

**COMMERCIAL THINNING AND FERTILIZATION IN LODGEPOLE PINE INCREASE
MERCHANTABILITY
A TWENTY-YEAR STUDY ON GROWTH**

APSANA KAFLE, BRADLEY D. PINNO AND ROBERT E. FROESE
DEPARTMENT OF RENEWABLE RESOURCES
UNIVERSITY OF ALBERTA

INTRODUCTION

- Timber exports in Canada \$45 billion in 2021
 - Growing incidents of wildfire, pest, drought, and land conversion
 - Potential timber supply reduction in the future
 - Forestry in Alberta supports 21% of the GDP
 - Intensive silviculture management is a potential solution



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Lodgepole pine *Pinus contorta* var *latifolia*

- Commercially important species in Western Canada
- 46% of the land base in the foothills of Alberta
- 26% of total Growing Stock in the province
- 60% of lodgepole pine >70 years old
- Regenerates abundantly after a wildfire (~1000,000 stems/ha) leading to growth stagnation
- Often nutrition deficit with nitrogen, boron, sulfur

Commercial Thinning

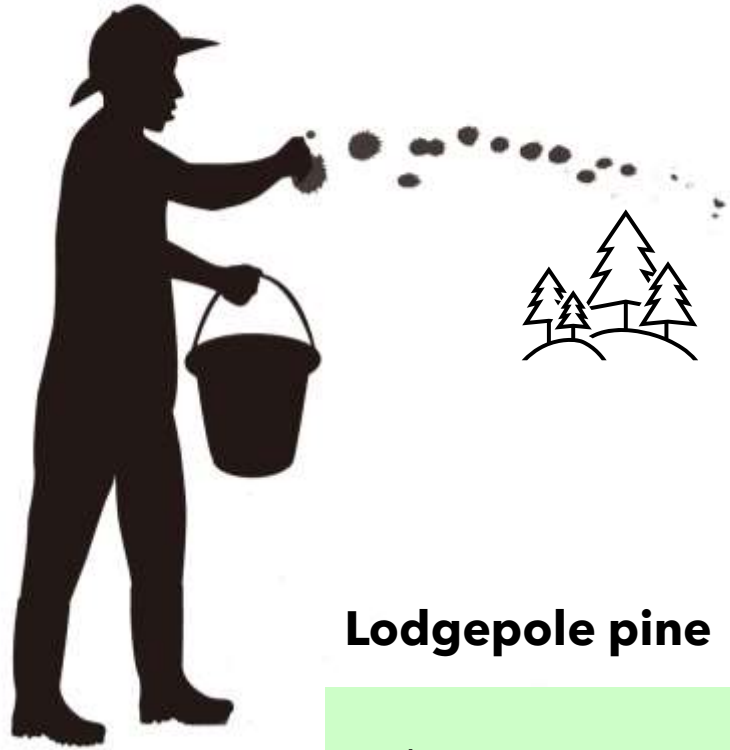
- Immediate timber extraction
- Capture volume that would otherwise be lost due to mortality
- Promoting stand and individual tree growth

Lodgepole pine

- Shorten rotation length → early fiber access
- Increase the cumulative merchantable volume → to sustain supply of 2nd growth timber
- Promote individual growth → increases piece size



Fertilization



- Increases resource availability per tree per hectare
- Promotes individual growth without loss in stand-volume

Lodgepole pine

- Increases stand and tree productivity
- PL shows the variable response to standing age, N-source, site index, frequency

Thinning and Fertilization

- Better individual and stand growth than conducted individually
- Trees remained after thinning are benefitted by increased resource availability



Research Gap

- Late rotation lodgepole pine
- Operational scale
- After 20 years

Research Objective

Assess the long-term response of commercial thinning and fertilization (single or combination) on



Stand level growth



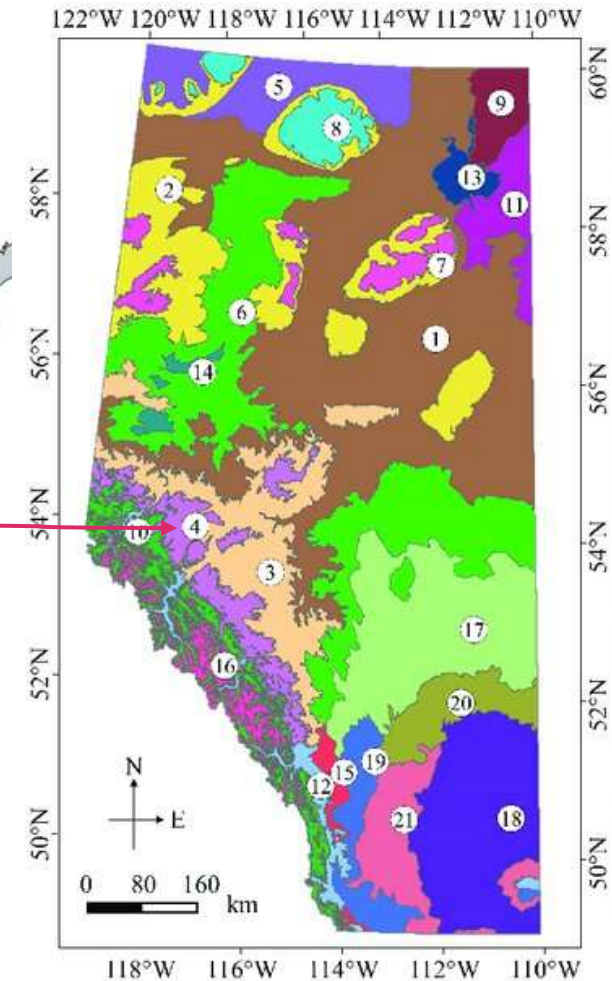
Individual level growth



Mortality

Study Area

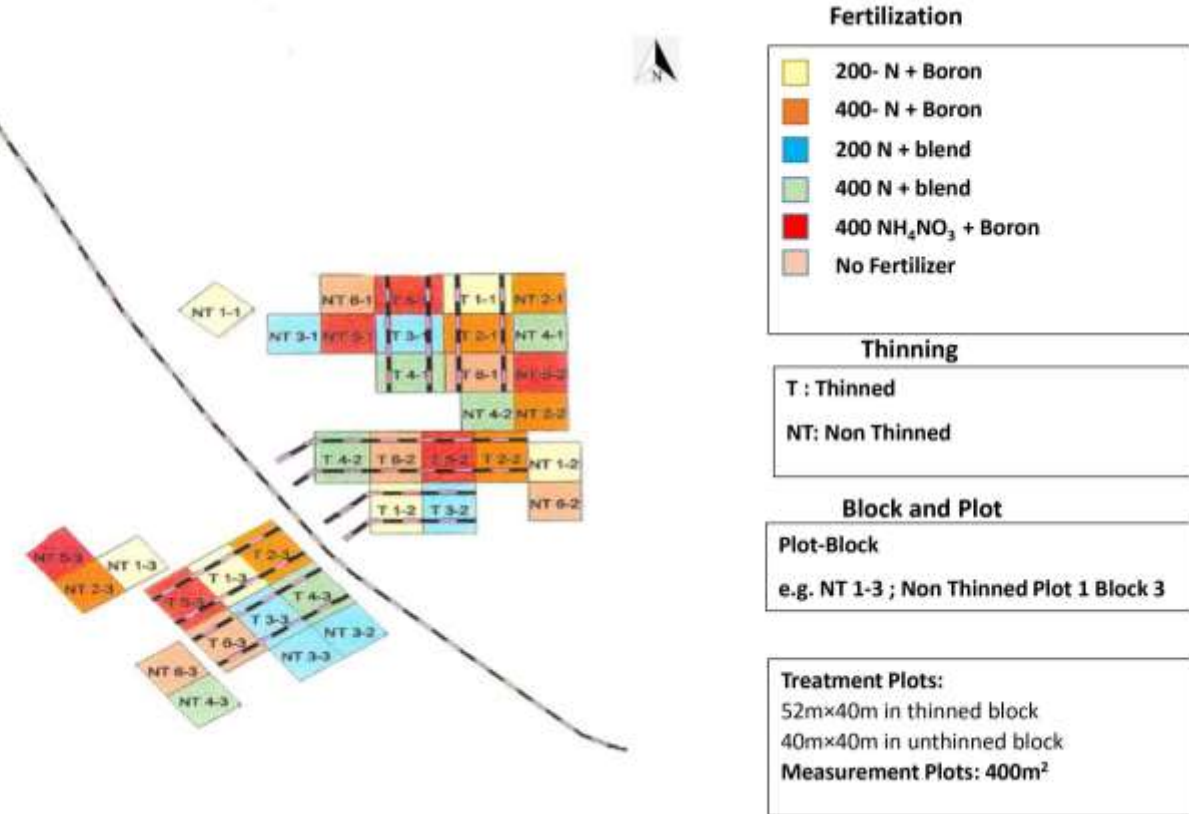
- Upper Foothills of Alberta
- Currently managed under Hinton FMA
- Experiment installed in spring 2000
- 68-year-old fire-originated lodgepole pine
- Severe deficiency of nitrogen and micro-nutrients



Methods continued

- Partial Split plot (2 × 6) factorial design
- 3 blocks and 2 sub-blocks (CT and Unthinned)
- 6 plots within sub-blocks (5 fertilizer, 1 control)
- CT- 50% BA removal (~19 m²/ha), 1680 TPH

- Measurement: 2000 and 2021
- DBH, Height, HTLC, Mortality status



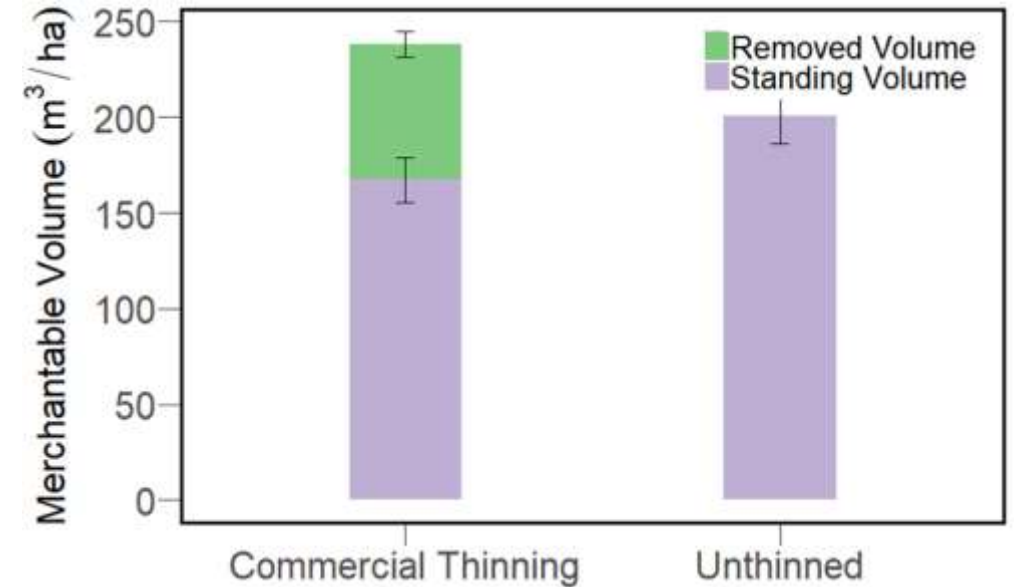
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- Individual tree and Stand level → Periodic Increment
- Merchantable DBH 13.4 cm
- Saw log trees → DBH > 20 cm
- ANOVA (T × F)
- Mixed model type → Individual size and growth
- Pairwise comparison → (Urea vs. Ammonia, 200 kg/ha N vs. 400 kg/ha N)



Results & Discussion

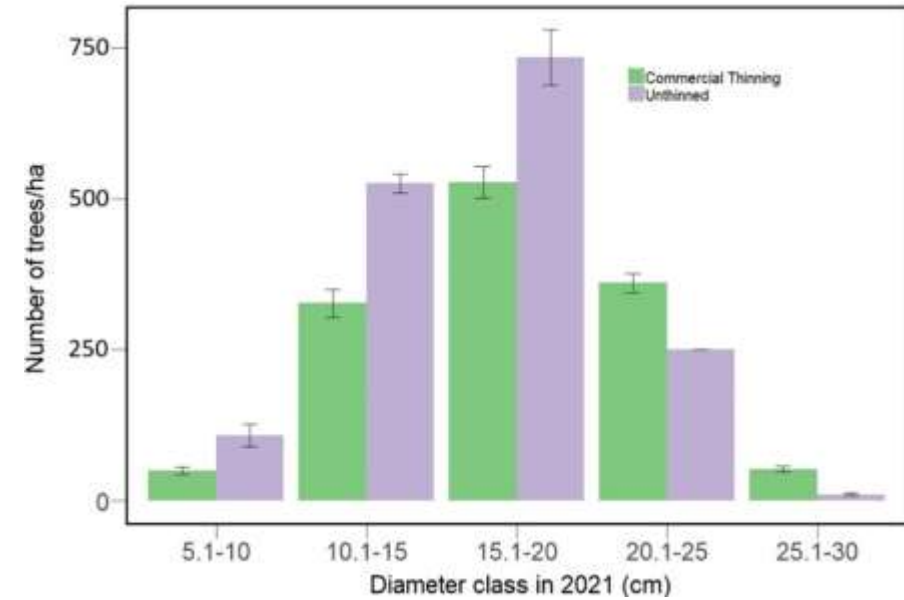
- Standing merchantable volume > Unthinned ($p=0.03$)
- Cumulative merchantable volume at age 88 > Thinned ($p=0.004$)
- Basal Area Growth similar between thinned & unthinned



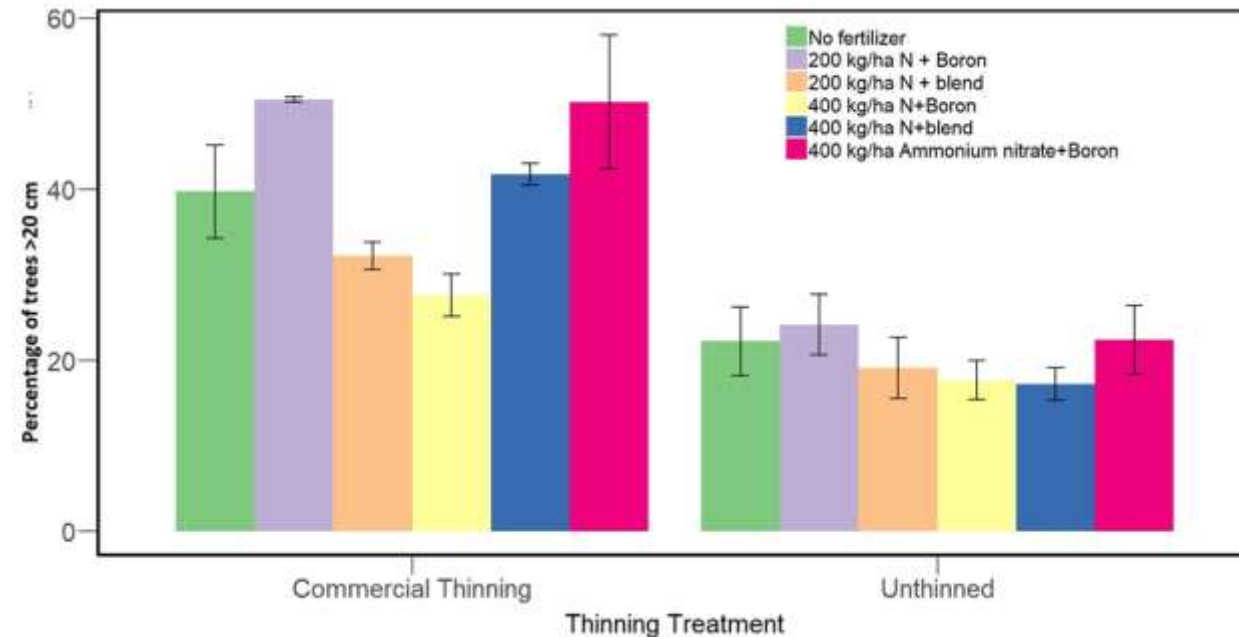
- CT relaxed growth suppression of residual trees and capture mortality

Density

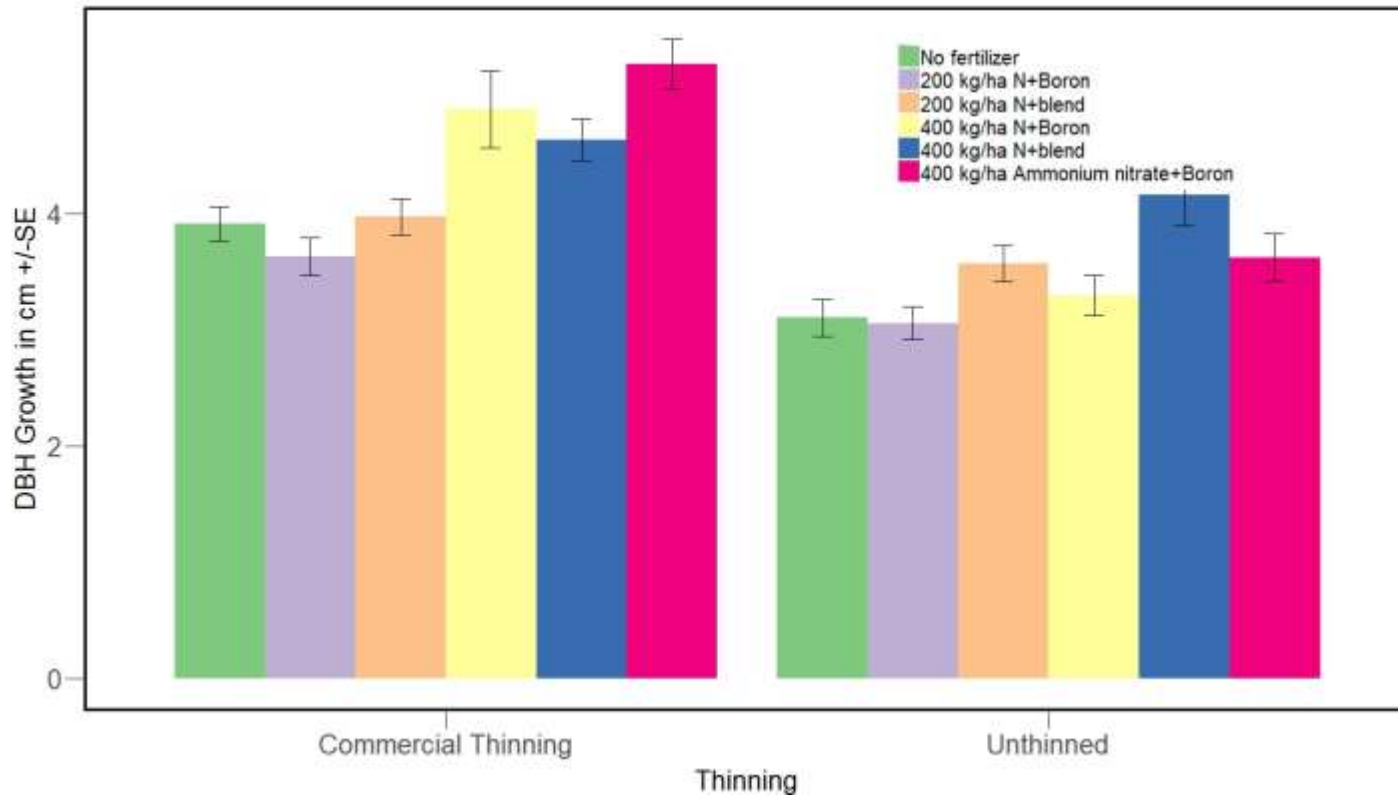
- Density > Unthinned (3218 trees/ha) ($p < 0.001$)
- Proportion of saw log trees (> 20 cm) > thinned by 20% ($p = 0.03$)



- Makes harvesting operations efficient and economic



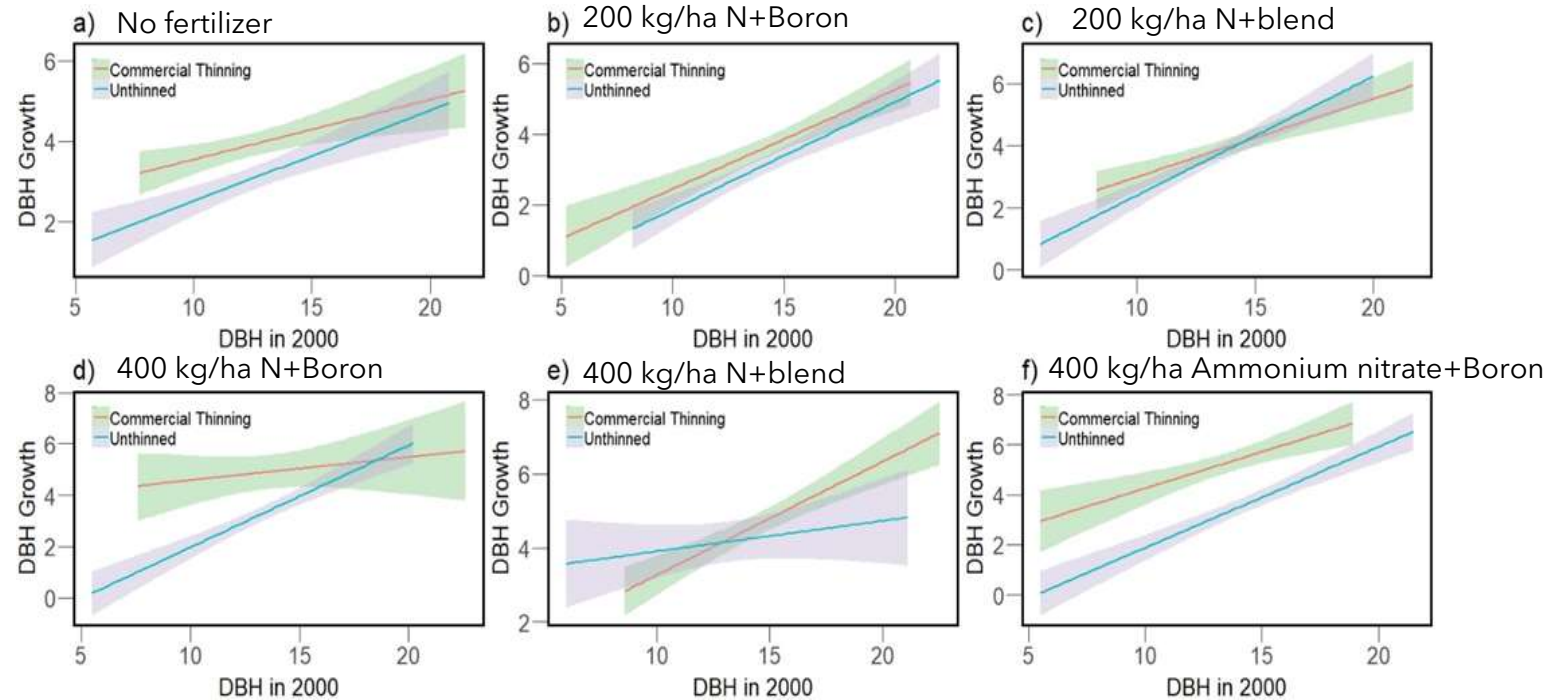
Individual level growth



- Growth since thinning > thinned (4.32 ± 0.2 cm) than unthinned (3.39 ± 0.05 cm)
- Within fertilization \rightarrow 400 kg/ha > 200 kg/ha N+blend > Control > 200 kg/ha+Boron
- No difference (Urea vs. Ammonia) and (Boron vs. Blend)
- Greater growth by fertilization in thinned trees ($T \times F$, $p=0.01$)

Individual tree size & growth

- Initial DBH strongest predictor of growth ($p < 0.001$).
- Similar growth in 200 kg/ha and 400 kg/ha N+blend
- Thinned trees upto 15 cm grow more than unthinned at (Control and 400 kg/ha N+Boron)
- Growth of all trees upto largest (~20 cm) is more in thinned at 400 kg/ha Ammonium nitrate+Boron



Growth of residual trees → Release from the competition

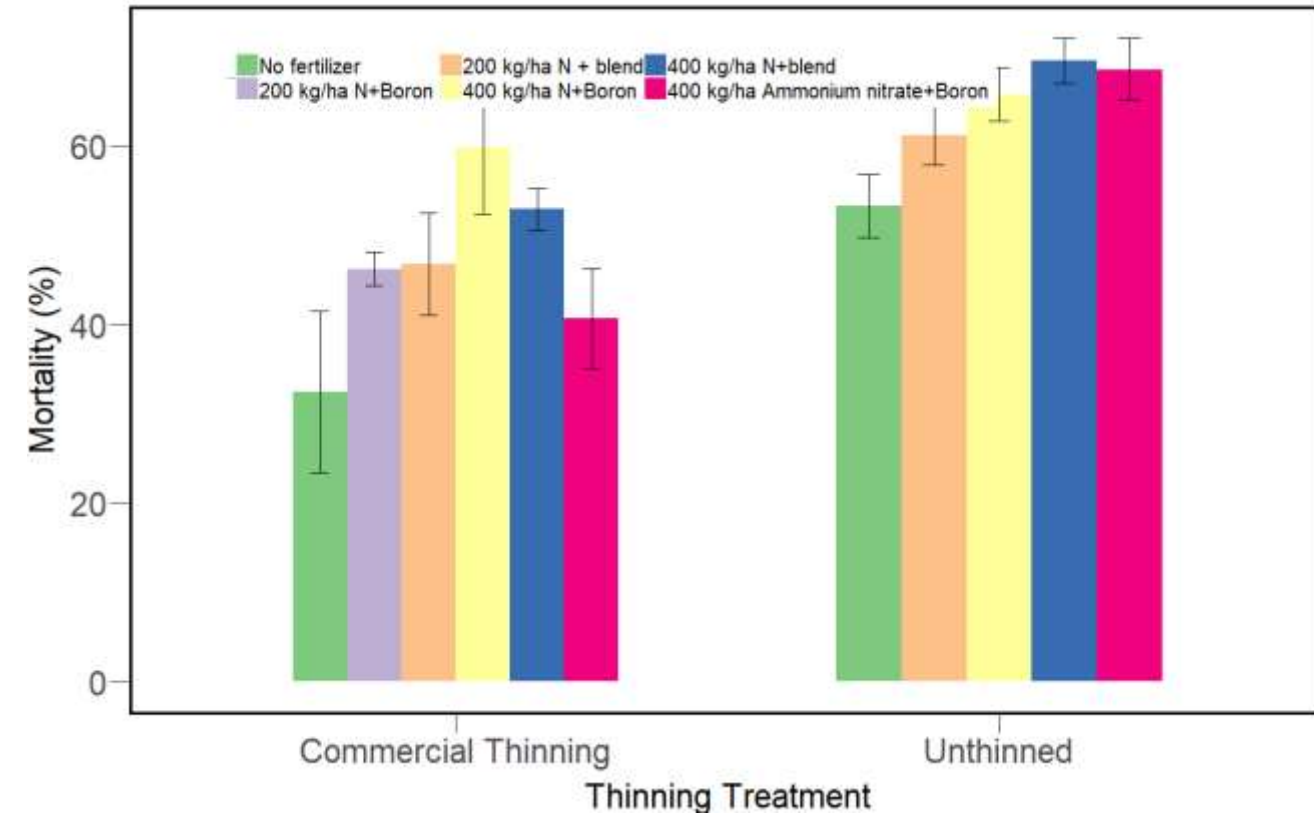
Growth of small and medium trees → Otherwise dominated by large trees, Nutrients from fertilization

Increased fertilization increased growth → Increased availability in the soil

Fertilization > growth of thinned trees → Reduced competition, Increased nutrients

No difference in Ammonia vs. Urea → Single Fertilization, Long term measurement

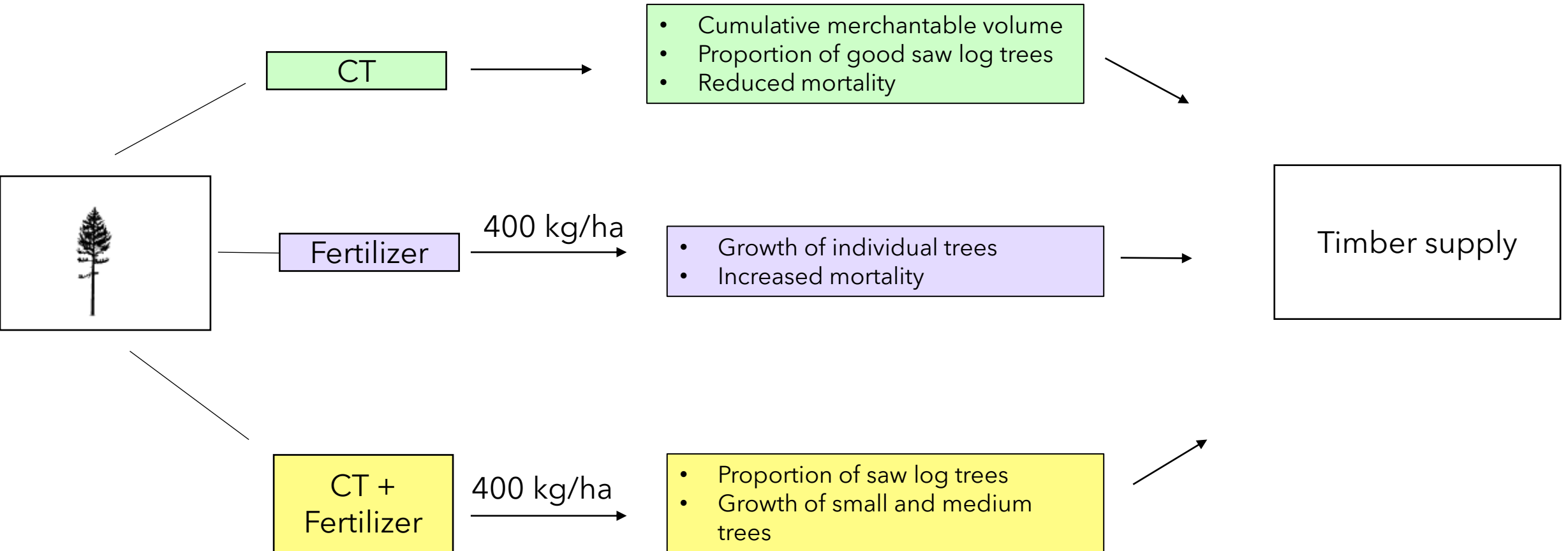
Mortality



- Dead trees > Unthinned (2022 trees/ha) than thinned (758 trees/ha) ($p=0.02$)
- Mortality increased with fertilization ($p=0.04$) and is higher in unthinned plots ($p=0.03$).

- Chain saw effect
- Thinning reduces density-dependent mortality
- Fertilization promoted the growth of medium-large trees → mortality of smaller trees

Take Away





Thank You

Any Questions?