New Project

Determination of crown morphological traits using laser scanning in Douglas-fir and loblolly pine genetics trials

Project 23.103

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Justification

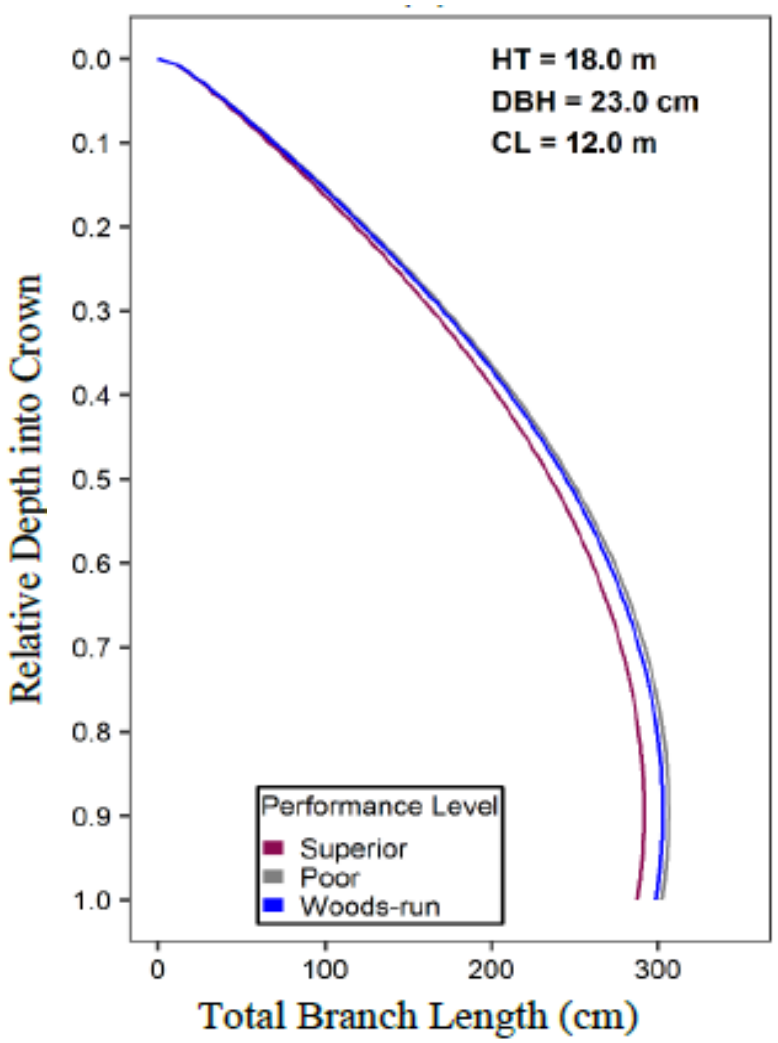
- Accounting for genetics within growth models has been based on genetic worth, assigning an elevated height or diameter growth rate based on results from progeny tests or realized gain trials

- Improved performance of genetically select trees has been associated with specific crown morphological traits.
  - High leaf area density
  - Short branches, narrow crowns

- Accounting for crown traits within growth and yield equations would provide a means of predicting the benefits of deploying specific families of known traits

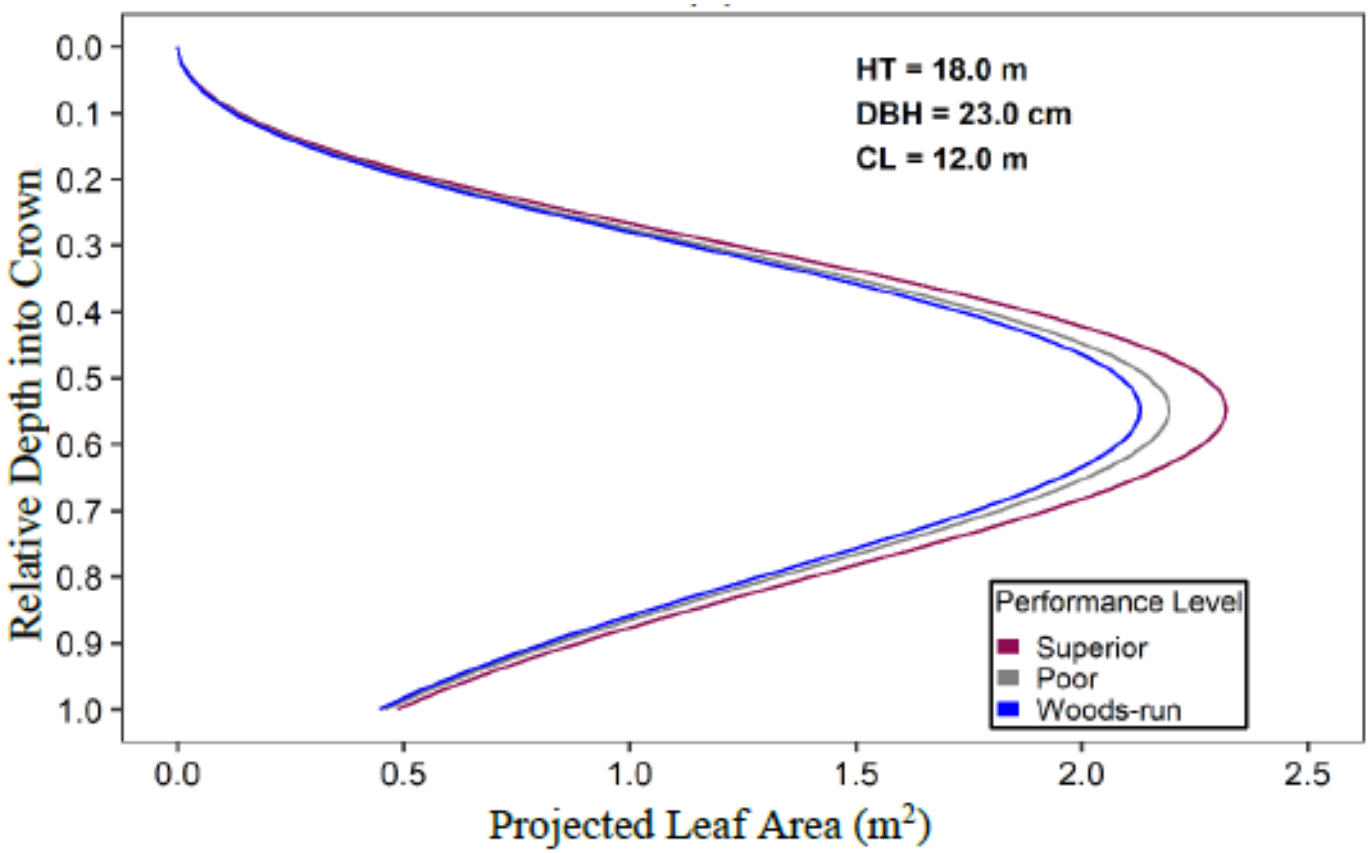
Justification

- Based on intensive crown sampling within a Douglas-fir realized gain trial, superior performing Douglas-fir families had shorter branches/narrower crowns for a given height, dbh, and crown length…



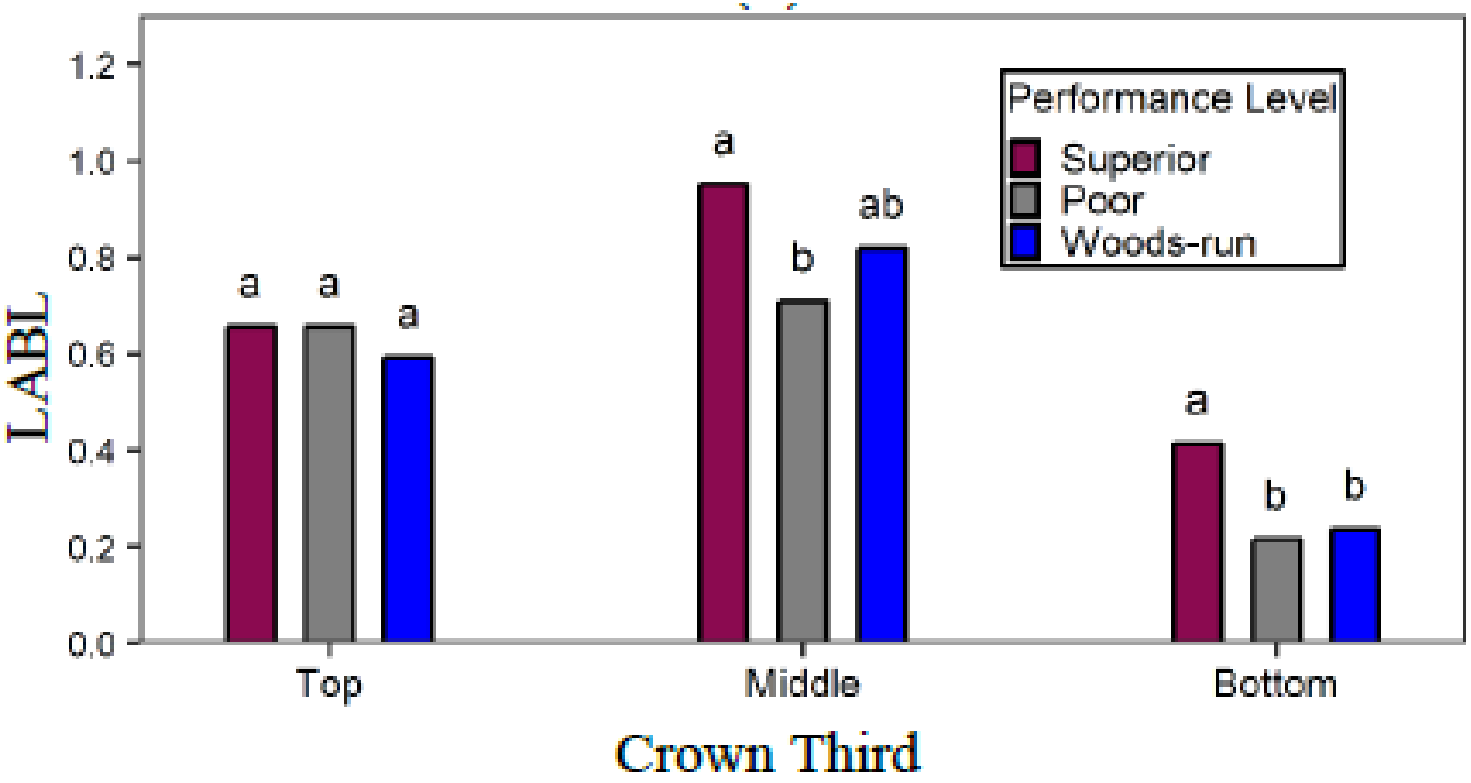
Justification

- …had greater total leaf area for a given height, dbh, and crown length…



Justification

- …and had greater leaf area per unit branch length (LABL), particularly in the lowest crown third.



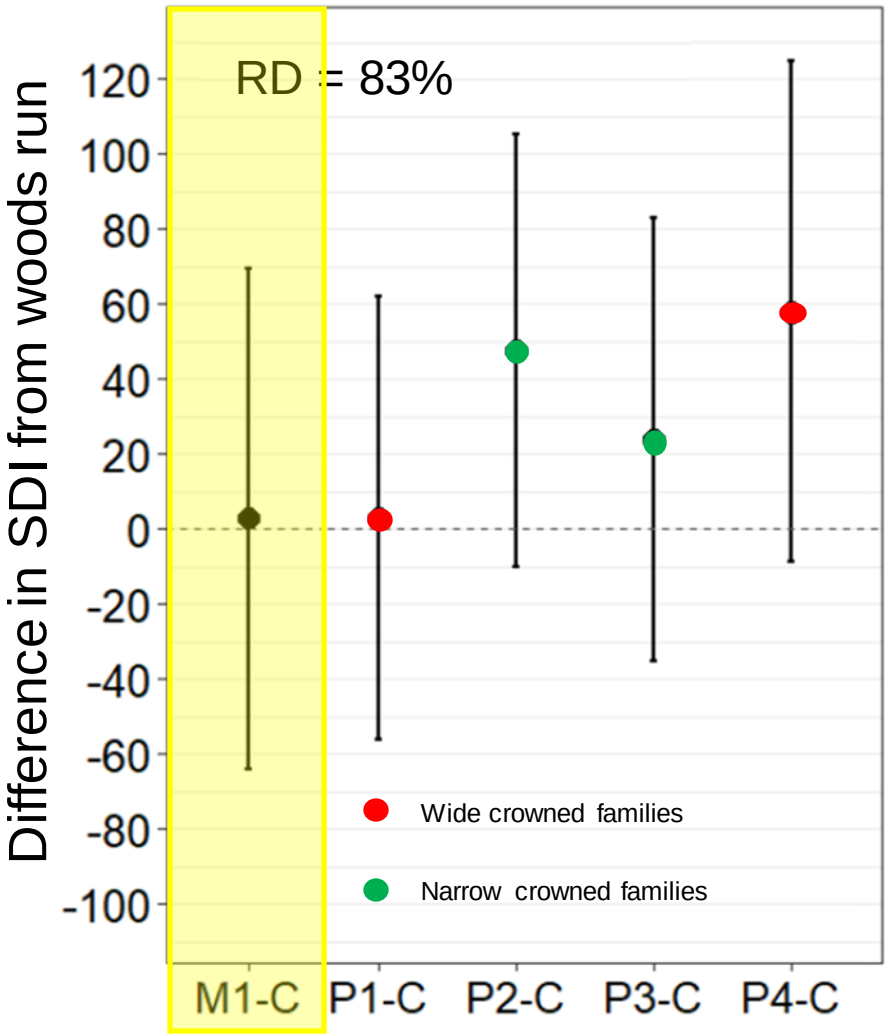
Justification

- Narrow crowns and high leaf area density imply spatially efficient trees, conforming to the crop ideotype concept

- Increased spatial growth efficiency may increase maximum carrying capacity, providing a potential additional means by which genetically select trees can produce yield increases beyond simple height and dbh growth.

Justification

- Graph compares pure family blocks (fams 1, 2 , 3 ,4) to mix (M1) of the same four families (6x6 spacing)
- Advantages in carrying capacity gained in pure family blocks may be lost when the same families are mixed
- Increased carrying capacity of a stand may depend on planting blocks of trees with similar crown traits



Justification

- Pure family ideotype-representative Douglas-fir plantations are available
- **Planting densities**
  - 3 x 3 ft
  - 6 x 6 ft
  - 9 x 9 ft
  - 12 x 12 ft
- ***Opportunity is now***
  - Storm damage
  - Threatened PCT

Winter 2018-19, 3 x 3 ft

Winter 2020-21, 6 x 6 ft

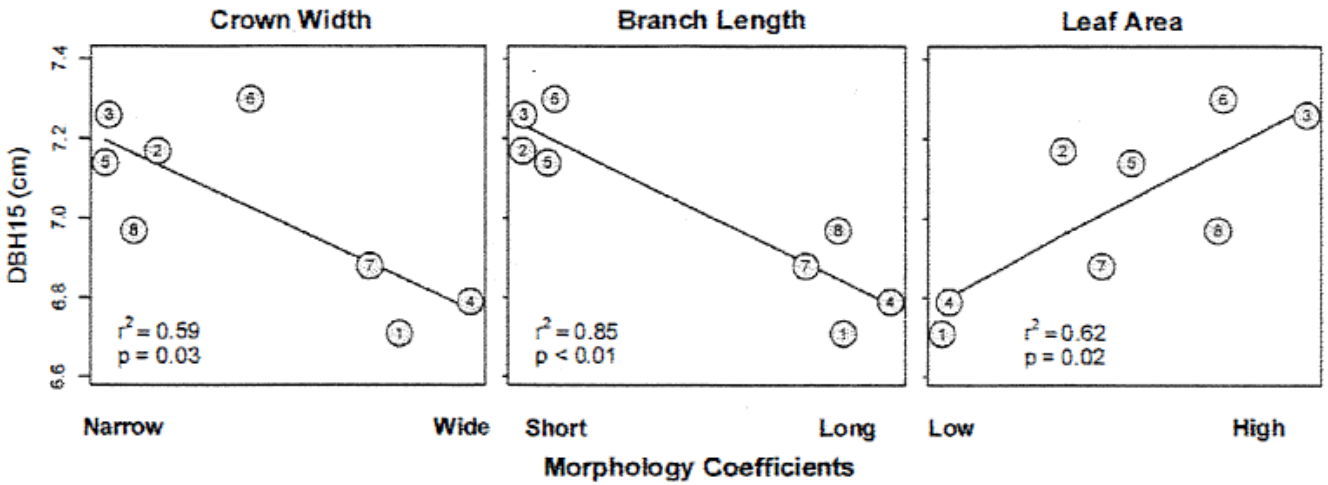
Objectives

- From laser scan point data, develop an algorithm for identification of heritable crown morphological traits associated with enhanced growth rates (leaf area density, crown width)

- Using increment and allometric data from measurement of families representing contrasts in crown density and width, attempt to account for genetically-relevant crown morphological traits in pertinent growth model equations

Methods

- A family deployment study was established in 1997, containing replicated, improved, pure family blocks (8) representing contrasts in crown width and leaf area density, providing a good dataset for developing an algorithm for aerial identification of crown traits.



- The variation in family performance requires that accounting for ideotype be based on as many representative families as possible

- Two other pure-family blocks (30, 38 families) of genetic selections are available for the identification of additional ideotype-representative families for creating a modeling dataset

Methods

- Collect drone-based 450 ppm laser scans of pure family blocks at three western Oregon sites containing improved stock
- Analyze point cloud, developing algorithm for identifying traits of interest (FPC)
- Measure pure family blocks of interest at three sites, collecting data on dbh, height, HCB, and two crown widths on each tree.
- Fit modifier equations for max/largest CW
- Test for crown trait-adjustments to pertinent G&Y equations: diameter increment, height to crown base, and crown recession.
- Using any significant changes, produce model simulations of ideotype-based plantations.

Timeline

- **Fall 2023:** Drone flights of 3 sites and measurement of FDP site
- **Fall/Winter 2023**: Development of algorithm for determination of crown traits based on laser scan
- **Winter 2023-24:** Measurement of MO and 6G sites based on results from laser scan
- **Spring 2024:** Equation fitting
- **Summer 2024:** Final report

Projected Budget

- Drone-based laser scanning, 3 sites: ($7,851)
- Analysis of point data: ($4,800)
- Field sampling: (21 person-days) ($6,825)
- Travel: ($913)
- **Total: ($20,389)**

Deliverables

- Algorithm for estimation of crown traits from laser scan data
- Dataset of measurements from field sites
- Report with final models describing adjustment of G&Y equations to account for crown traits
- Public presentation of findings at CAFS Annual Meeting and regional Coop meetings
- Draft manuscript for peer-reviewed journal

Company Benefits

- First iteration of growth model adjustments to account for genetic differences in crown traits
- Ability to test for the benefits of growing Douglas-fir in ideotype plantings
- An algorithm for aerial detection of crown traits within progeny tests, realized gain trials, and plantations