



Forest Biosecurity and Protection

Cyclaneusma needle-cast ~ current knowledge and knowledge gaps

March 2005

Symptoms

- **Scattered individual trees are affected within a stand – susceptibility varies considerably between individuals**
- **The same individuals are affected from year to year**
- **Needles turn yellow, then brown**
- **Symptoms are visible in September/October, and April/May**
- **Needles detach very easily**



Infection process

- Needles are susceptible to infection when >6 months old
- Main infection period is autumn/early winter
- Needles are cast primarily in spring, but a less severe cast occurs in autumn – resulting in two peak spore periods
- The autumn cast produces spores that continue the infection cycle because current year needles are susceptible to infection then
- Spores are produced throughout the year, after rainfall, on needles that are on the ground. Spores are airborne, so travel long distances
- Therefore: wet mild weather in autumn/early winter will lead to heavy needle-cast in spring



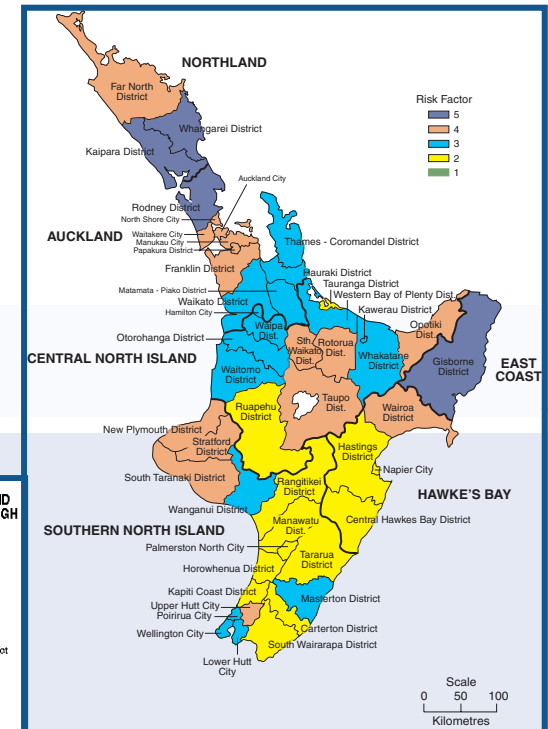
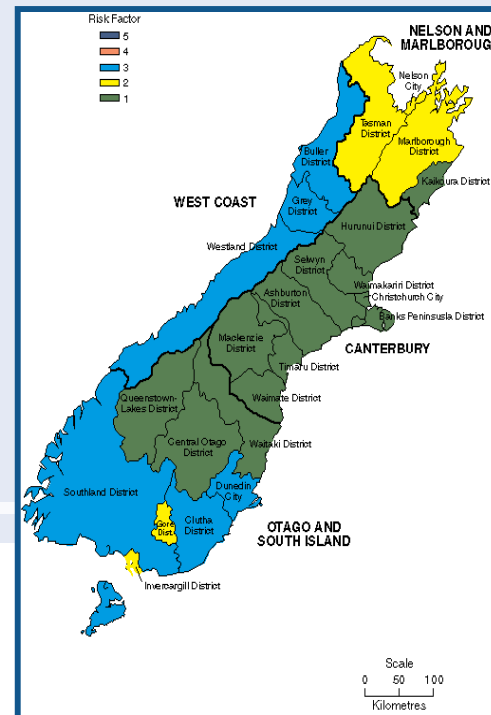
Population variation

- Morphological differences indicate that there are at least two types in New Zealand
- *C. minus* 'simile' is more common than *C. minus* 'verum'
- *C. minus* 'simile' is found more often in the North Island



Distribution

- Auckland and Northland, East Cape, Bay of Plenty are the most severely affected regions (approx. 20% of trees have disease severity of over 40%)
- Hawke's Bay, Canterbury, Nelson have the least disease



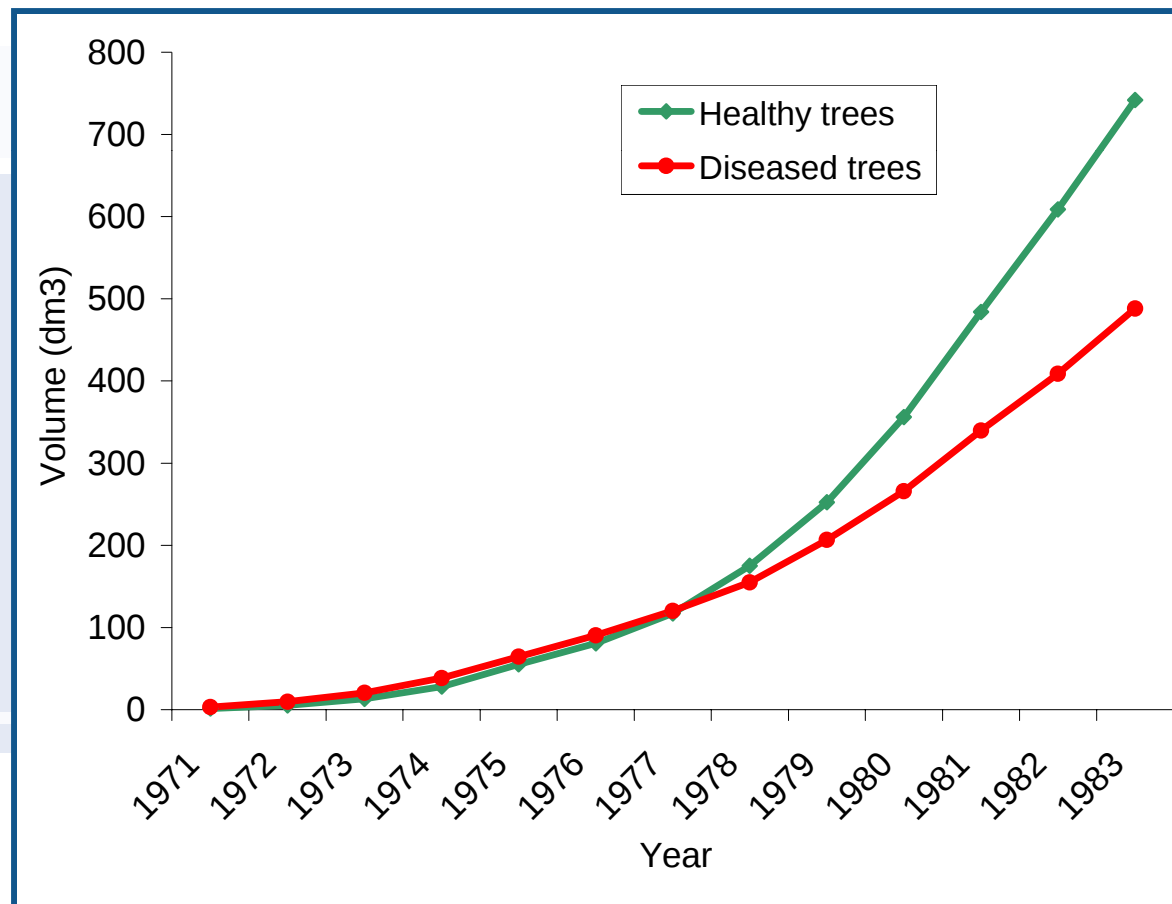
Microsite and crop effects

- Disease severity is worst in moist sites (i.e. gullies or high altitude sites prone to mist)
- Disease is most severe in trees aged between 6 and 15 years.
- Trees younger than 6 years or older than 20 years are rarely affected

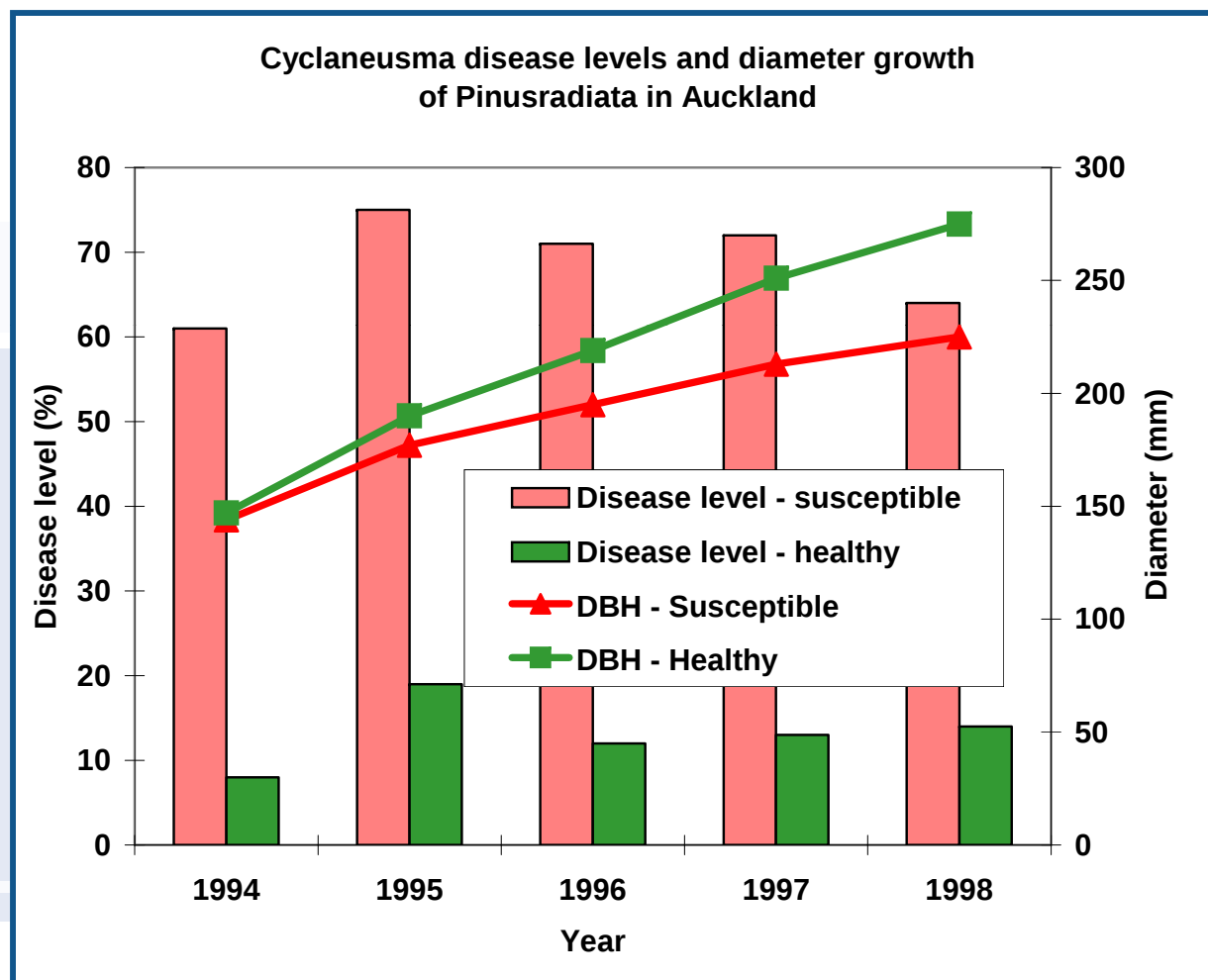


Impact – volume growth loss

- **Cyclaneusma causes significant growth loss – average disease of 80% resulted in 60% volume loss**



Impact – diameter growth loss



Impact – value loss

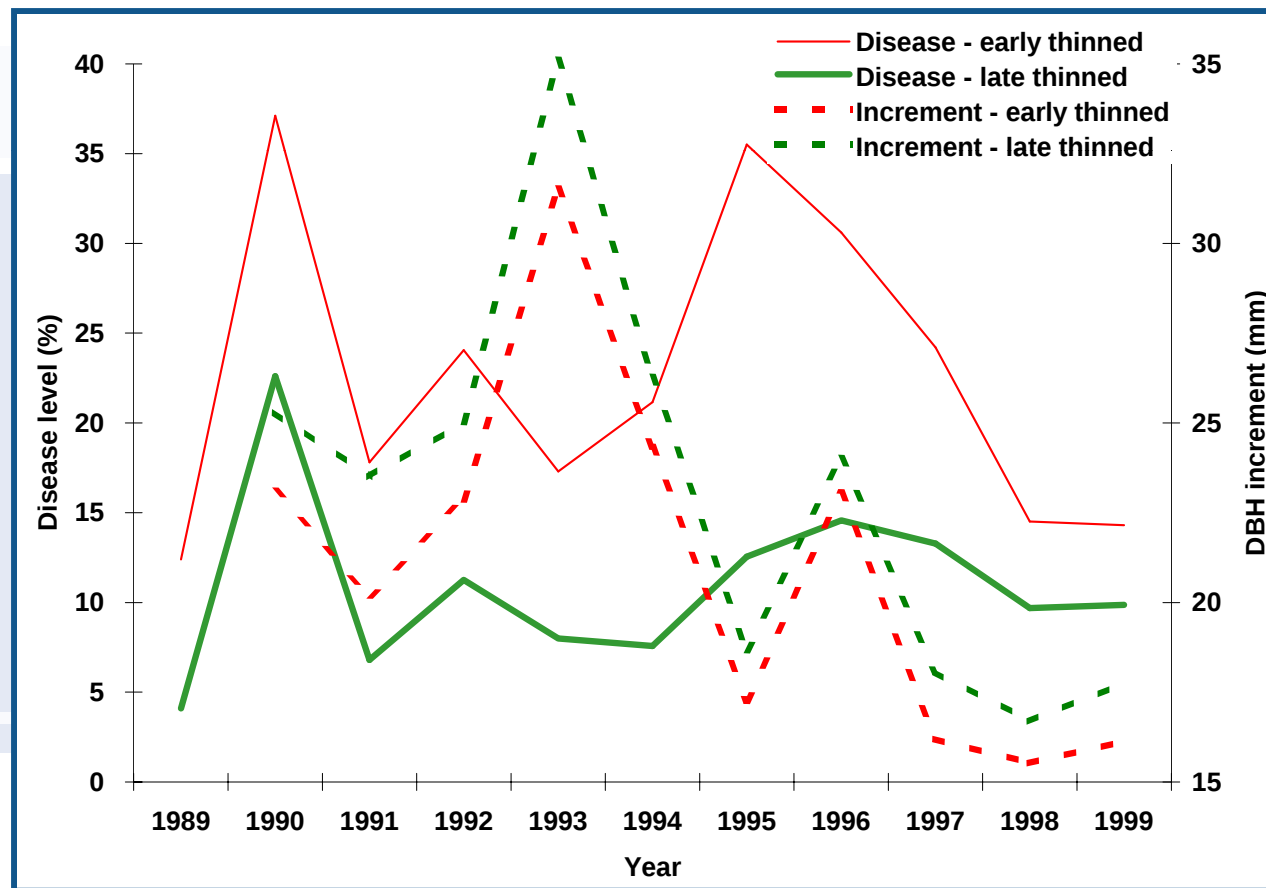
- **When 50% of the crop is diseased, revenue reduction of \$3,200-\$3,600/ha may be expected (1984 dollars)**
- **Average loss in volume of 6.5% per annum is estimated for the national estate aged between 6 and 20 years**
- **Financial loss is estimated to be \$60m per annum**

- Aerial spraying can be effective, but very expensive
- Pruning has no effect, because spores are released from needles in litter
- Genetic selection has focused on needle retention and not specifically *Cyclaneusma*
- Selections from dry areas had poorer needle retention and growth when planted in *Cyclaneusma*-prone regions
- However, selection for *Cyclaneusma* resistance has resulted – *Pinus radiata* from the Cambria provenance was identified as highly susceptible to needle-cast and removed from the breeding programme

- **Selective thinning removes susceptible trees**
- **Selection must be carried out when symptoms are present – in Spring and when trees are at least 6 years old**

Treatment		Disease incidence (%)	Disease severity (%)
Thinned age 4 or 5	After first thinning	48	64
Thinned age 7 or 8	After first thinning	23	62
Thinned age 10	After second thinning	25	53
Thinned age 10	After second thinning	3	50

- Selective thinning removes susceptible trees resulting in lower disease and increased increment



Knowledge gaps

- **Genetics**

- ▶ Genetic gains specifically for *Cyclaneusma*
- ▶ Inoculation of aged cuttings

- **Population variation**

- ▶ What is the genetic variability of *Cyclaneusma minus* in NZ? How many types exist?

- **Physiological dynamics that cause *Cyclaneusma* to move from an endophyte to a pathogen**

- ▶ *Cyclaneusma* is present in needles of healthy and susceptible trees
 - what initiates and causes disease in susceptible trees?
 - what factors are involved?



Future New Zealand research priorities

- **Genetics**

- ▶ Assessing genetic gains trials specifically for *Cyclaneusma*
- ▶ Establishing new trials in *Cyclaneusma*-prone areas
- ▶ Glasshouse inoculation
- ▶ Gene-assisted selection

- **Selective thinning**

- ▶ Examine economics of selective thinning (i.e. pruning all trees, thinning in spring only, delaying thinning)

- **Effect of infection on wood properties**

Future New Zealand research priorities

- **Habitat preference modelling**

- ▶ Development of a GIS-based overlay to identify high risk microsites at a sub-stand level
- ▶ Use of disease mapping tools (i.e. hyperspectral, digital photographs) with climate/topography overlays
- ▶ Leading to a DSS that enables targeted planting of resistant breeds or alternative species