Incorporating crown ideotype into CIPSANON

Growth Model Users Group
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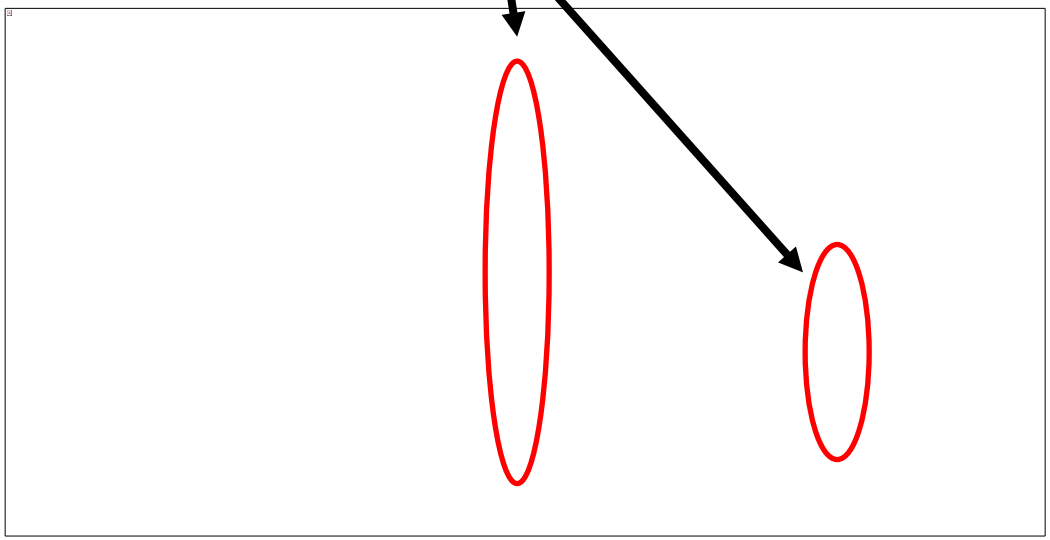
Year 20 crown measurements in mixed-family realized gain trials

- On average, superior performing families have shorter branches…..
- and have more leaf area per unit branch length in lower crown thirds



Ideotypes

- **Ideotype**: a conceptual model that describes the phenotypic characteristics of a plant that are hypothesized to lead to greater yield.

- Conditions under which the plant is managed must be specified for any ideotype, because the conditions influence phenotypic performance.

- Typical ideotypes described for forestry are ***competition*** and ***crop*** ideotypes

Crown ideotypes

- ***Competition*** **ideotype:** A tree that is very competitive (greedy), rapidly exploiting site resources, aggressively expanding its crown and root structure to the detriment of neighboring trees
  - ***Simple representation:*** fast growing, wide crowned tree

- ***Crop*** **ideotype:** A tree that efficiently exploits locally available resources, while not competing strongly with neighboring trees.
  - ***Simple representation:*** narrow crowned tree

- Branch length and crown width are heritable

Why include ideotype within CIPSANON?

- Prediction of growth of genetically select trees is a priority
- Improved performance of genetically select trees can be tied to morphological characteristics
- Performance of family mixes suggest that benefits of specific morphological features can be lost when mixed.
- Best means of testing rotation length implications of pure contrasting ideotype planting using currently available data

Do we have pure Douglas-fir ideotype plantings?

- No
- Family Deployment Study, established in 1997 near Mill City, Oregon by Brad St Clair, contains 8 pure family plantings (4 reps) at three densities (3x3 ft, 6x6 ft, 12x12 ft)
- Families represent contrasts/gradients in crown width, leaf area density
- It is unknown to what extent these contrasts represent the full range of ideotype expression

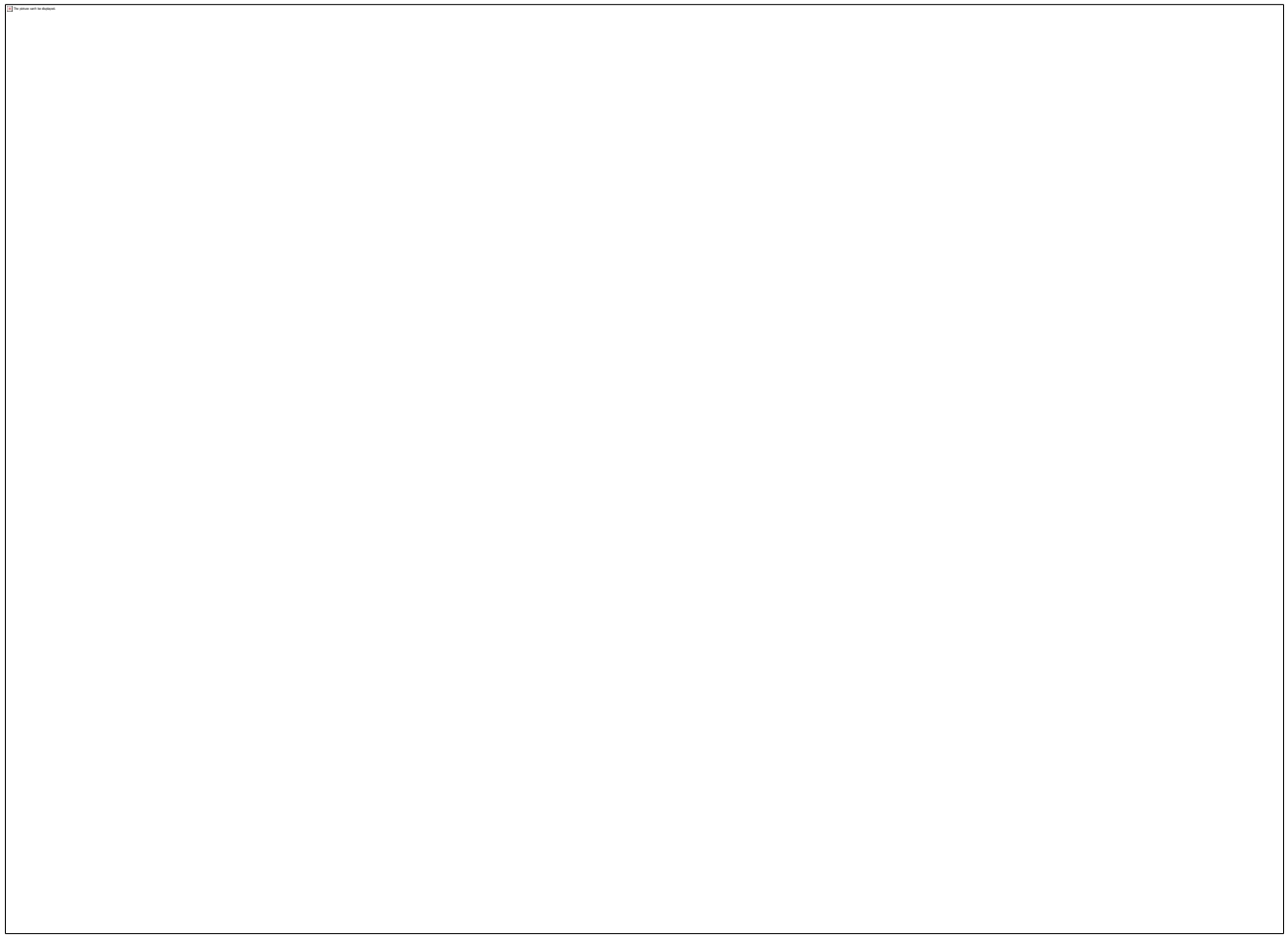
Family Deployment Study

- Sites have separate plantings of 8 full-sib fams, a woods-run control, and three 4-family mixes.
- 8 pure families provide contrasts in crown morphology
- Families were from single-pair crosses of parents selected from the Molalla breeding zone (NWTIC)
- Parental breeding values were predicted from results from nine progeny test sites, age=15y
- Parents were selected to create a range of predicted 15-yr volume gains (10-35%)

Family Deployment Study

Year 10 crown measurements

- Adjusted for Dbh
- Based on average of two wide crown families, two narrow crown families



Measurements

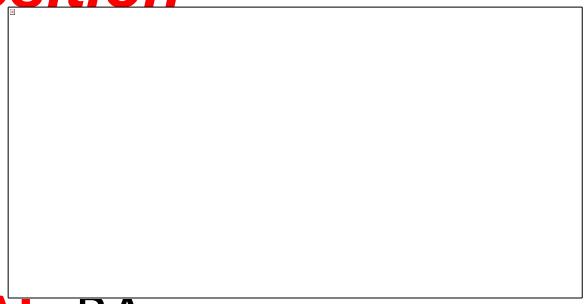
- Dbh, Ht, HCB measurements (at plantation ages 5, 12, 25, 27 *(next fall)*).

- Upcoming short period measurement (25-27) is to not lose the opportunity of additional increments on the 6x6 density

- Crown widths measured at age 10, will be measured at age 27

Ideotype representation within CIPSANON

- ***Variables in blue influenced by max and largest CW***
- ***Variables in red represent social position***



- **Diameter increment**
  - Currently predicted by DBH, **CR**, SI, **BAL**, BA
- **Height to crown base** (imputation)
  - Currently predicted by height, BA, **CCFL**, SI
- **Height increment** (ΔHt)
  - Currently predicted by SI, **CCH**, **CR**
- **ΔHCB**
  - Currently predicted by Ht, ΔHt, **HCB**, **CCFL**, SI
- **Mortality**
  - Currently predicted by DBH, **BAL**, **CR**, SI

Analytical dataset

- Crown width observations for max crown width (MCW) and largest CW (LCW)
  - Woods run ~180
  - Wide crown ~220
  - Narrow crown ~330
  - Current MCW and LCW predictions within CIPSANON will be adjusted using ideotype-based multipliers
- Observations of increment
  - Woods run ~1400
  - Wide crown ~3800
  - Narrow crown ~5800
  - Ideotype-based modification of diameter increment can be tested post-calibration to woods run trees
- Continued monitoring of mortality and the possibility of improved carrying capacity in genetically select stands

Remote assessment of ideotype for additional data?

- **Problem**: identifying families representing ideotypes
- We've identified two additional 2nd gen pure family plantings (38, 30 families) where this could be used to identify range in crown widths

Deriving internal crown geometric features of Douglas-fir from airborne laser scanning in a realized-gain trial

Article *in* Forestry · January 2021

- Airborne laser scanning predicted branch length and angle
- 200 points/m^2 scan
- Significant differences were found in branch lengths and angles between gain types, unadjusted for DBH
- Could be used to screen trees in gain trials


Questions?