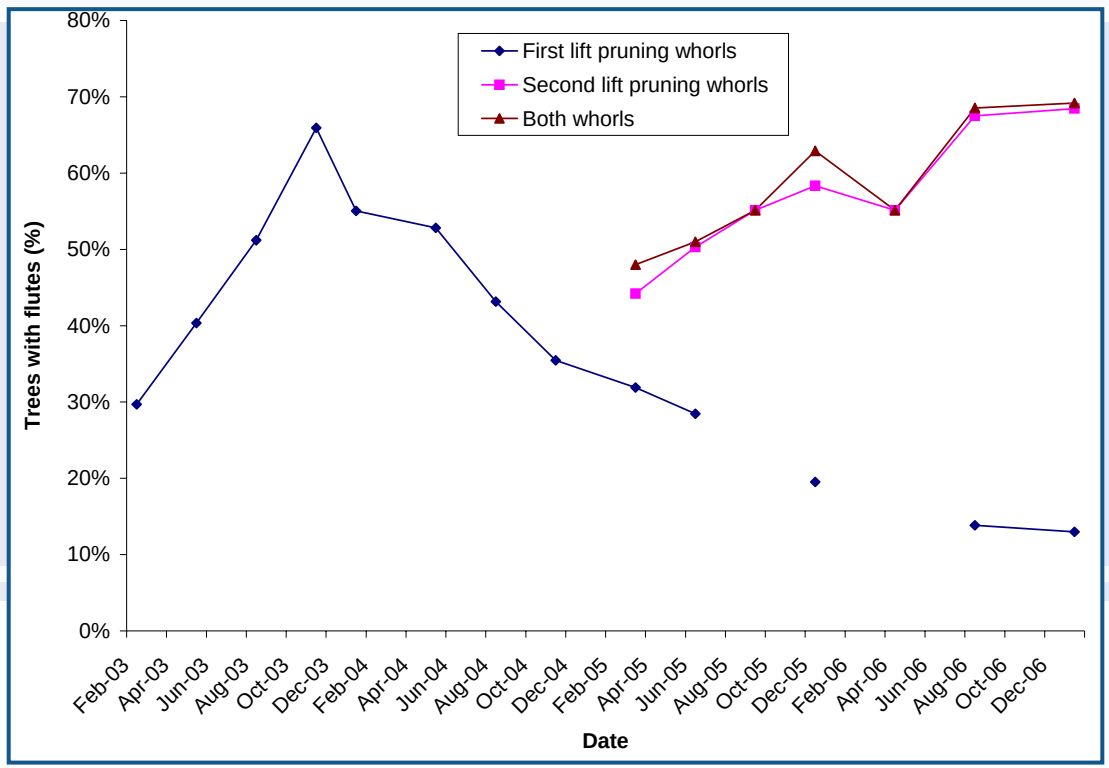
Nectria research – pruned stub trial

- Treatments: prune, inoculate, protect in summer and winter
- Fluting initially increased and then decreased
- Winter treatments resulted in more fluting
- Winter inoculation statistically different from other treatments



Pruned stub trial – disease progress

- Percentage of affected trees increased after first prune and then reduced
- Incidence increased after second prune
- 30% and 45% of trees had some flutes immediately after pruning

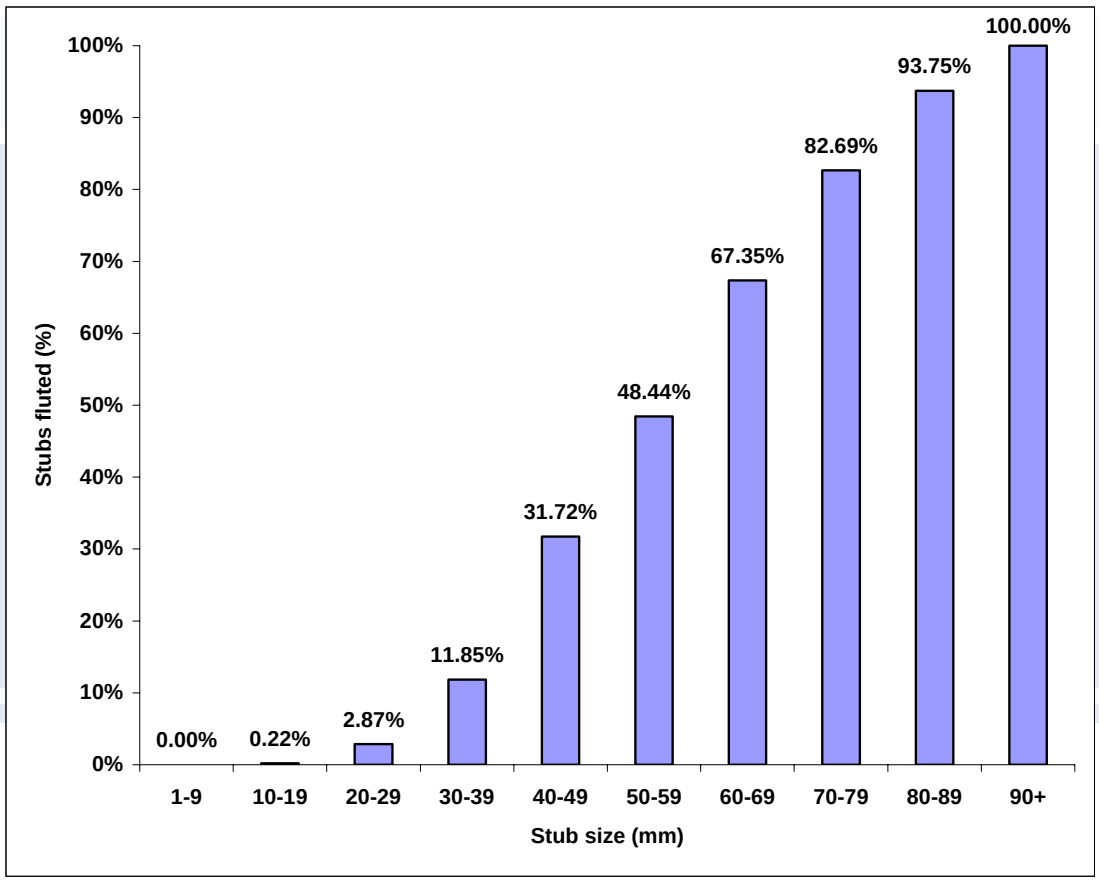


Disease development

- Flutes – pruning took place just before this photograph was taken (not from the pruned stub trial)
- Flutes associated with large stubs

Pruned stub trial – effect of stub size

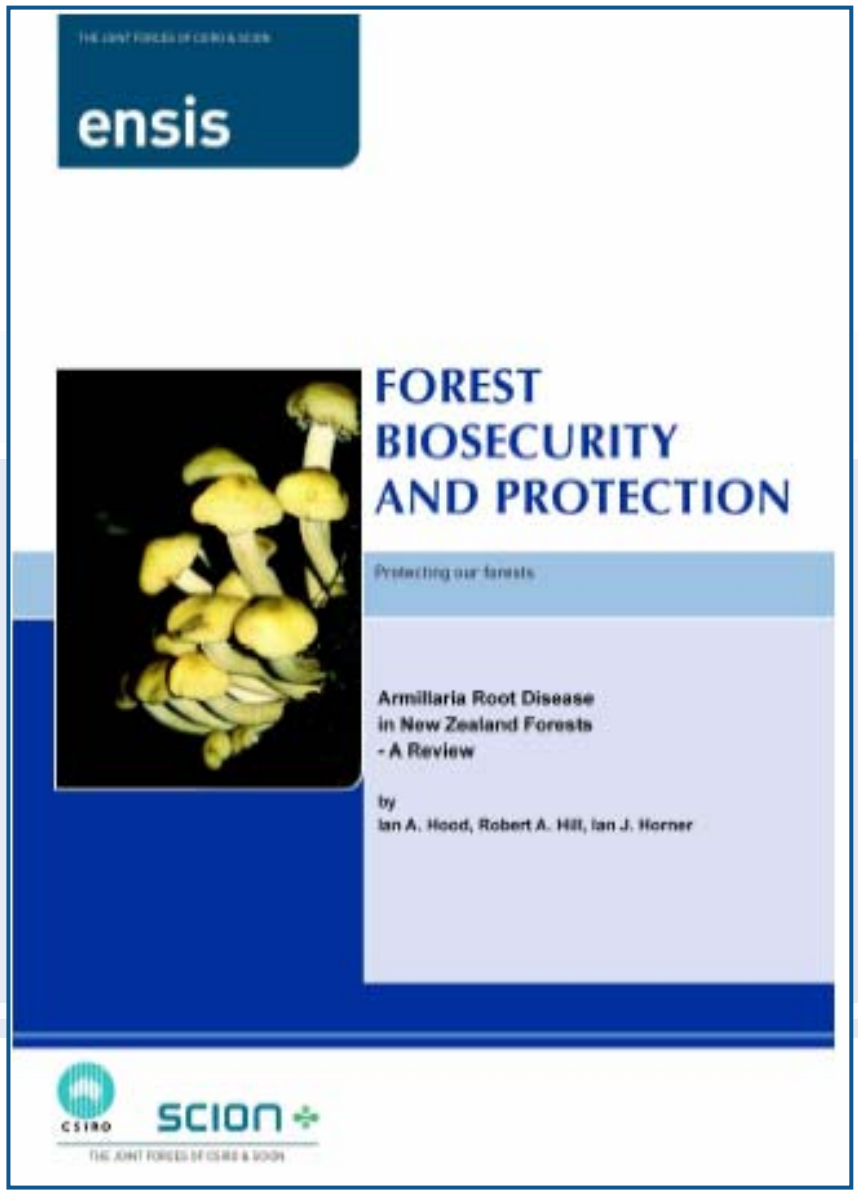
- From second lift whorls, incidence of flutes is low in stubs smaller than 30 mm



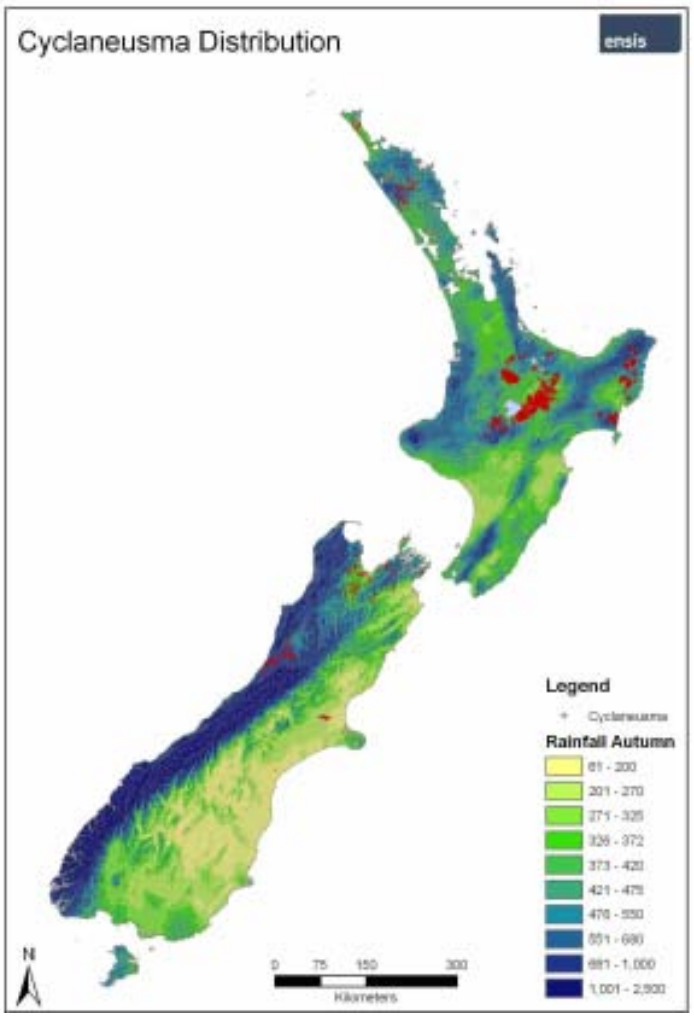
Armillaria review

Review Armillaria research

- Aim: To develop a strategy for future research
- Report completed September 2006
- Ian Hood - Ensis
- Robert Hill - Biodiscovery
- Ian Horner - HortResearch



Cyclaneusma



Economic impact assessment

- Aerial survey completed throughout NZ in 2005 and 2006
- 2005 was a low impact year – almost no Cyclaneusma in Northland, low levels elsewhere except CNI
- In 2006, Northland again low, CNI high, East Cape medium-high
- Pest impact assessment in progress

Cause of Physiological Needle Blight

Hypothesis:

PNB is caused by needle water stress in early spring

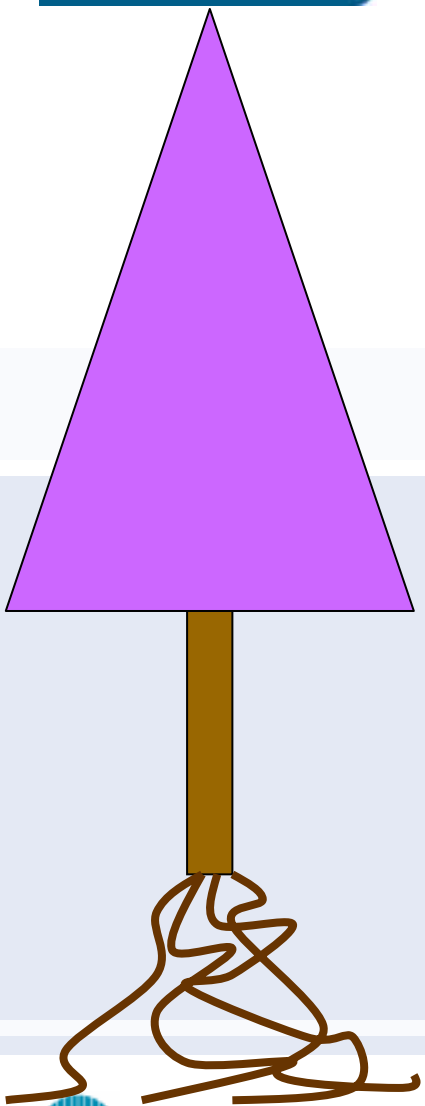
Question:

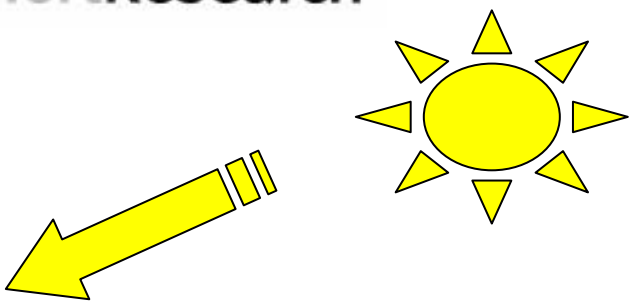
Do large water potential gradients from roots to needles cause cavitations in xylem water columns?

Problems:

Predicting where PNB is going to occur

Whole plant water relations on large trees





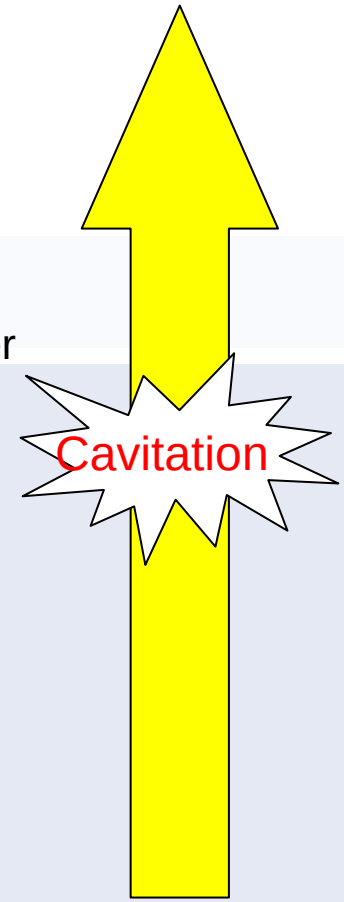
High air temperature and irradiance in spring

= low water potential?

Cold anoxic roots, little new growth = high water potential?

Low water potential in needles

Large water potential gradient root to shoot



High soil water availability

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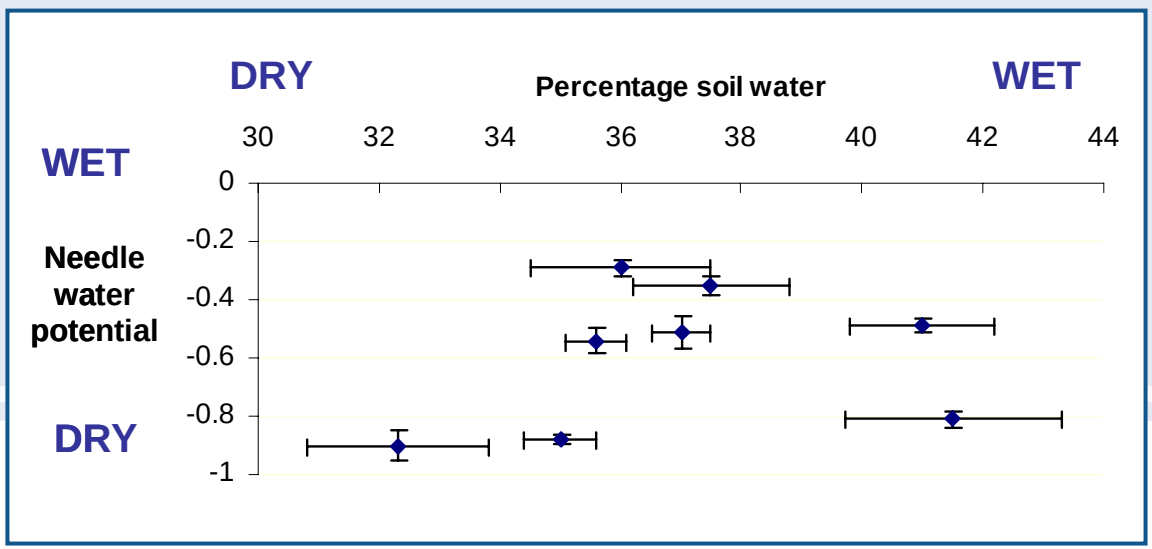
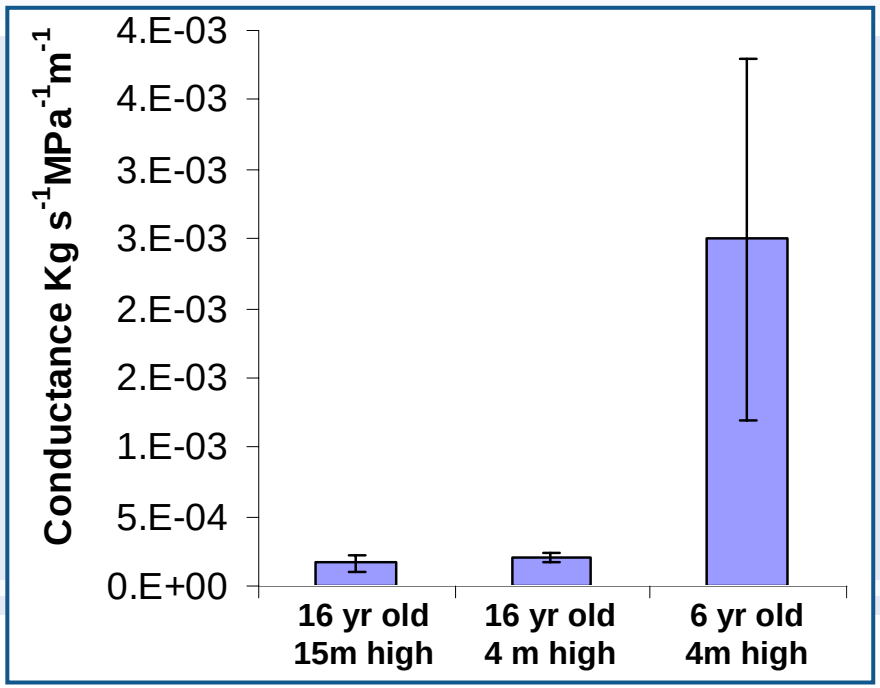
Water uptake into needles

- Does soil water availability relate to needle water status?
- Soil water content and needle water potential measured in winter/early spring
- **High soil water availability does not necessarily provide needles with high water status**



- Pathway conductance from branch to needles reduced in older trees
- Older trees more prone to cavitation at branch/needle junction?



Further work

- Create extreme winter/spring conditions in the lab to induce large root to shoot water potentials and monitor susceptibility to cavitations
- Select trees with PNB history
  - Measure root and shoot water potential through winter and spring
  - Correlate soil water content, soil temperature, air temperature, and humidity with water potential measurements
- Ensis project started in Tasmania looking at a similar hypothesis – shoot/root temperature differentials in spring leads to stress

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Acknowledgments

Pitch canker - *Beccy Ganley, Margaret Dick*

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Cyclaneusma - *Lindsay Bulman, Sam Alcaraz*

PNB - *Nick Gould (HortResearch), Lindsay Bulman, Margaret Dick, Chris Beadle*

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