Eucalypt Health: Defoliation impacts, selection & monitoring

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Threats to Eucalypt Health

- Abiotic drought / frost tolerance etc.
- Biotic insect pests & disease

Mortality
Limit productivity
Reduce wood quantity & quality
Interactions with heartwood?

NZDFI & Eucalypt Health

- Future-proofing developing industry by reducing & mitigating risks
- Minimise impacts
 - Select for pest tolerance
 - Optimise tree vigour
- Maximise sustainability
 - Effective pest monitoring
 - Economically & environmentally sustainable management



Pests are inevitable;



Pests are inevitable;

Ongoing risk:

- Proximity to source 1800 km
- Prevailing weather
- Climatic similarity
- Trade & travel
- Food resource
- Enemy release





Close et al 1978: Int. I J Biometerology 22

Pest impact is not

- All crops subject to pests to some degree
- ~450 insect species feed on Pinus
- ~147 in NZ of which 40 can feed on radiata



"... to ignore the notorious susceptibility of *P. radiata* to insects and fungi, the extreme vulnerability of the extensive monoculture in which it occurs ... is tantamount to challenging all the laws of Nature"

Canadian biologist J. J. de Gryse (1955) forest health program report commissioned by NZFS

Sirex wood wasp



Site matching, stand management, biocontrol

Insect Threats to Eucalypts

- Most damaging = leaf beetles
 - Paropsis charybdis 1916
 - Trachymela sloanei 1976
 - Trachymela catenata 1992
 - Paropsisterna beata 2012
 - Paropsisteran variicollis 2016
- + 13 others intercepted since 1955
- > 400 species native to Australia
 Can we manage the risk?





Paropsis charybdis

- Impeded early industry
- Still outbreaks in central NI
- Site matching & biocontrol





Not all leaf beetles are equal



Reducing Pest Risks

- `Thrive in the presence of established & future pests'
- Established pests response to new hosts & environments unknown
- Future pests unpredictable
- Pest mitigation must be;
 - Effective
 - Feasible
 - Environmentally favourable
 - Socially acceptable



1) Selection for Pest Tolerance

- NZDFI species not commercially grown limited pest information
 - *E. argophlioa* poor host for
 P. atomaria (common AU pest)
 - E. tricarpa sideroxylonals variable & heritable = good basis for breeding for pest tolerance







1) Selection for Pest Tolerance

Eucalypts - vary in nutritional, physical, chemical characteristics

- Eucalypt defoliators vary in time & space
 - Food /stage preferences
 - Host species composition
 - Interactions with environment
- Assess variation
- Identify most pest tolerant breeds from those selected for elite wood & growth properties



General Tolerance - Programme

- Part 1: screen un-improved genotypes for one species to develop assessment method
- Part 2: roll out screening across species & genotypes in as many sites as possible to inform selections
- Part 3: screen improved selections to confirm selection choices
- Part 4: repeat screening of initial material to determine the ability of early assessment to represent health & growth later in the rotation

Natural variation in E. bosistoana

- Genetic susceptibility to 4 pest species
- 200 E. bosistoana, 15 families
- 2 assessment methods compared over 2 yrs







Preliminary Results

- Some families are showing more / less tolerance
- Aim rank all families for pest load and impact
- Future links to chemical traits?



Specific Tolerance - Eucalyptus variegated beetle

- January 2017
 - 3 HB trial sites assessed
 - 11 eucalypt species
- Level of chewing damage
 Other species present
- OLS eggs, larvae, adults





Specific Tolerance - Eucalyptus variegated beetle

- Parasitism observed
- All species chewed0% 60% defoliation
- Degree of damage variable
 between & within sites
- Eggs/larvae minimal & variable
 - = basis for selection





Site A Site B Site C Site A Site B Site C Site A Site B Site C

2) Pest Monitoring & Management

- Understanding link between defoliation & impact
 - How much defoliation can eucalypts withstand?
 - In which part of season?
 - In which part of rotation?
- Determining action thresholds
 - Understand regional pest phenology
 - Quantify links between pest numbers & future impacts
 - Optimise monitoring methods

Defoliation Trial

• How does *E. bosistoana* tolerate and recover from defoliation?

- Is it worth controlling pests?
- When decision point?

Manual leaf removal:

- Mimic chewing defoliators
- Severity 0%, 50%, 90%
- Timing spring, late summer, both
- Total 140 trees, 20 per treatment





50% Moderate

90% Severe

Natural defoliation

Timing & Severity

- Moderate spring = small growth reduction
- Severe spring = larger reduction
- Late summer severity less important (equally -ve)



Frequency & Severity

Moderate matches severe if repeat in late summer





Frequency & Severity

- Spring event reduces stem growth
- Late summer repeat prevents recovery
- Stronger effect with more severe defoliation



Eucalypt health programme:

- Pests (& disease) inevitable
- Variation in preferences & tree susceptibility
- Novel associations to be formed
- NZDFI opportunity
 - Identify & reduce variation in breeding program
 - Understand impacts to prevent unnecessary action
 - Optimise monitoring methods \rightarrow efficient tools
 - Develop regional action thresholds → sustainable management

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breeding tomorrow's trees today





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