

USDA FOREST SERVICE LONGLEAF PINE PROGENY TEST REVIEW AND ANALYSIS

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Genetic Resource Management Program

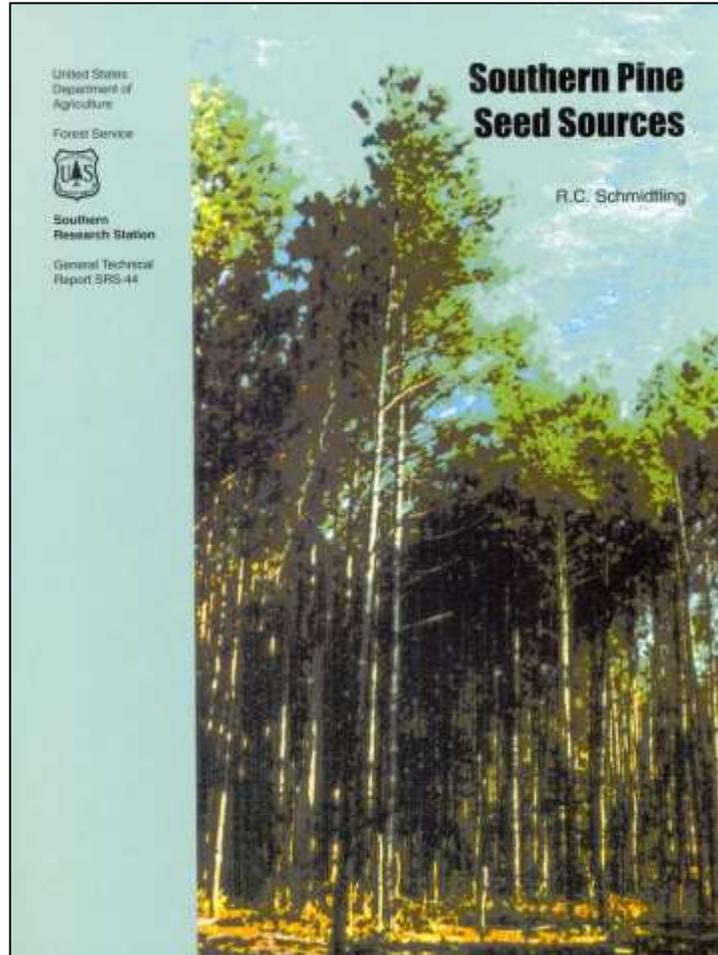
Reforestation & Restoration Genetic Conservation Partnerships

Formerly known as Tree Improvement

National Genetics Strategic Plan ***2017 under revision***

•Southern Region Program activities:

- Collect & maintain seed supply to support reforestation & restoration, seed forecasting
- Use local seed source, e.g., seed orchard seed, seed production areas, using appropriate seed zones

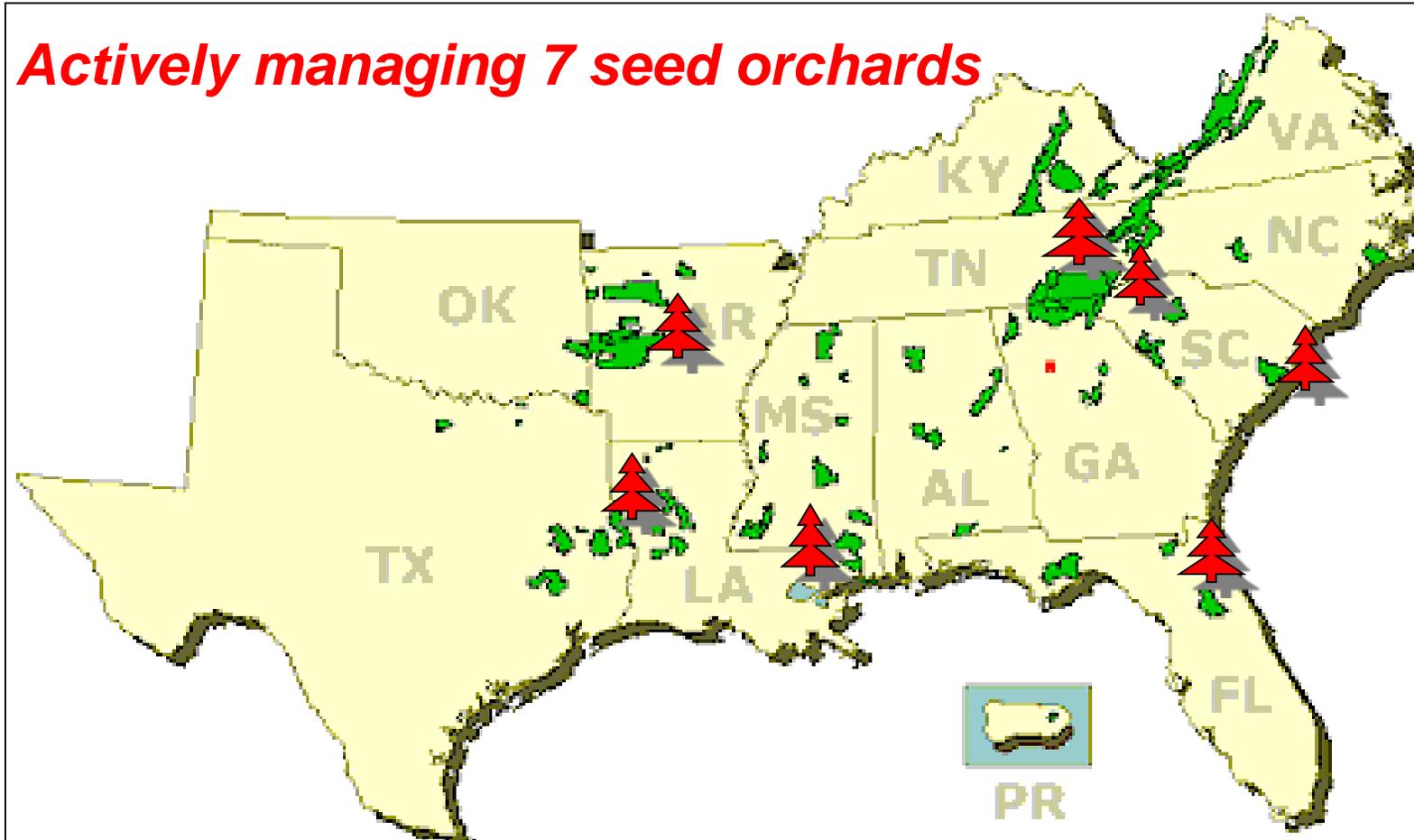


Ashe seed bank, DeSoto National Forest



**USDA Forest Service Region 8
Genetic Resource Management Program**

Actively managing 7 seed orchards



Seed orchard locations & species:

**pinus -- loblolly, longleaf (coastal & mountain), sand, slash,
shortleaf, table mountain, Virginia, white**

hardwoods -- American chestnut, black cherry, butternut, oaks

Major Region 8 Pine Species— Shortleaf & Longleaf



Shortleaf pine seed orchards

500 acres 1st Generation
27 acres 2nd Generation
0 acres 3rd Generation
? acres Seed Production Area

Longleaf pine seed orchards

503 acres 1st Generation
37 acres 2nd Generation
2.5 acres 3rd Generation
272 acres Seed Production Area

Longleaf pine

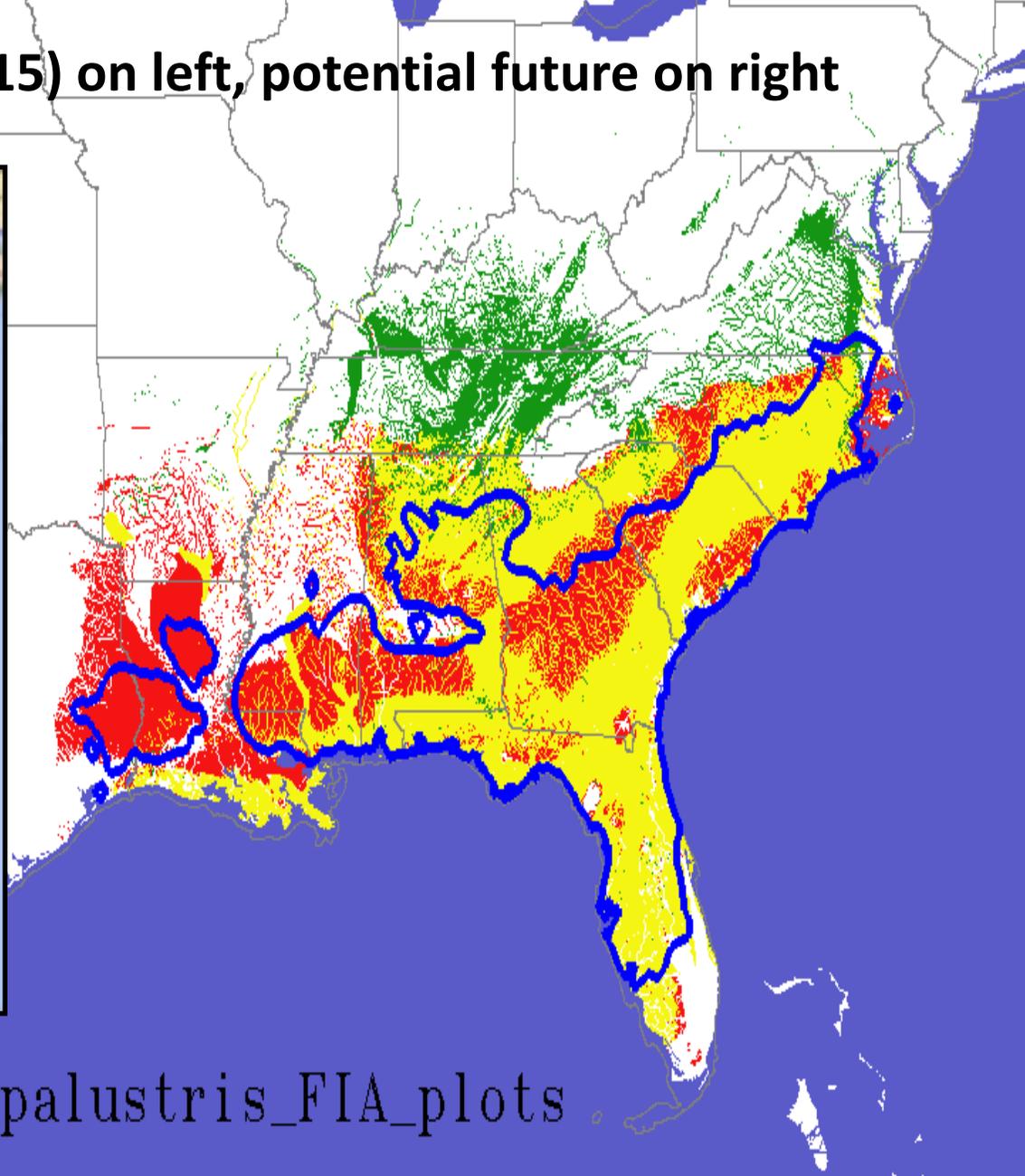
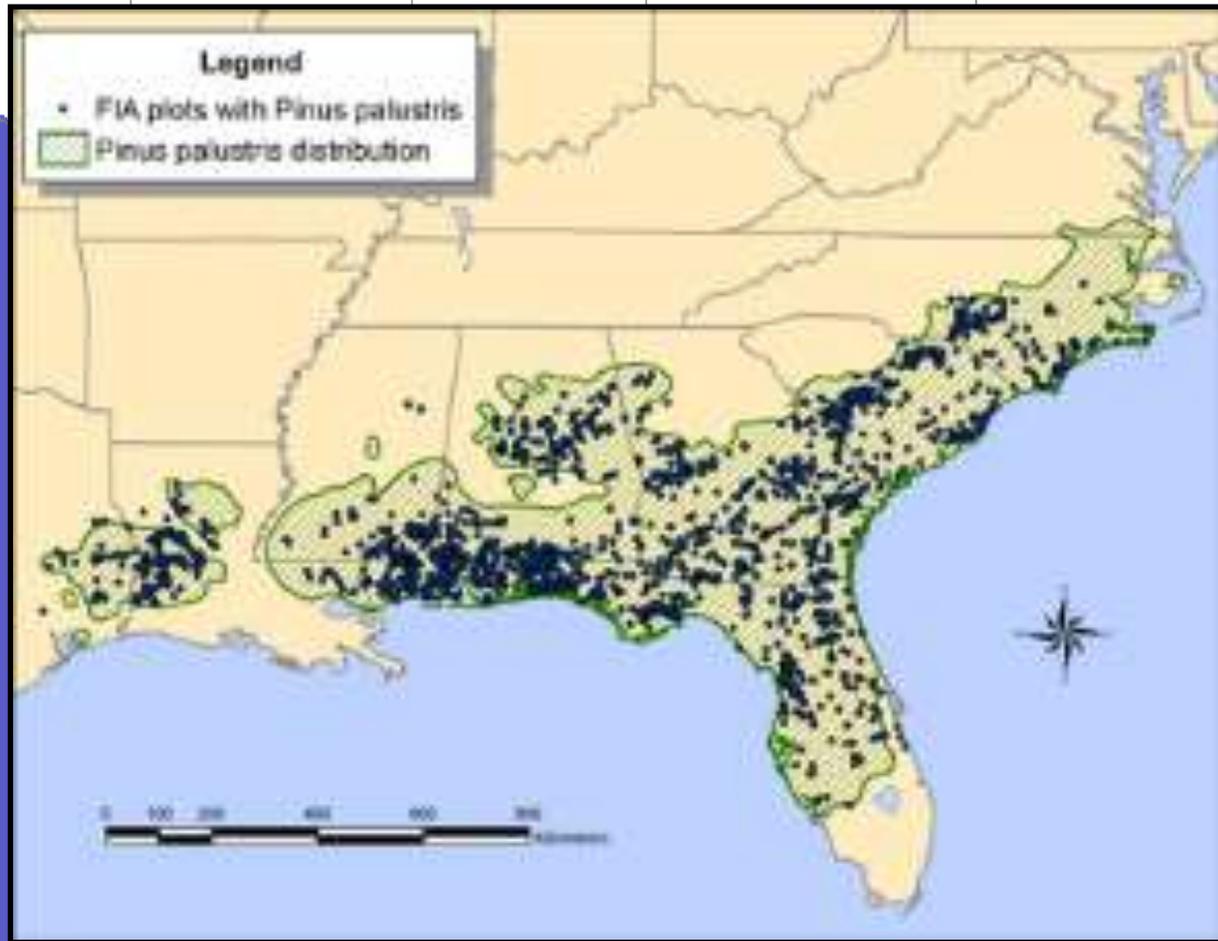
- *Forest Service seed orchards comprise ~ 75% of all longleaf pine orchard resources across the south*
- *Most other agencies that have longleaf pine orchards provide little or no maintenance*
- *NFS 35/55 progeny tests re-established (prescriptions written, measurements completed and first reported here)*
- *Progeny tests are valuable resources for seed and scions for next-gen orchard development*

***Why do we want to establish new orchards?
To ensure productivity
And where do we establish new orchards?
To ensure adaptability***



Longleaf pine seed orchard in MS

Longleaf pine distribution, current (2015) on left, potential future on right



Pinus_palustris_FIA_plots

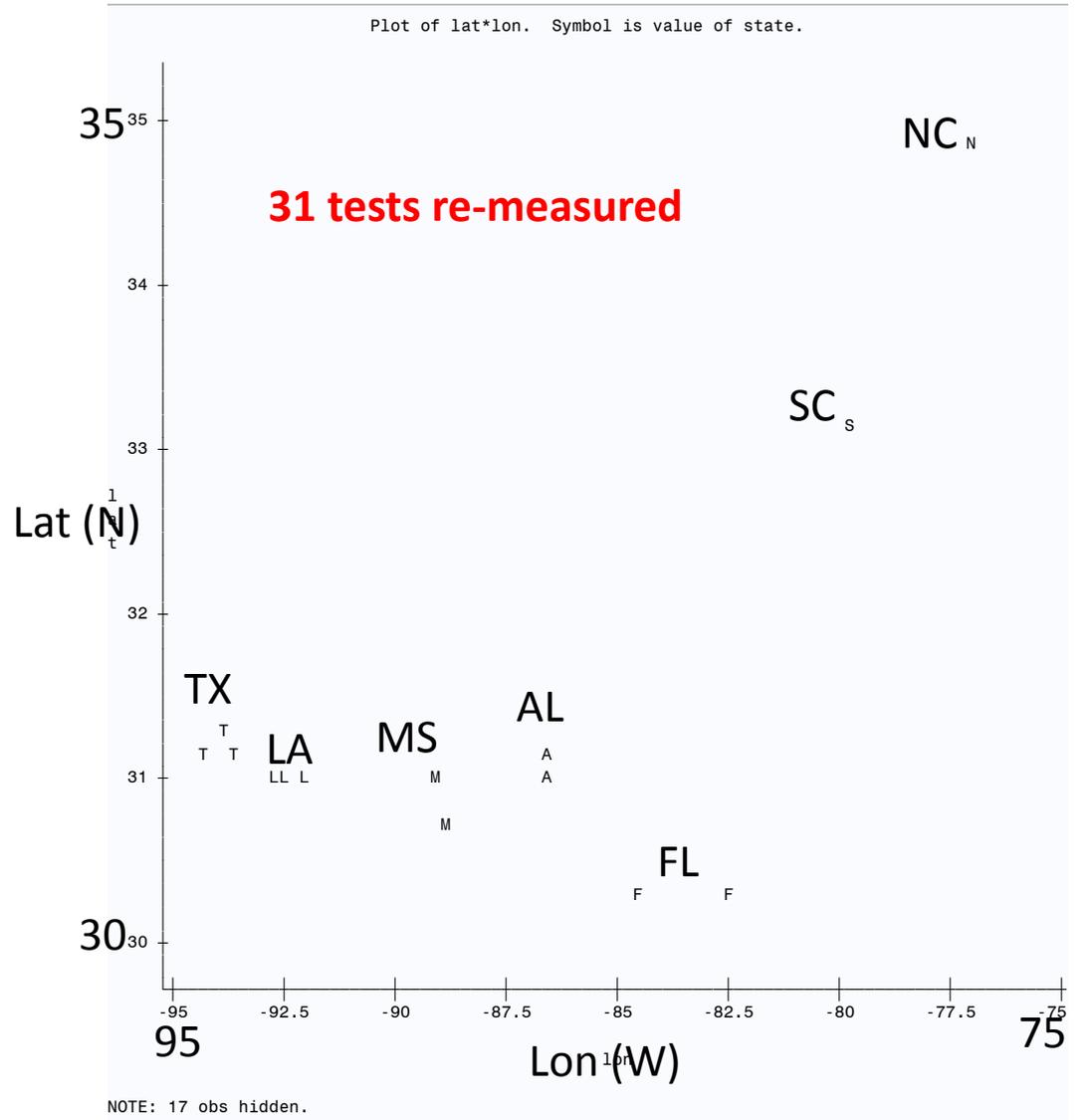
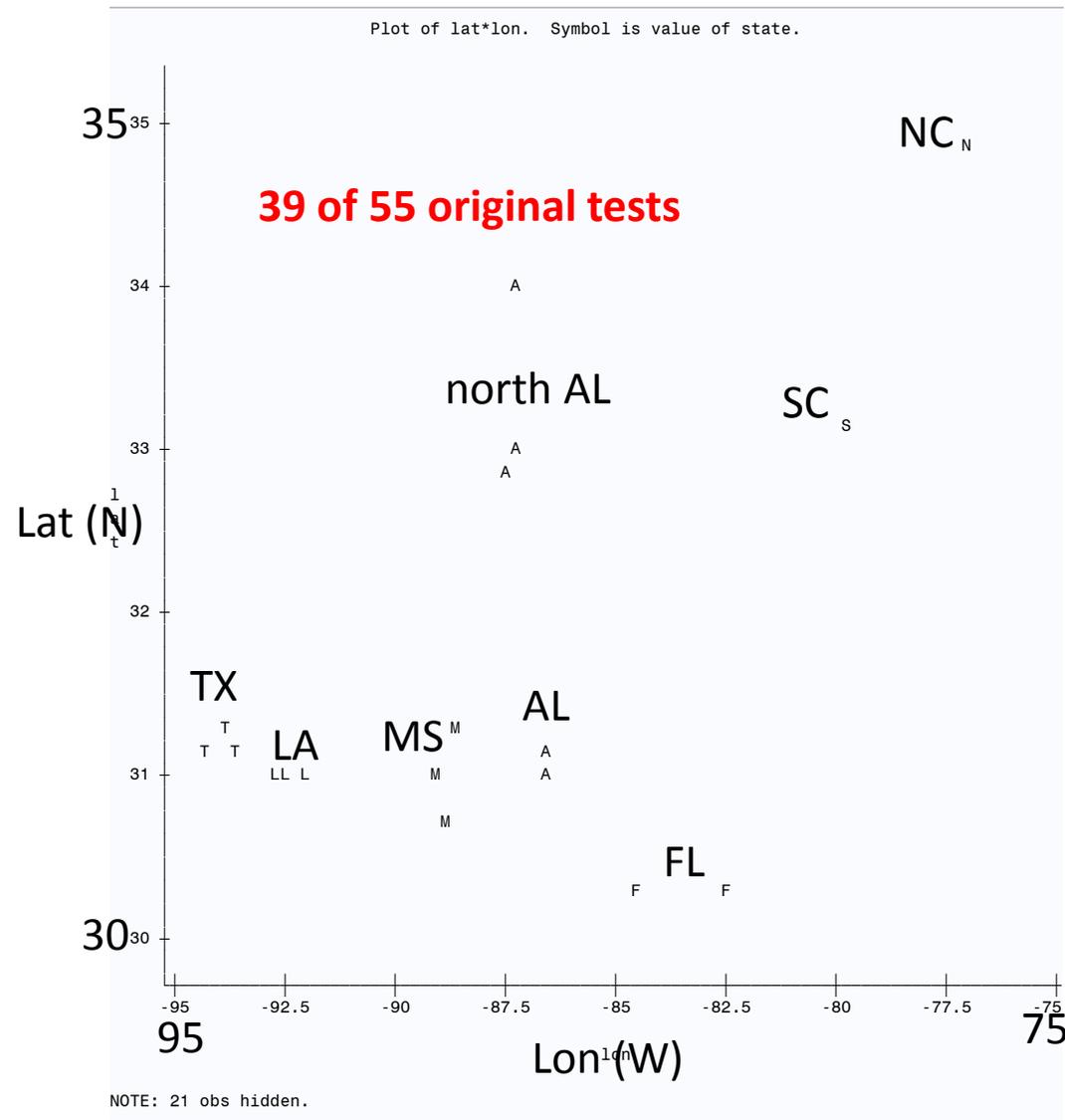
Longleaf pine containerized nursery, seedling and seed storage



USFS Region 8 Longleaf Pine Progeny Test



Geographic (Lat, Lon) distribution of Test sites

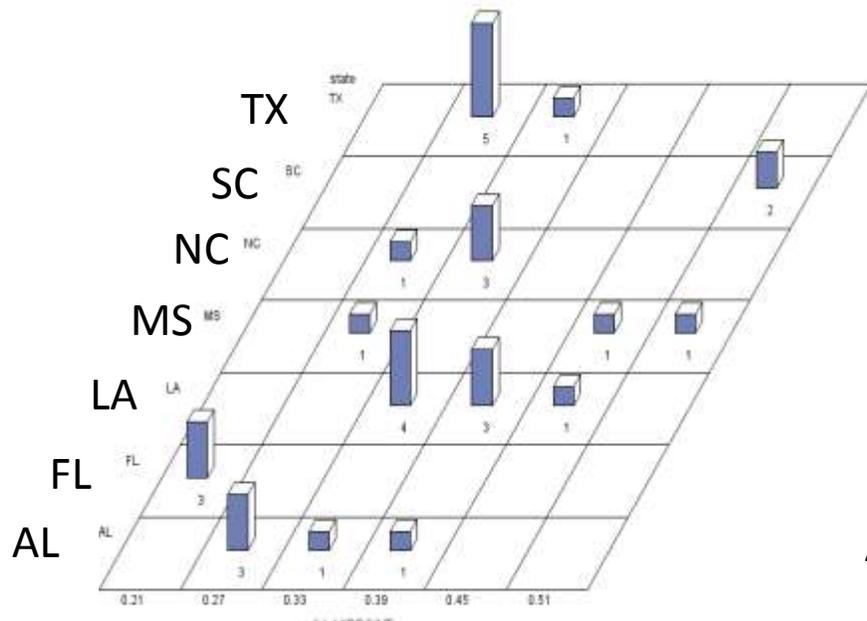


Over all 31 Tests– Number, Mean, Std Dev, Min, Max

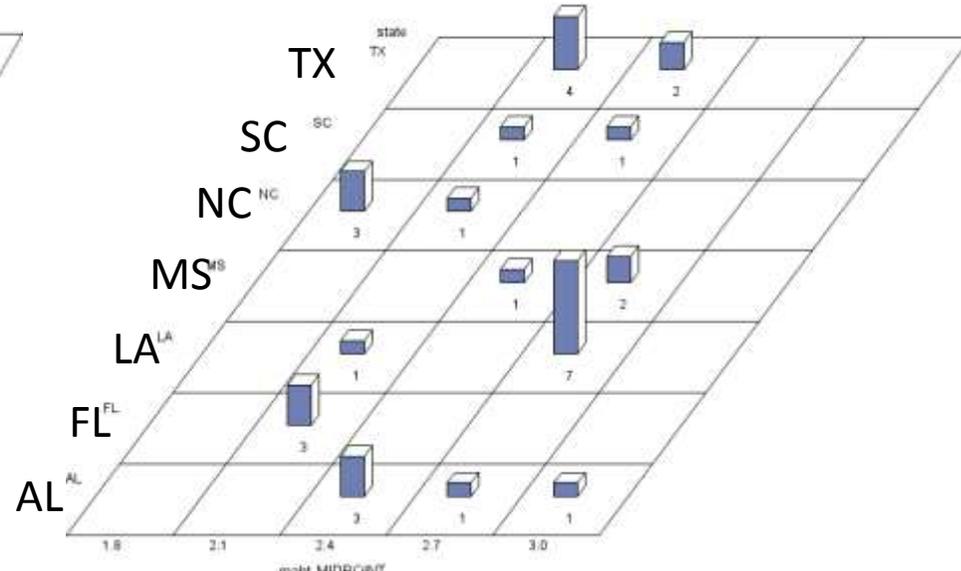
Variable	N	Mean	Std Dev		Minimum	Maximum
ma DbH (in/yr)	31	0.337	0.0844		0.210	0.523
ma HT (ft/yr)	31	2.36	0.322		1.70	2.98
N live Trees	31	498.7	321.69		69	1232
N Females	31	30.4	10.06		15	47
Survival	31	0.38	0.203		0.09	0.74
Age (yrs)	31	20.4	2.29		16	22
Lat (N)	31	31.6	1.38		30.3	34.8
Lon (W)	31	87.8	5.98		94.4	77.1

Statistical and Genetic models

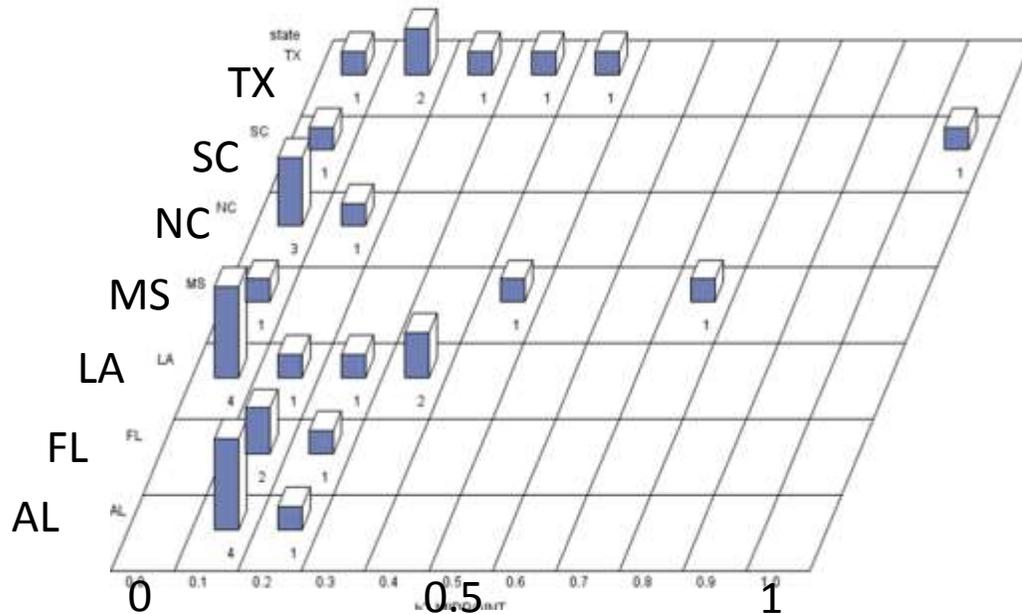
- Randomized complete block design at each test
 - 6 to 8 reps per test
 - 7 to 4 trees/plot (row plots)
- Variance components and narrow sense heritability
 - $Y = \text{Rep}(\text{Test}) + \text{Female} + R * F + \text{Error}$
 - All factors considered random, SAS proc mixed
 - $H^2 = 4 * \text{FemVar} / (\text{FemVar} + R * \text{Fvar} + \text{ErrVar})$
- approximate Female breeding values
 - Female LSMs in same model expect Females considered fixed



Mean Annual DbH (0.2 to 0.5 in)

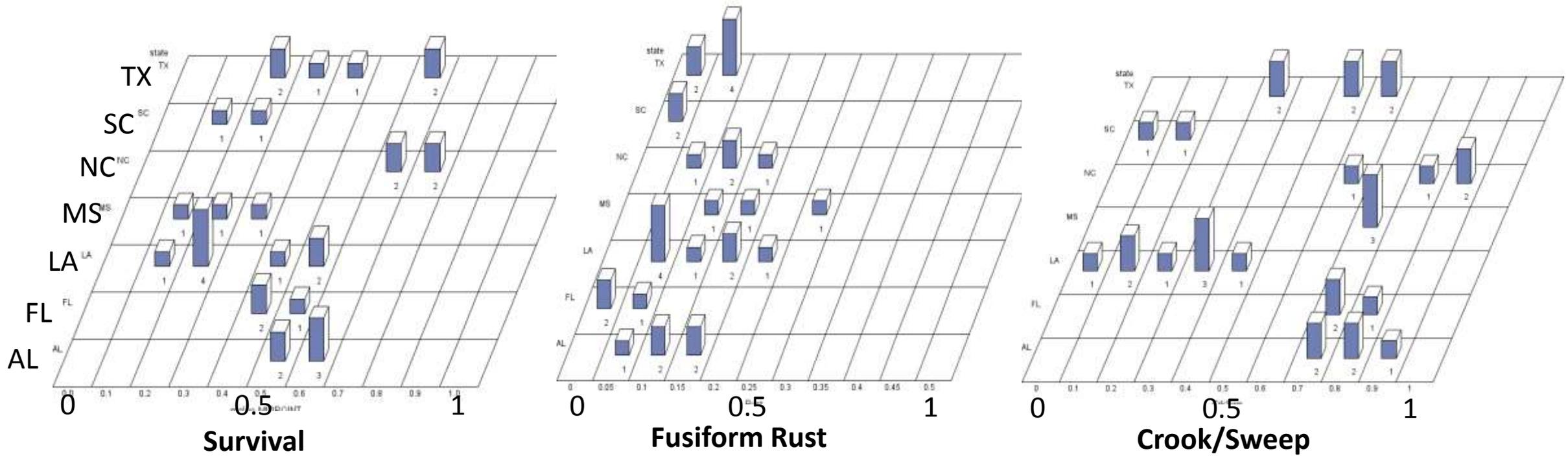


Mean Annual HT (1.8 to 3.0 ft)

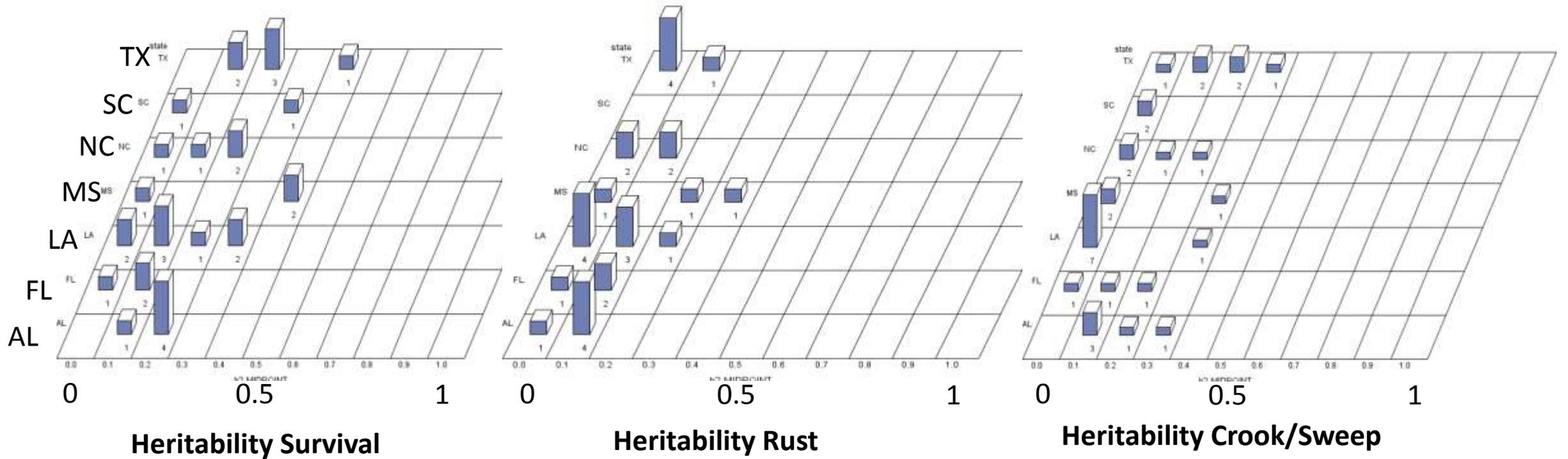


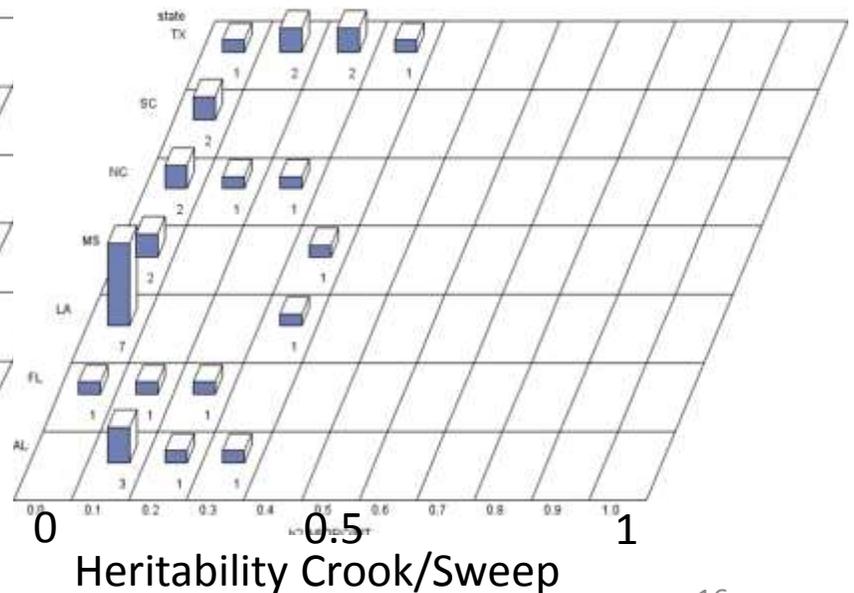
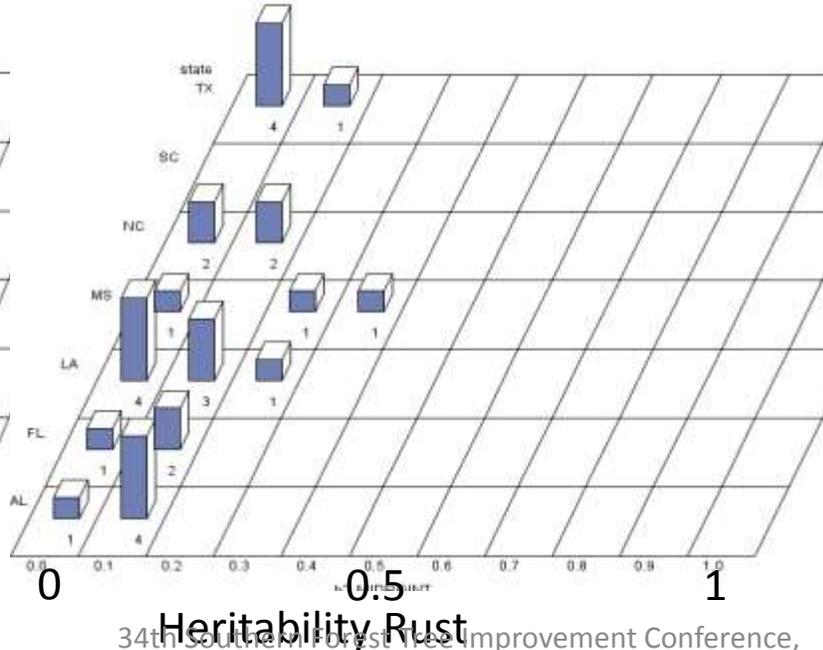
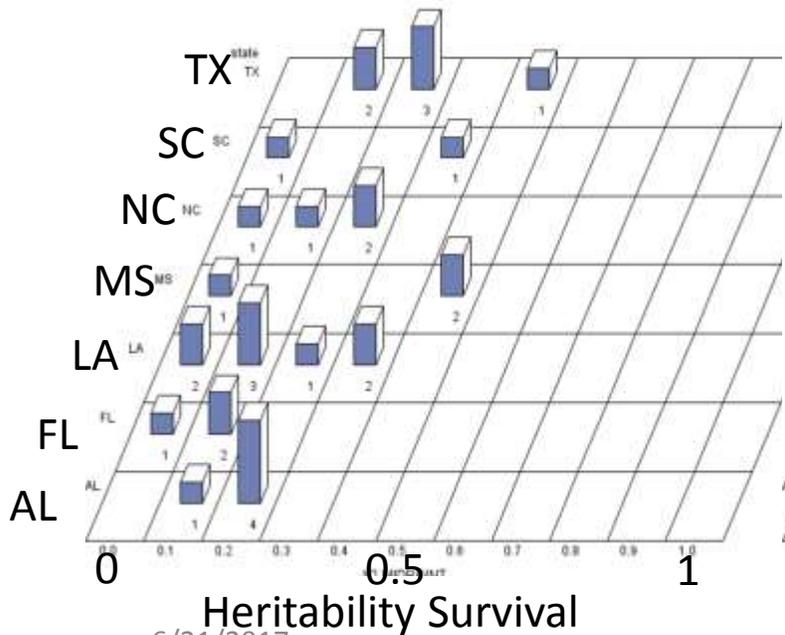
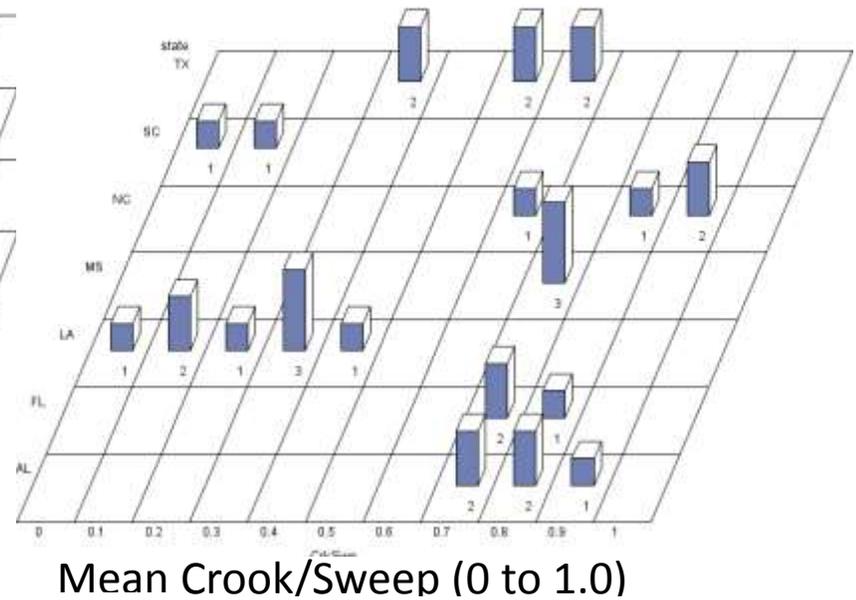
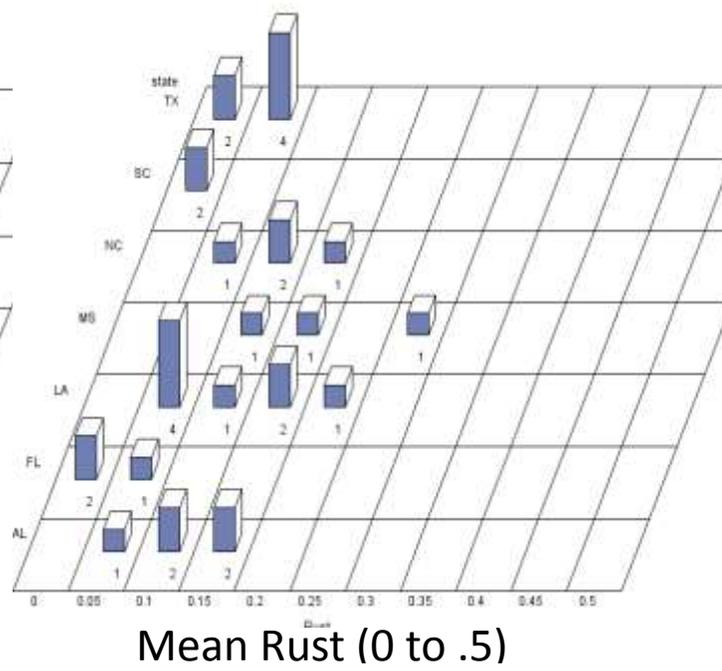
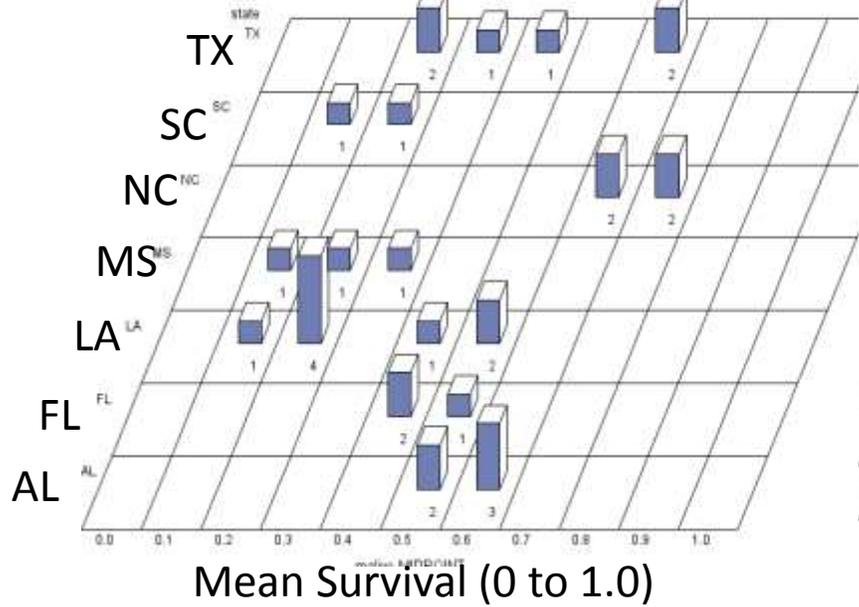
Heritability DbH

Distribution of Test Means by state

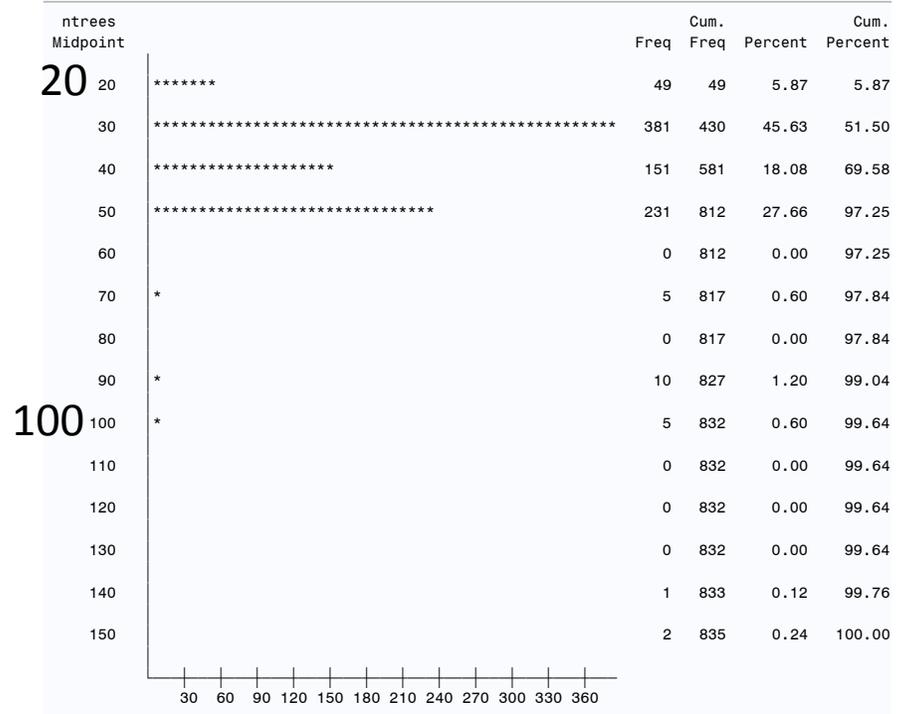
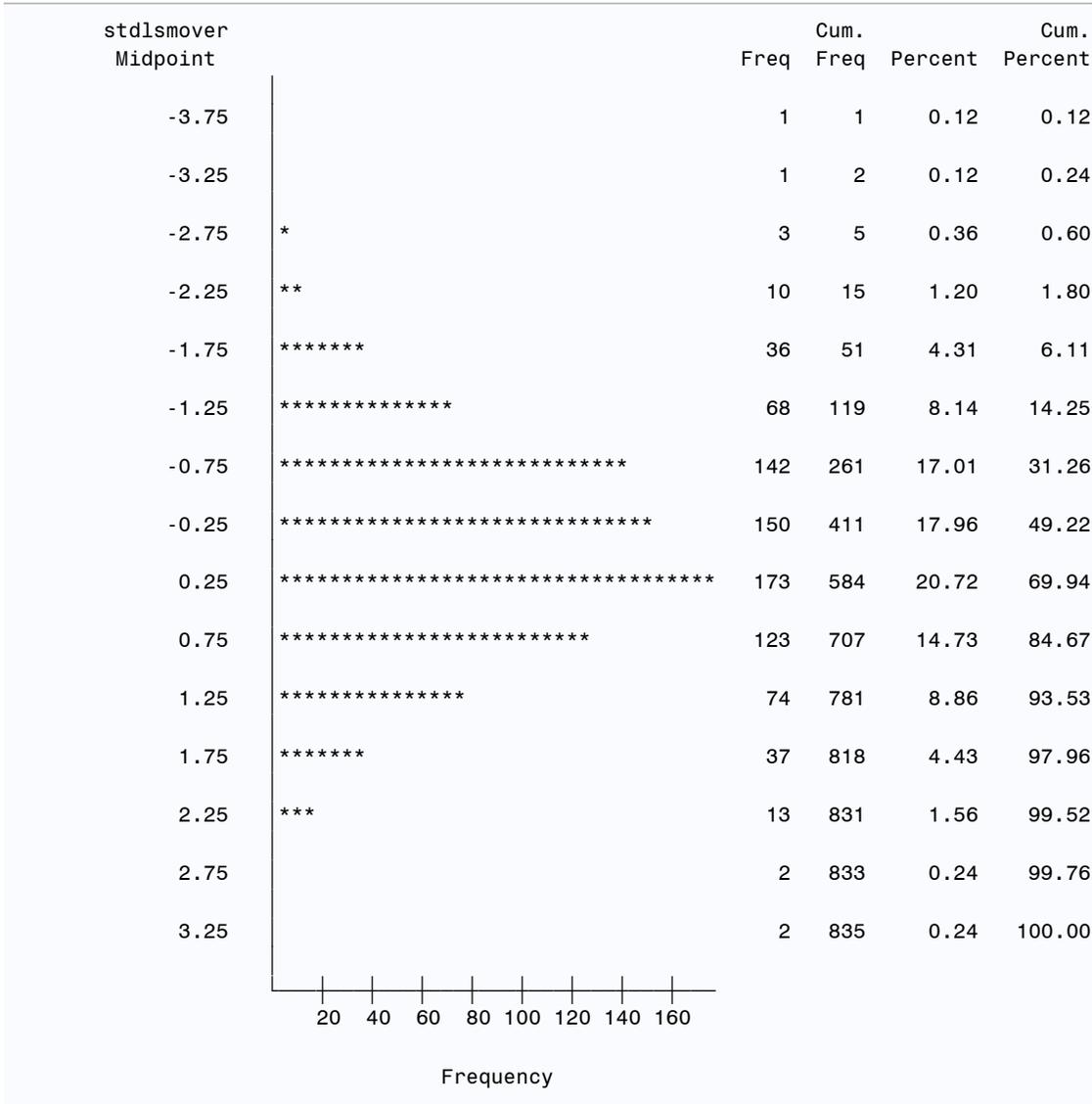


Distribution of Heritability by state

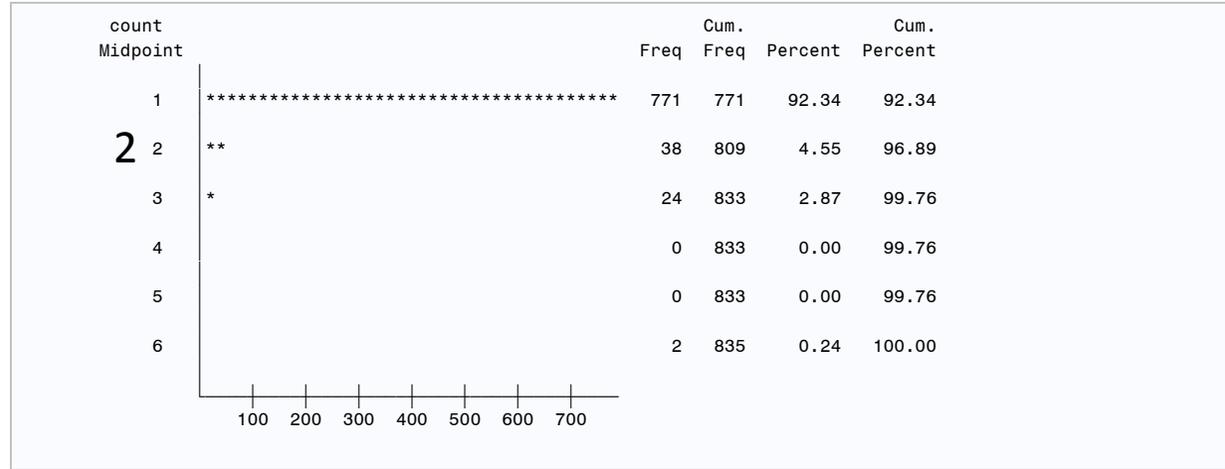




Trait = DbH, std Female LSMs over Tests



Number of Progeny (within states) per Female



Number of Tests (within states) per Female

Selection Strategy

- First-gen orchard rogueing
 - Use Female BV to rogue existing 1st gen orchards
 - Keep much genetic diversity, while rogueing inferior Females to optimize spacing and seed production
- Second-gen orchard establishment options
 - A. Use individual tree BVs to select 2nd generation orchard– collect scions and graft 100 local optimized genotypes per orchard
 - May weight selections more heavily on warmer test locations
 - B. Use individual tree BVs to select 2nd generation orchard– collect seeds for seedling seed orchard

Summary and Conclusions

- USFS Southern Region's longleaf progeny tests and data provide valuable resources for longleaf pine restoration
- Survival varies widely among tests, but heritability (additive genetic variance) is observable for most important traits
- Over 800 parents were tested over 7 states (region-wide), so a wide sampling of genotypes and environments was achieved
- Genetic gains can be achieved while maintaining most genetic diversity
 - Old orchards can be improved (genetics and seed yield)
 - New orchards can be established