AI, Chemical Thinning and Precision Forestry in Aotearoa New Zealand

Growing Better Forests with Science, Mathematics and Technology

In the forests of Gisborne, forester Jack Truelock from Aratu Forests is using modern science, mathematics, drones, AI and forestry knowledge to improve the health and productivity of plantation forests.



Meet Forester Jack

Jack's work combines:
Biology
Environmental science
Mathematics and statistics
Digital technologies
Artificial intelligence
Geography and mapping
Health and safety
Sustainability
Students can explore how science and mathematics are used in real forestry operations in New Zealand.

The Challenge: Trees Compete for Resources
Radiata pine trees compete for:

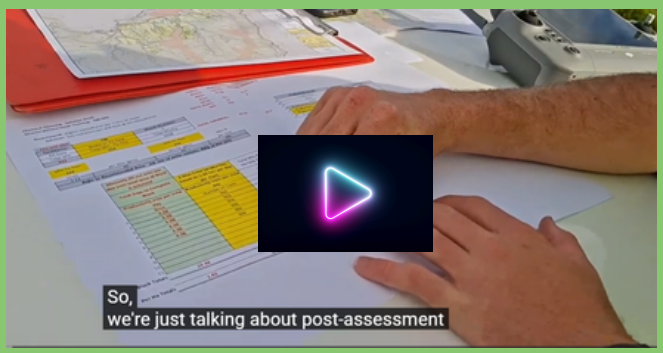
- sunlight
- water
- nutrients
- growing space

If too many trees grow close together, they become tall and thin. Smaller trees become "subdominant" because larger trees block their access to light.
Foresters use silviculture to shape how the forest grows.
Silviculture includes:

- thinning
- pruning
- measuring tree growth
- monitoring forest health
- improving timber quality

The goal is to grow healthier trees that produce stronger and more valuable timber.





WHAT IS THINNING?

Thinning means removing selected trees so the remaining trees have more space to grow.
A forest block may be thinned to:
500–700 stems per hectare (SPH) blocks are thinned depending on the regime the company chooses
If land is steep or erosion-prone, more trees may be left standing to stabilise the soil.
Students can investigate:
Why forests on steep land need more root strength
How forests help reduce erosion
How land slope affects forestry decisions

Two Methods of Thinning

1. Motor Manual Thinning
Workers use:
- **chainsaws**

to remove smaller subdominant trees.
Advantages
- **Immediate increase in sunlight**
- **Precise selection of trees**

Challenges
- **Labour intensive**
- **Expensive**
- **Higher injury risk**

2. Chemical Thinning
Chemical thinning involves drilling a small hole into selected trees and injecting a herbicide called:
Metsulfuron
The chemical moves through the tree and can sometimes move through connected root systems into nearby trees. This movement is called translocation.
Foresters must carefully calculate:
- **dosage**
- **spacing**
- **tree size**
- **species response**

to avoid damaging healthy crop trees.

Students can explore:

- **How chemicals move through plant systems**
- **Diffusion and transport in biology**
- **Ratios and measurements**
- **Risk management in environmental science**

AI and Drones in Forestry

Jack uses drones and artificial intelligence (AI) to monitor forests.
The drone captures images of the forest canopy. AI systems analyse:
- **colour**
- **shading**
- **canopy density**
- **tree health patterns**

AI can identify signs of disease before humans notice obvious symptoms.

One important forest disease is: Dothistroma Needle Blight This fungal disease damages pine needles and reduces photosynthesis. When trees lose needles:
- **growth slows**
- **timber yield drops**
- **forest profitability decreases**

AI helps foresters identify disease early so they can respond quickly with copper fungicide spraying. AI can help and work is still in the trial phase.

Science and Mathematics in Forestry Students can investigate

Science Behind Photosynthesis
Trees need needles for photosynthesis.

Students can investigate:

- **how plants produce energy**
- **why needles matter**
- **how disease affects growth rates**
- **relationships between sunlight and biomass production**

Forest Growth
Jack measures tree diameter to assess forest growth and thinning success.
Foresters often measure:

- **Diameter at Breast Height (DBH)**
- **tree height**
- **stem straightness**
- **spacing**
- **canopy development**

Students can collect data and calculate:

- **averages**
- **percentages**
- **growth rates**
- **area per tree**
- **stems per hectare**

Genetics and Forest Growth
Students can investigate:

- **inheritance**
- **selective breeding**
- **genetic variation**
- **environmental influences on growth**

Mathematics in Forestry

Tree Spacing
If a hectare contains:
1200 trees before thinning,
600 trees after thinning
Students can calculate:
percentage reduction
average spacing changes
predicted growth increases

Seedlings vs Cuttings
Seedlings
Seedlings are grown from seed.

Cuttings
Cuttings are cloned from selected parent trees.

Students can compare:

- **graphs of growth data**
- **averages and trends**
- **variables affecting plant development**

Environmental Protection

- **waterways**
- **native species**
- **culturally significant sites**
- **steep erosion-prone land**

- **sustainability**
- **ecosystem management**
- **environmental regulations**
- **balancing economics and conservation**



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WIDE TRUST

The Wood Industry Development and Education (WIDE) Trust is a charitable trust established in 2018 with the mission to support development and education in the forestry and wood industry sectors through the provision of grants and scholarships to New Zealand students and institutions.

FOREST GROWERS LEVY TRUST (FGLT)

The Forest Growers' Levy Trust collects the commodity levy paid on harvested wood material from forest growers and acts as the custodian of those funds. The Trust ensures the levy is invested in research, development, biosecurity, promotion and other industry-good activities that benefit New Zealand's plantation forest sector.