

# Genetic Selection for Wood Properties of Standing Trees

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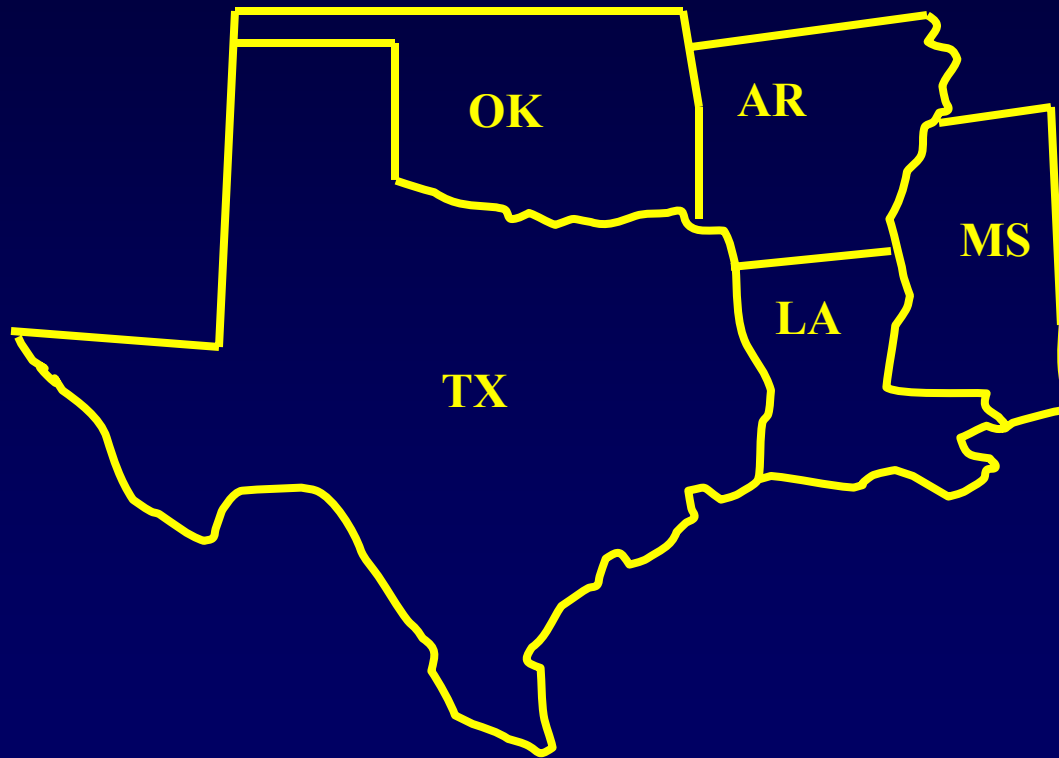
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**T E X A S**  
FOREST SERVICE  
The Texas A&M University System



**Missouri Dept. of Conservation**

# Western Gulf Region



# Background

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- **Majority of timberland owned by several different types of landowners**
  - **Most own no milling facilities and grow timber as a commodity for open market**
- **Many of region's wood users rarely grow >50% of the raw material needed**
  - **Some own no forestland**

# Background

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- **Manufacturing facilities rely heavily on gatewood**
  - **Compensation based on weight or volume meeting minimum standards**
- **Economic emphasis on adaptability and volume**

# Background

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- **Western Gulf Forest Tree Improvement Program (WGFTIP)**
  - **Cooperative of 9 industrial members and 5 state agencies**
  - **Members plant ~300 million trees on roughly 180,000 ha per year**
  - **Members produce wide range of pulp/paper and solid wood properties**

# Background

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- **Selection and breeding focus on improving growth rate and expanding natural range**
- **Wood quality also considered important**
  - **Traits unfavorably correlated with growth**
- **WGFTIP must define selection criteria given:**
  - **No strategy is best for all products**
  - **Wood quality has no recognized importance in market**

# Background

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- **WGFTIP strategy:**
  - **Maintain a larger breeding population than necessary so deployment populations can be customized**
  - **Develop an elite population focused on wood quality**

# Program Structure

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- **WGFTIP manages**
  - **Breeding population used to produce next generation of selections**
  - **Selection population used to identify next generation breeding population**
  - **Deployment population used in orchards and plantations**



# Program Structure

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- **Loblolly breeding pop comprised of 3,223 progeny-tested first-generation parents and 1,554 second-generation selections**
  - **divided into 8 seed zones with overlapping deployment and procurement recommendations**
  - **4 breeding zones**
  - **902-1853 per breeding zone**
    - **Larger than needed for single trait**

# Program Structure

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- **Breeding and selection objectives consistent across members**
  - **Production of an all-purpose tree**
  - **Primary focus on vigor and adaptability**
  - **Secondary emphasis on straightness and specific gravity**
  - **Large pop size allows flexibility**

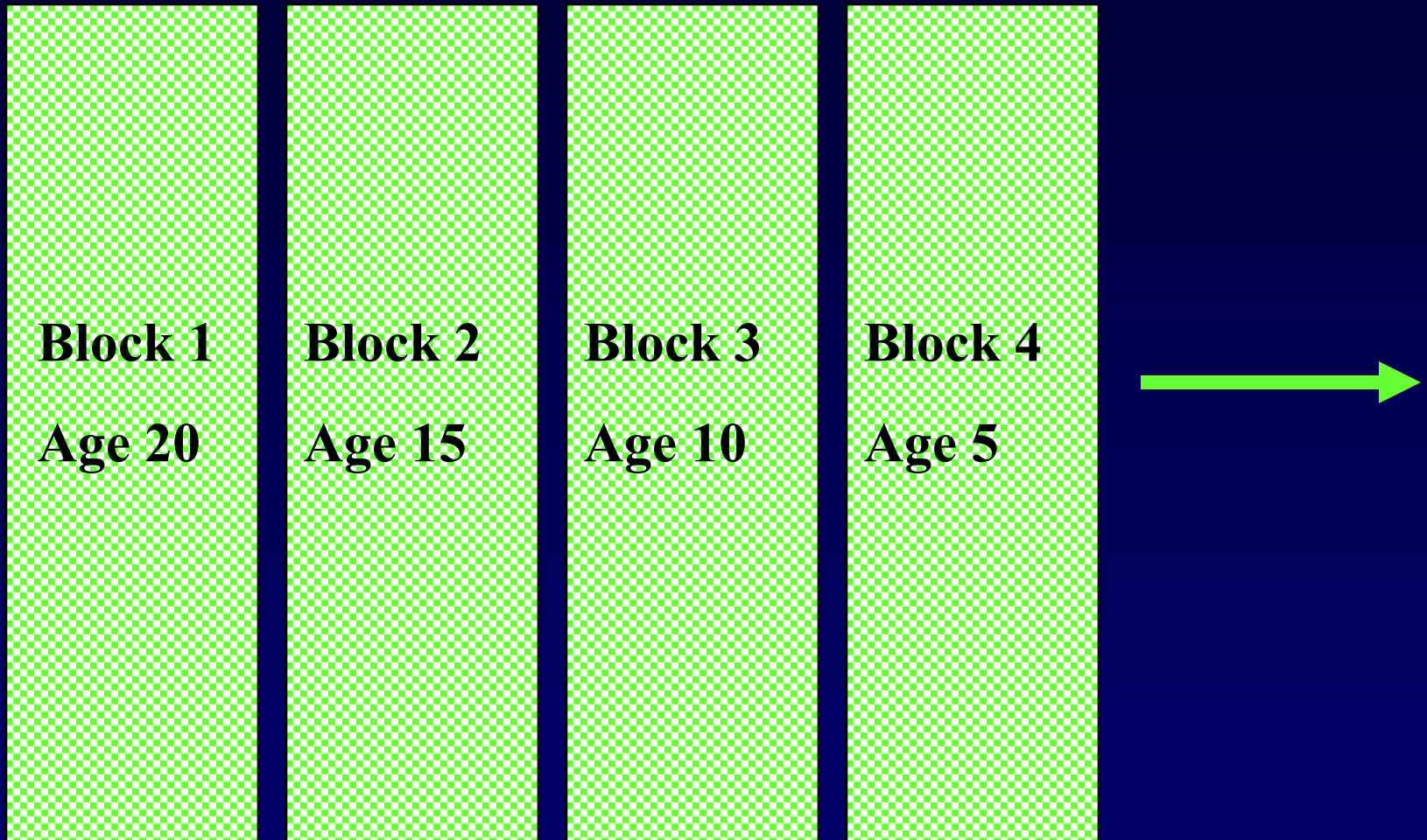
# Program Structure

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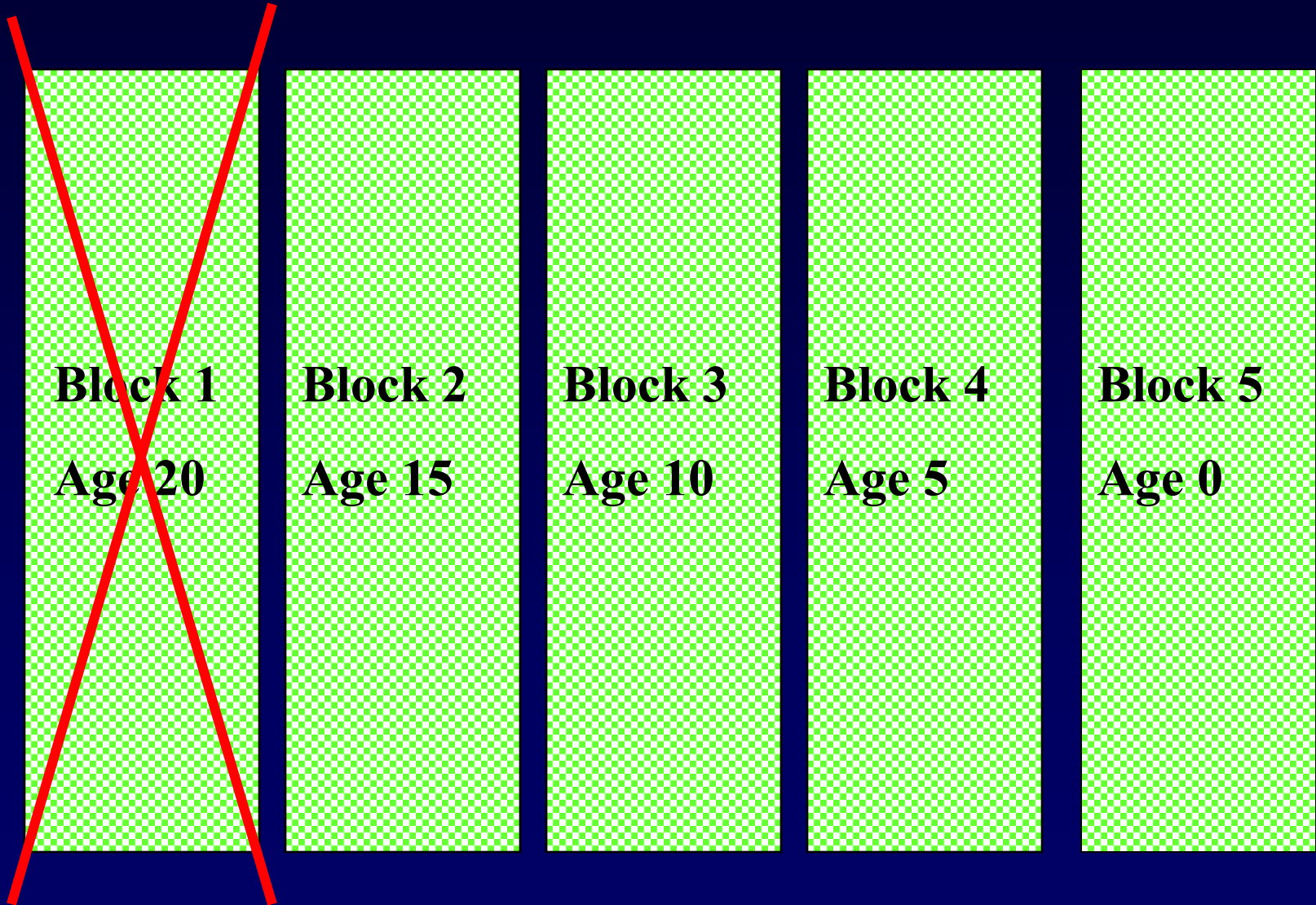
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- **Deployment populations managed independently by each member**
  - **Use advancing front orchard design**

# Orchard Example



# Orchard Example



# Orchard Example

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- 20 clone orchard in Arkansas

	<u>Volume alone</u>	<u>Pulp Index</u>
<b>BV(MAI<sub>20</sub>)</b>	<b>37.8%</b>	<b>14.9%</b>
<b>Spec. Grav.</b>	<b>-0.019</b>	<b>0.030</b>
<b>Straightness (sd)</b>	<b>0.45</b>	<b>0.52</b>
<b>\$ saved/ton kraft pulp</b>	<b>0.13</b>	<b>12.90</b>

# Program Structure

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- **Over all first-gen. parents, genetic corr:**

<b>volume and specific gravity</b>	<b>-0.13</b>
<b>volume and straightness</b>	<b>0.01</b>
<b>straightness and specific gravity</b>	<b>0.02</b>
- **Continued selection on volume will decrease wood quality**

# Elite Population

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- **Wood Quality Elite Population (WQEPop)**
  - **30 backwards selections from each breeding zone**
  - **Selections based on Pulp Index**
    - **Economic weight for specific gravity 7x that of volume**
    - **Infusions from mainline whenever suitable individuals identified**



# Elite Population

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- **Anticipated within-family selection will be inefficient**
  - **All selections polymix and/or clonally tested**
  - **Rooted cuttings or somatic embryos for multiple observations**
    - **Especially important because of negative genetic correlation and low heritability**

# Elite Population

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- **In order for success, importance of wood quality must be recognized AND efforts of landowners and growers must be rewarded**

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- **Economic importance of specific gravity**
  - **Pulp mill efficiency**
  - **Juvenile wood**

# Elite Population

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- **Need quick, reliable, and inexpensive methods of measurement for large sample sizes**
  - **Limited size of WQEPop allows possibility of including additional traits e.g. MFA**
  - **Need studies of heritability of different traits, understanding of whole-tree variation, etc.**

# Elite Population

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- **New methods of within-family selection to improve accuracy of selection**
  - **Marker-assisted selection**
    - **QTLs identified for MFA, specific gravity, lignin, hemicellulose,  $\alpha$ -cellulose, etc.**
    - **Map to same linkage groups as QTLs for volume**
  - **Clonal forestry**

# Summary

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- **Tree improvement community balancing need to improve growth while maintaining wood quality**
- **Economic focus will continue to be on volume production but WGFTIP is:**
  - **Maintaining flexible population**
  - **Developing specialty program**

# Summary

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- **For WQEPop to be successful,**
  - **Recognition of the importance of wood quality**
  - **Better and less expensive measurement techniques**
  - **Better methods of within-family selection**
  - **Acceptance of clonal forestry**

# Summary

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- **Ultimate breeding objective remains increased value whether achieved solely with improvements in volume or a combination of improvement in volume growth and wood quality**

Happy Father's Day!