Benchmarking gains from planting genetically improved loblolly pine

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Objectives

• Evaluate the stand-level properties of enhanced genotypes across a range of genetic families with different levels of genetic homogeneity (HS, FS, Clones)
  • Diameter distributions
  • Height-diameter relationships
  • Variation
  • Volume

• Re-measurement data will be evaluated to see how the stands are developing over time
Introduction

• Around 30 million acres of planted Loblolly pine in the SE
  • Vast majority are genetically improved

• Stands with different genetic backgrounds lead to different stand characteristics over time

• Need to develop benchmark for comparison to see if improvement gains are being met
Methods

- Data from five designed research trials containing single genotype block plot plantings across a range of enhanced genetics with multiple measurements over time will be used to assess changes in stand structure over time. (Pre-thin)

- Physiographic regions represented from the southeast U.S.:
  - Piedmont
  - Lower Coastal Plain
  - Upper Coastal Plain

- One commonly planted, well-tested, first-generation open-pollinated (OP) family was planted in all studies and will serve as the baseline for a comparison among genotypes.
Methods

• Datasets—PMRC
  • Elite Variety Block Planting Study
    • Est. 2007
  • Improved Planting Stock & Vegetation Control Study
    • Est. 1986-1987
  • Clonal Block Plot Installations
    • Installations 20 and 21: High-end genetics by density: Est. 2005
    • Installation 23: 2nd gen block plot study: Est. 2001
    • Installation 26: MCP vs. OP block plot study: Est. 2003
  • Coastal Plain Culture-by-Density Study
    • Est. 1995-1996
  • Consortium for Accelerated Pine Production Study (CAPPS)
    • Est. 1987
Data Attributes

- **Silviculture**
  - Herbgen
    - Herbicide
    - No Herbicide
  - CAPPS
    - Control
    - Fertilization
    - Herbicide
    - Fertilization / Herbicide
  - Culture/Density
    - Operational
    - Intensive
  - Guyton
    - Fertilization/ Herbicide
  - CAFS
    - Herbicide
    - No Herbicide
Data Attributes

- **Planting density**
  - Herbgen
    - 700-750
  - CAPPS
    - 680
  - Culture/Density
    - 300-1800
  - Guyton
    - 435-726
  - CAFS
    - 388-538
Data Attributes

• Site Index
  • Herbgen
    • 60’s-70’s
  • CAPPS
    • 60’s-80’s
• Culture/Density
  • 70’s-90’s
• Guyton
  • 70’s
• CAFS
  • 70’s-90’s
Methods

• Summary statistics
  • Average height and diameter per plot
  • Presence or absence of fusiform rust at earliest ages
  • Sawtimber quality scores evaluated at latest ages
  • Variation in measurements of height and diameter
Rust occurrence—earliest age available
Sawtimber Scores—latest ages available
Coefficient of Variation (DBH)

Culture by Density

Guyton

CAPPS

Herbgen

CAFS
Coefficient of Variation (Height)

Culture by Density

Guyton

CAPPS

Herbgen

CAFS
Diameter Distribution—Herbgen
Weibull Distribution

- Flexible and can assume a variety of unimodal shapes making it useful to describe diameter distributions
  - 2 and 3 parameter distributions were fit to data
  - 2 parameter work is shown in the following slides
    - Kolmogorov-Smirnov test (KS test) indicated that the 2 parameter distribution was a good fit to the data
7-56 Weibull curves from age 6 to age 25
Two Parameter Weibull-Distribution—DBH
Two Parameter Weibull-Distribution

- Follow methods of Bullock and Burkhart, 2002 to model Weibull parameters

- Parameter recovery techniques were used to derive the shape and scale parameters.

  - The 25th and 97th percentiles of the empirical diameters were modeled as a function of: Age, basal area per hectare, and planting density

    \[ \ln(\hat{D}_i) = b_0 + b_1 \ln\left(\frac{BA}{TPH}\right) + b_2 \ln(A) \]
Diameter 25\textsuperscript{th} and 97\textsuperscript{th} percentiles

\textbf{DBH(in) 25th percentile}

Psuedo R-squared = 0.9904517
Root mean squared error = 0.507587

\textbf{DBH(in) 97th percentile}

Psuedo R-squared = 0.9856139
Root mean squared error = 0.8415794
Volume

Cubic ft Volume/Acre

AGE

CAPPS

CD

Guyton

Herbgen
Future Work

• Continue to evaluate stand characteristics of block plots across a variety of genotypes and genetic improvement over time.

• Characteristics
  • Diameter distribution
  • Height-Diameter relationships
  • Volume
  • Rust occurrence
  • Sawtimber scores
    • Forking

• Genetics
  • Half-Sib
  • Full-Sib
  • Clonal
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Questions?