Plantation Management Research Cooperative
Warnell School of Forestry & Natural Resources
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A Combined Silvicultural and Genetic Approach to Understanding Forest Growth and Yield Responses in the Southeastern U.S.

Include Project Code (i.e. CAFS.22.36)

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Plantation Management Research Cooperative

Presented by Lainey Paulus (M.S. Student)

Justification

Genetic Improvement and Productivity

- Since the 1950s, breeding efforts have more than doubled plantation productivity, reduced rotation lengths, and increased volume 63%+ for third-cycle selections over the nonimproved check lot (McKeand et al. 2021).

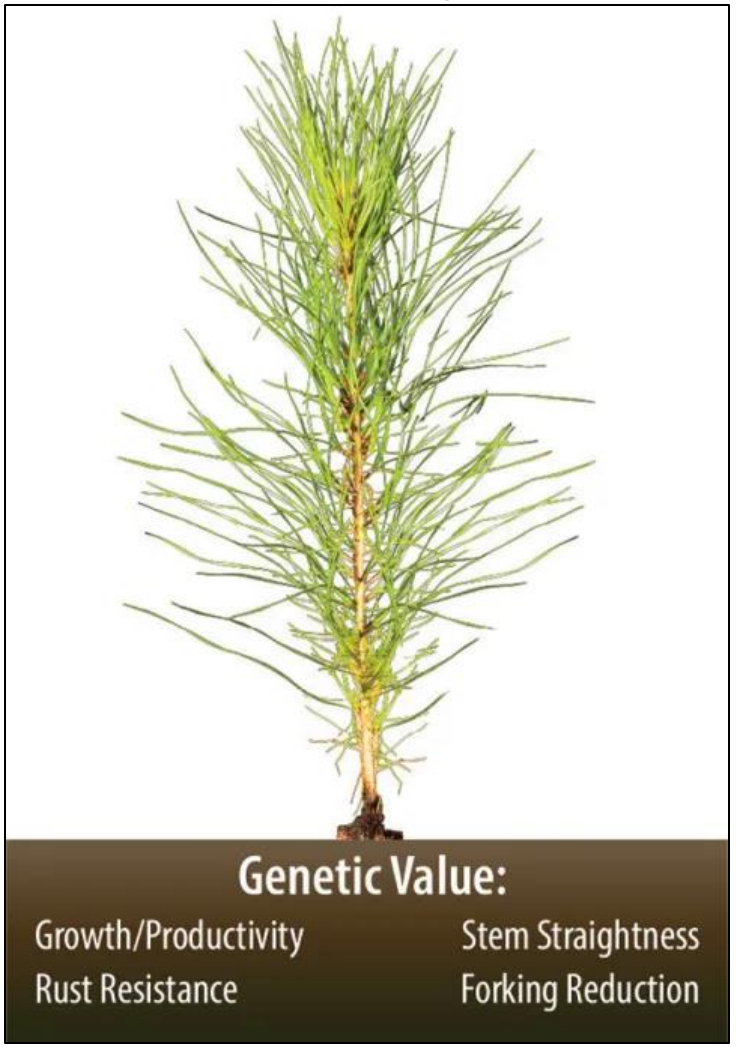
Economic and Silvicultural Benefits

- Improved genetics and silviculture have enhanced timber volume, stem form, and disease resistance, boosting tree and stand value.

Selection Methods and Future Gains

- Landowners choose from open-pollinated, full-sibling, and clonal varieties, with tools like the NC State Tree Improvement Program's Performance Rating System (PRS) guiding optimal selections.

@ https://www.arborgen.com/



General Objectives

1. Establish a large-scale research experiment across the southeastern U.S. to assess the effects of improved genetics and intensive silviculture on loblolly pine growth and long-term yields

2. Use early stand attributes and site environmental data to project stand development at rotation age

Specific Objective

- Evaluate survival rates and juvenile height growth to assess the effects of improved genetics and intensive silviculture on loblolly pine development.

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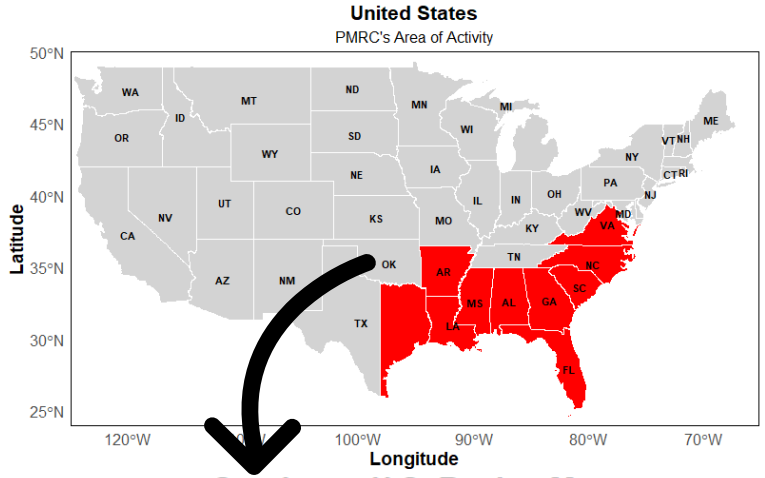
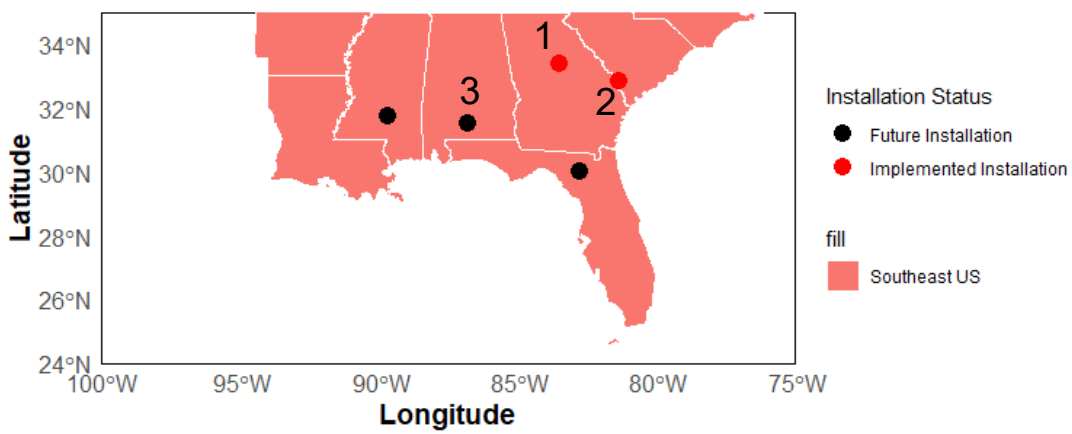
Materials and Methods

Silviculture and Genetics Trial Installation





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Materials and Methods

PRS Scores

TREE IMPROVEMENT PROGRAM
NC STATE UNIVERSITY

Dr. Trevor Walker
Co-Director, Cooperative Tree Improvement Program
Assistant Professor, Forest Genetics

Year_sown	Greenhouse_code	Productivity	Height	Rust	Rust Grade	Strt	Strt Grade	Fork	Fork Grade	PRS_Version
2023	GxS_1	80	22	19	A	37	B	43	C	2023 Piedmont
2023	GxS_2	63	19	15	A	54	A+	39	B	2023 Piedmont
2023	GxS_3	49	17	9	A	51	A	31	A	2023 Piedmont
2023	GxS_4	27	6	8	A	37	B	35	A	2023 Piedmont
2023	GxS_5	84	21	11	A	33	C	41	C	2023 Piedmont
2023	GxS_6	108	23	9	A	58	A+	41	C	2023 Piedmont
2023	GxS_7	67	15	11	A	42	A	34	A	2023 Piedmont
2023	GxS_8	60	15	4	A+	48	A	38	B	2023 Piedmont
2023	GxS_9	85	21	7	A+	33	C	34	A	2023 Piedmont
2023	GxS_10	45	10	9	A	50	A	35	A	2023 Piedmont
2023	GxS_11	71	22	14	A	58	A+	37	B	2023 Piedmont
2023	GxS_12	69	18	13	A	30	C	36	A	2023 Piedmont
2024	901	42	10	9	A	40	B	51	E	2023 Coastal
2024	902	78	27	0	A+	60	A+	46	C	2023 Coastal
2024	903	54	17	7	A	42	B	40	B	2023 Coastal
2024	904	70	24	22	C	43	A	53	E	2023 Coastal
2024	905	83	25	5	A	47	A	40	B	2023 Coastal
2024	906	34	14	0	A+	44	A	43	C	2023 Coastal
2024	907	41	13	7	A	40	B	39	B	2023 Coastal
2024	908	57	19	15	B	44	A	41	B	2023 Coastal
2024	909	63	19	10	A	42	B	41	B	2023 Coastal
2024	910	25	5	8	A	50	A	36	A	2023 Coastal
2025	PMRC_01	57	17	9	A	49	A	35	A	2023 Coastal
2025	PMRC_02	59	21	0	A+	38	B	34	A	2023 Coastal
2025	PMRC_03	52	20	3	A	42	B	32	A	2023 Coastal
2025	PMRC_04	52	16	26	C	35	C	45	C	2023 Coastal
2025	PMRC_05	64	18	0	A+	55	A+	35	A	2023 Coastal
2025	PMRC_06	72	22	27	C	44	A	51	D	2023 Coastal
2025	PMRC_07	53	20	13	A	38	B	41	C	2023 Coastal
2025	PMRC_08	56	15	22	C	39	B	39	B	2023 Coastal
2025	PMRC_09	48	15	17	B	41	B	39	B	2023 Coastal
2025	PMRC_10	83	25	5	A	47	A	40	B	2023 Coastal
2025	PMRC_11	97	27	7	A	47	A	63	E	2023 Coastal

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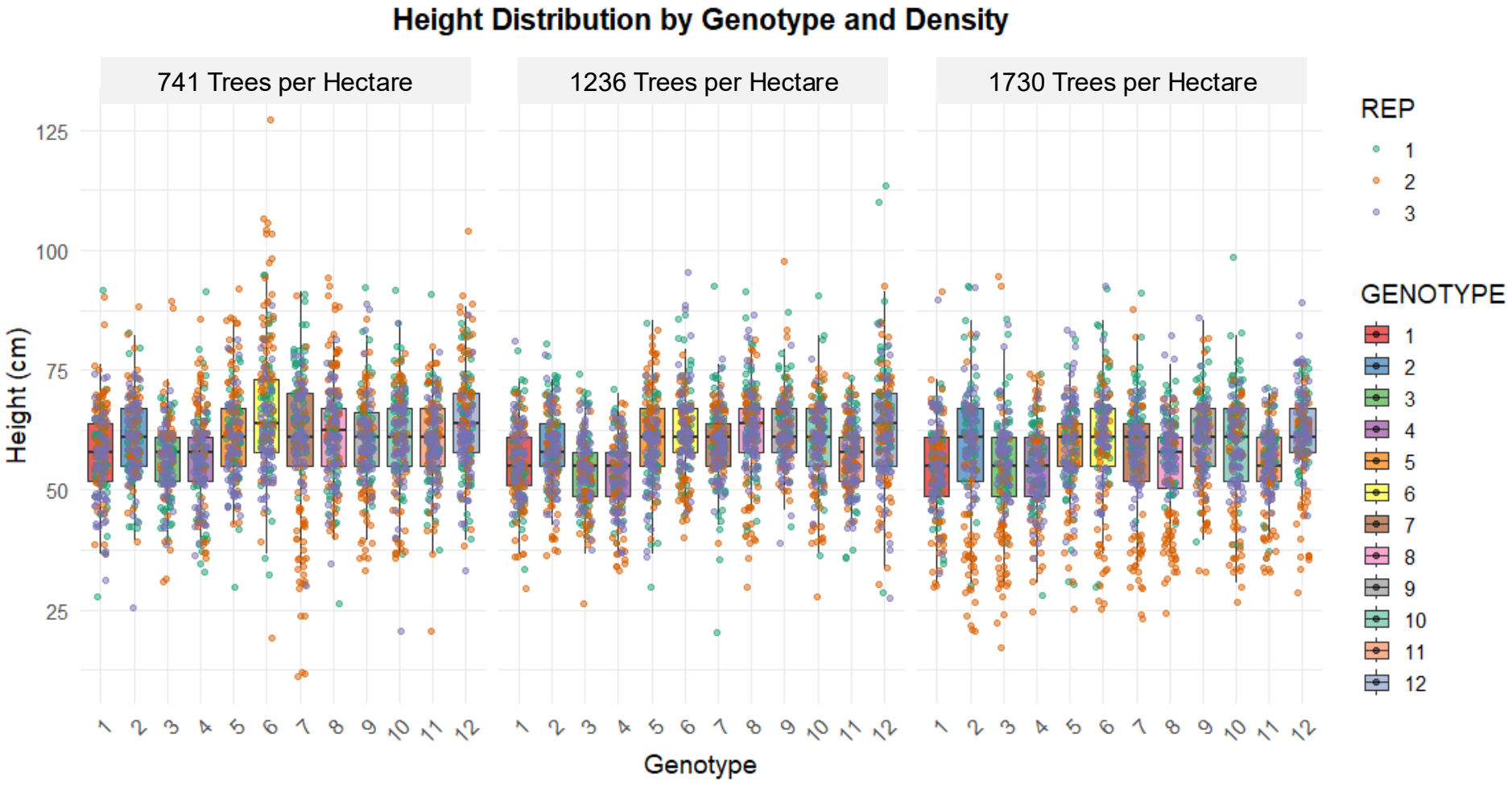
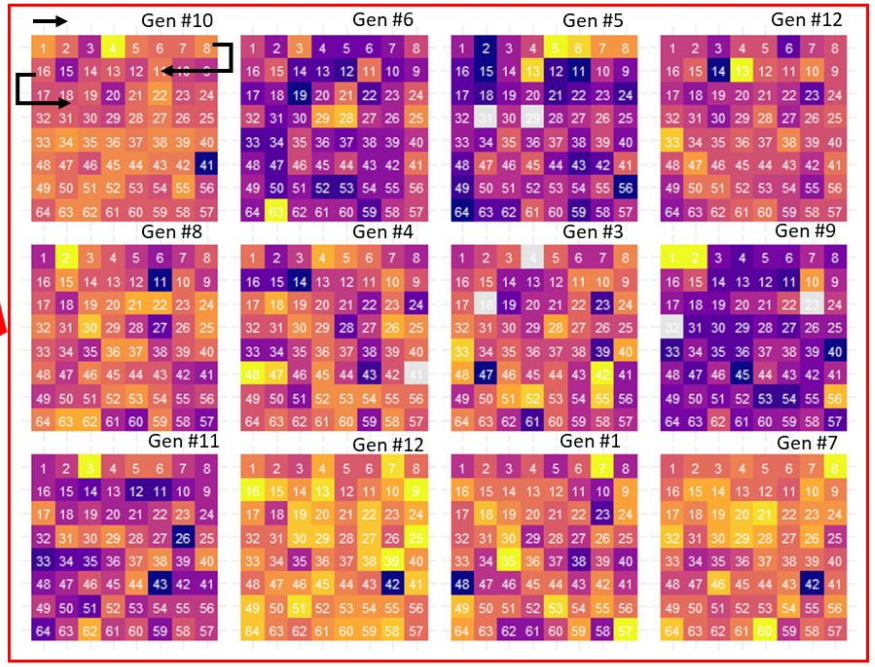
Major Findings

6,912 seedlings

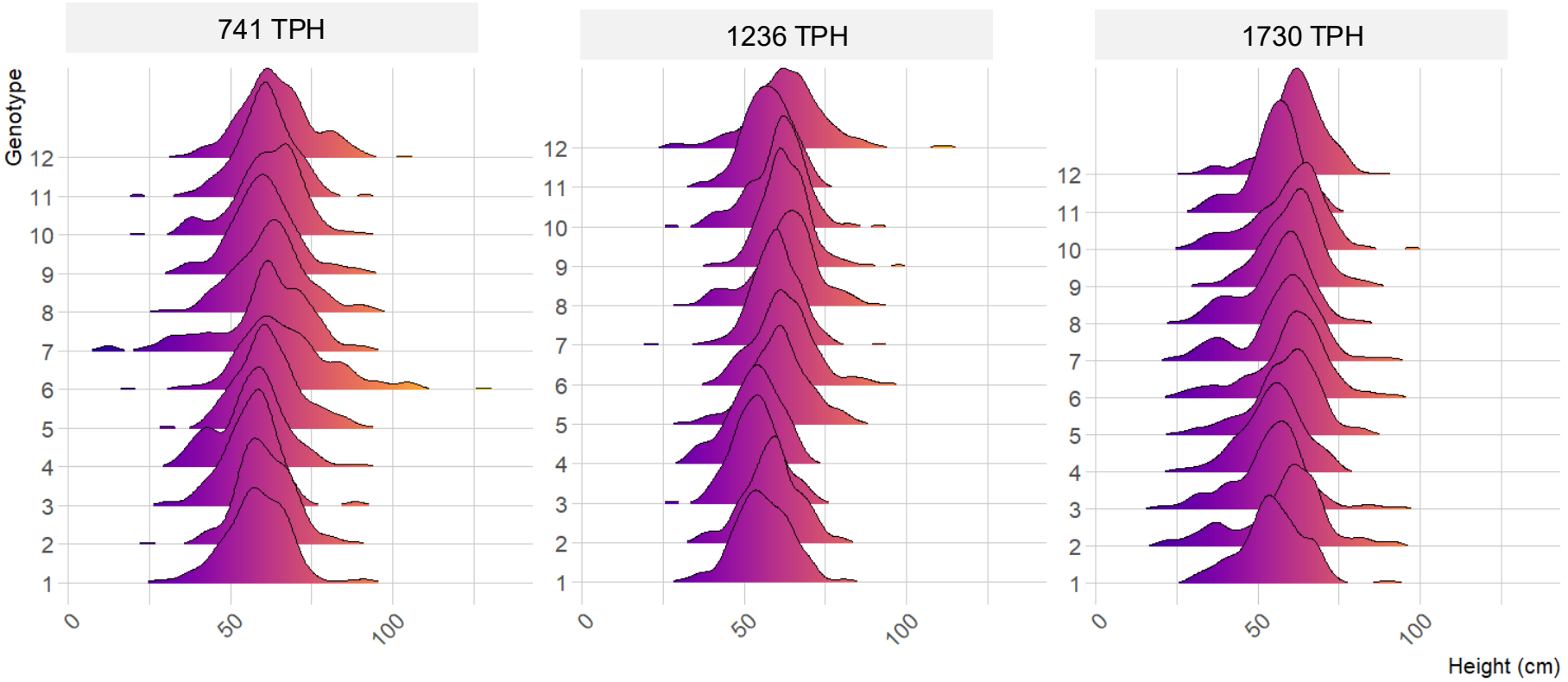


Major Findings



Major Findings

Height Distribution by Genotype and TPH



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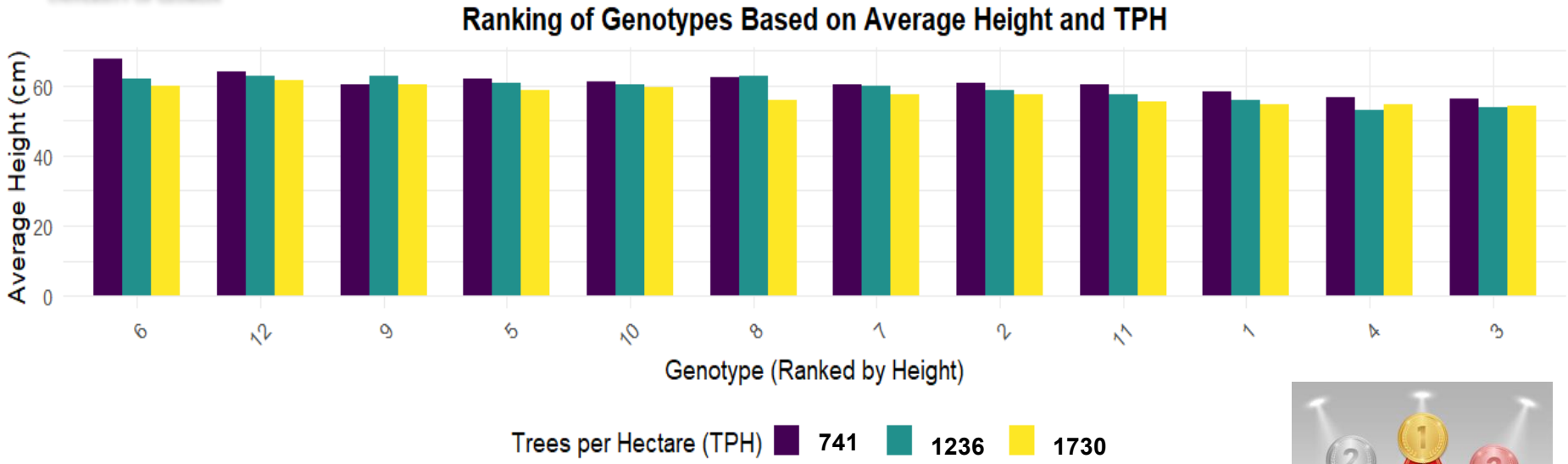
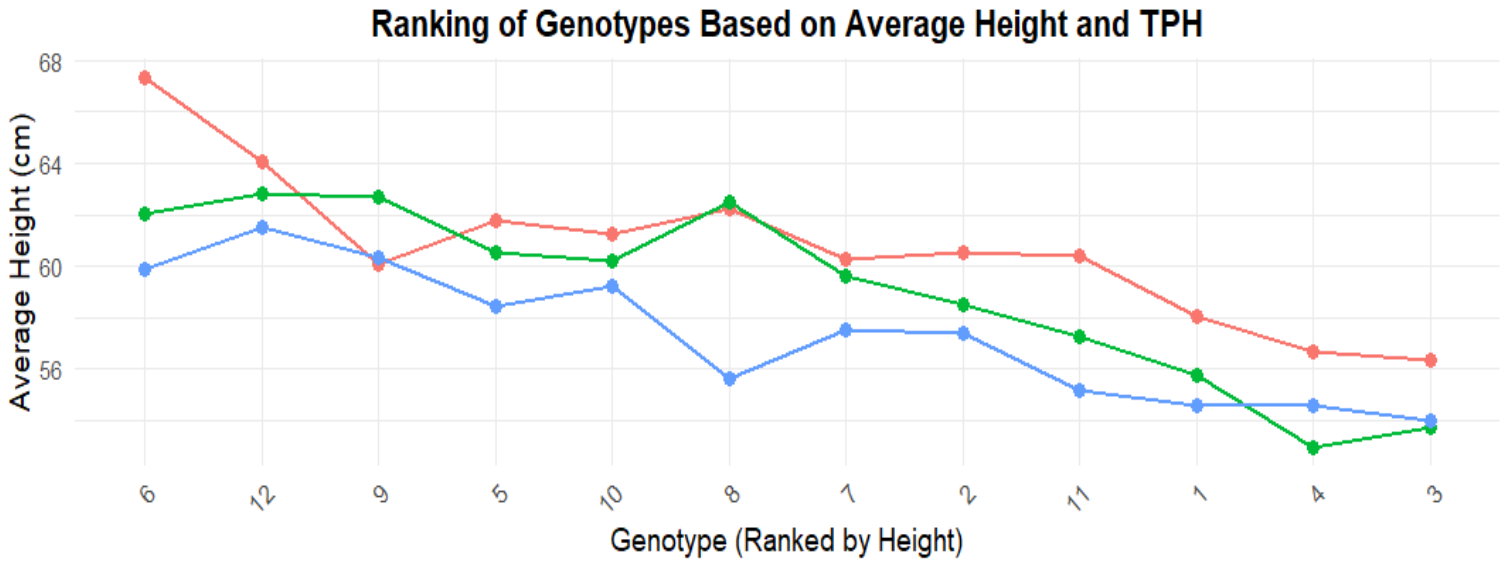
Deliverables





1 year

Company Benefits

1. **Improved Productivity and Profitability (Short & Long Term):** Information on how companies can achieve higher survival rates, faster growth, and increased yields—leading to greater timber volume and returns on investment.
2. **Optimized Management Decisions (Short Term):** Early predictive models enable better planning for site preparation, thinning, harvesting, reducing costs and improving operational efficiency.
3. **Tailored Genetic Deployment (Long Term):** Data from the experiment supports selecting the best genetic material based on TIP PRS for specific environments, maximizing performance across diverse sites.
4. **Reduced Risk and Uncertainty (Short & Long Term):** Accurate growth and yield predictions help companies better anticipate future stand conditions and market readiness, reducing financial and operational risks.
5. **Strategic Long-Term Planning (Long Term):** Enhanced models support long-term forest planning, carbon accounting, and sustainability goals—critical for certification, ESG reporting, and climate resilience.

Recommendations

Develop growth and yield models using early growth data to support adaptive forest management across a range of TIP PRS scores.

This approach enhances stand productivity, improves resource use efficiency, and reduces economic and ecological risks over the rotation.

Integrate Genetics and Silviculture in Operational Trials.

Develop or adopt predictive growth models that incorporate both genetic and environmental variables to support strategic decisions on rotation length, thinning, and yield forecasting.

Summary

- **Establishment of region-wide replicated silviculture x genetics research trial is important and on-going in the SE U.S.**
  - Costly and time-consuming – research cooperatives are essential!
  - Growing a range of genotypes across different densities
- **Genotype selection matters**
  - PRS as a mechanism to balance growth with other traits
- **Density matters**
  - Trends will likely diverge further after crown closure when intense inter-tree competition begins

Acknowledgements

PMRC Member Companies
PMRC Field Crew
NCSU Tree Improvement Program (TIP)

TREE IMPROVEMENT PROGRAM
NC STATE UNIVERSITY

THANK YOU!

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