

Short rotation yields of pure and mixed family plots of loblolly pine

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Research initiators

- Warren and Sam

Loblolly Pine

- Genetics and Tree Improvement
 - Tree Improvement Coops have completed three generations of selection and breeding
 - Selection based on breeding values (additive genetic variance) in small or single tree plots
 - Improved material deployed as OP families, CP families, and SE varieties
 - Often in single family blocks
 - Essentially all planting stock is genetically improved
 - Growth (Ht & DbH), Form, and Fusiform rust resistance

Loblolly Pine

- Silviculture and Production
 - Bareroot seedlings, around 500 TPA
 - First thin at 7-10 yrs– pulpwood
 - Second thin at 15-17 yrs– mixed products
 - Final harvest at 25 yrs– poles, lumber, veneer
- ~ 2.2 M ac planted per year
 - 750M to 1B seedlings
- Biomass yields as high as 12-15 Mg/ha/yr

The MIXING Study

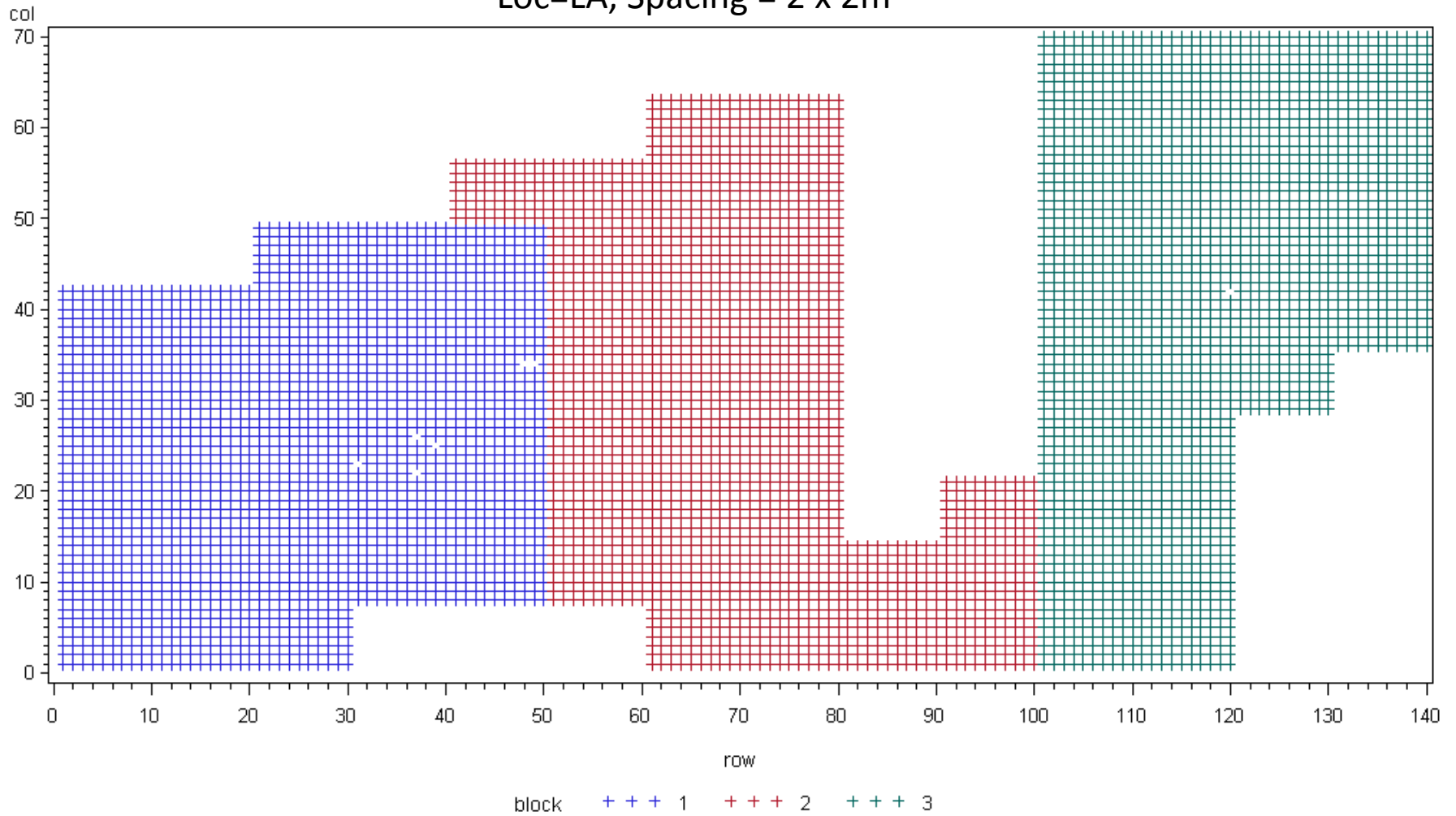
- Two Main Objectives
 - Determine and compare stand yielding abilities of loblolly pine families in pure and mixed plots
 - Model stand yields in pure plots with data from mixed plots

The MIXING Study

- Experimental Design
 - 10 representative families
 - Pure and Mixed plots
 - 70 tree plots (7 rows x 10 cols)
 - 3 types of mixed plots
 - Binary mixes (75/25 and 25/75)
 - Row mixes (simulates row plot progeny tests)
 - Blends (simulates non-contiguous tree plot progeny tests)
 - 2 Spacings at 2 Locations
 - 1 x 2 m (2024 TPA) and 2 x 2 m (1012 TPA)
 - Louisiana (LA) and Mississippi (MS)
 - Split plot, RCBD with 3 blocks w/in each spacing at each location

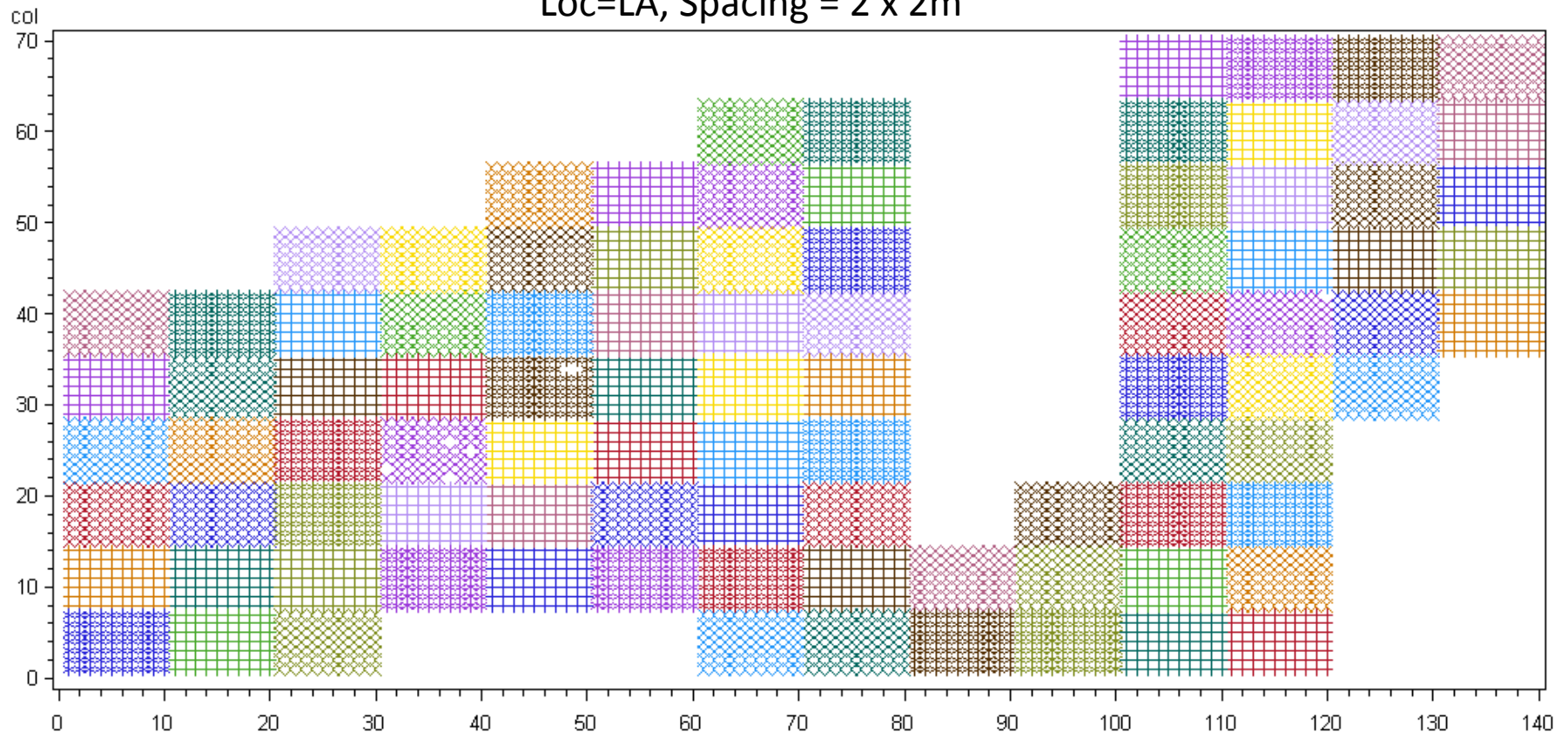
Mixing Study-- Loblolly Pine

Loc=LA, Spacing = 2 x 2m



Mixing Study-- Loblolly Pine

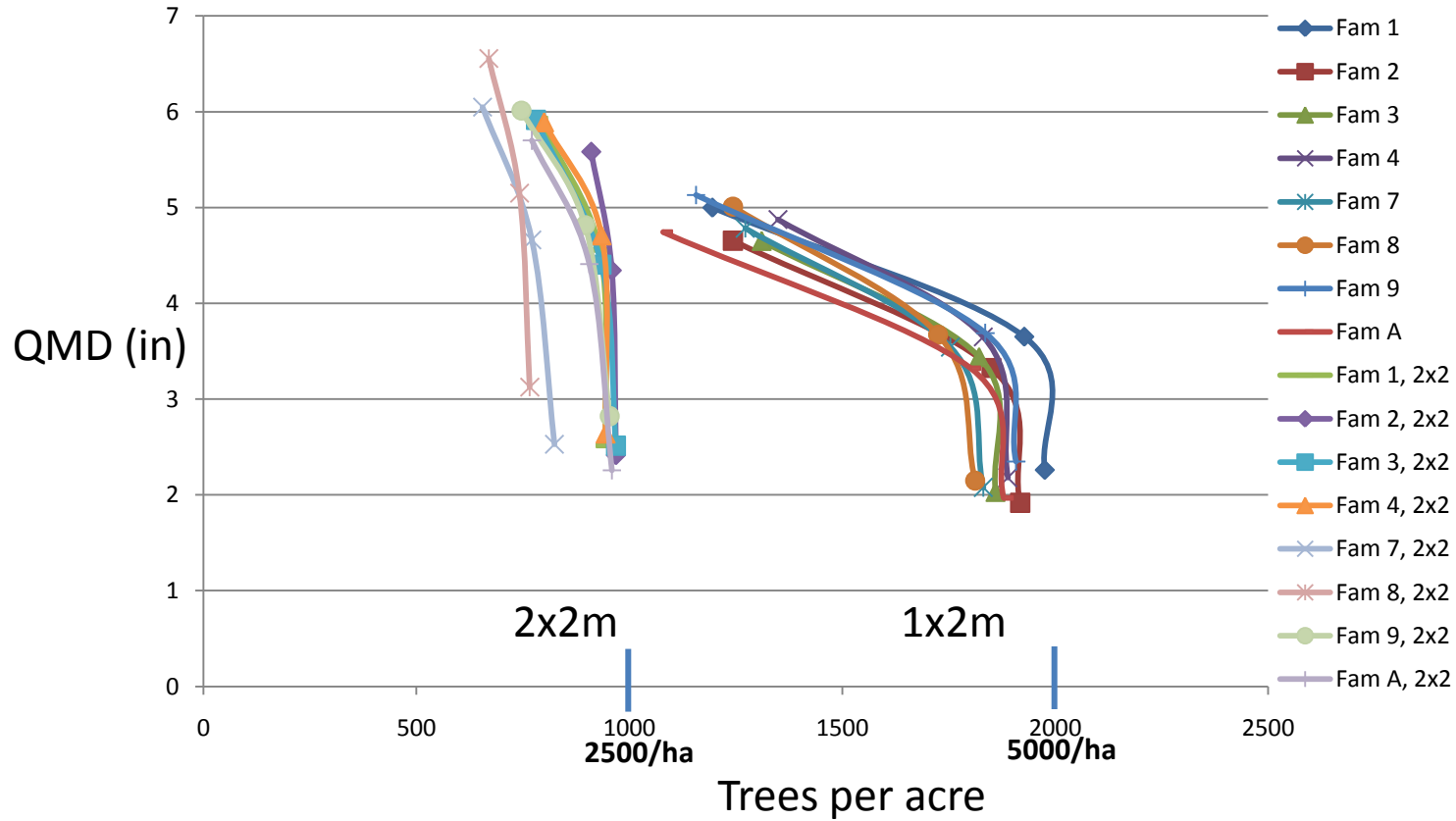
Loc=LA, Spacing = 2 x 2m



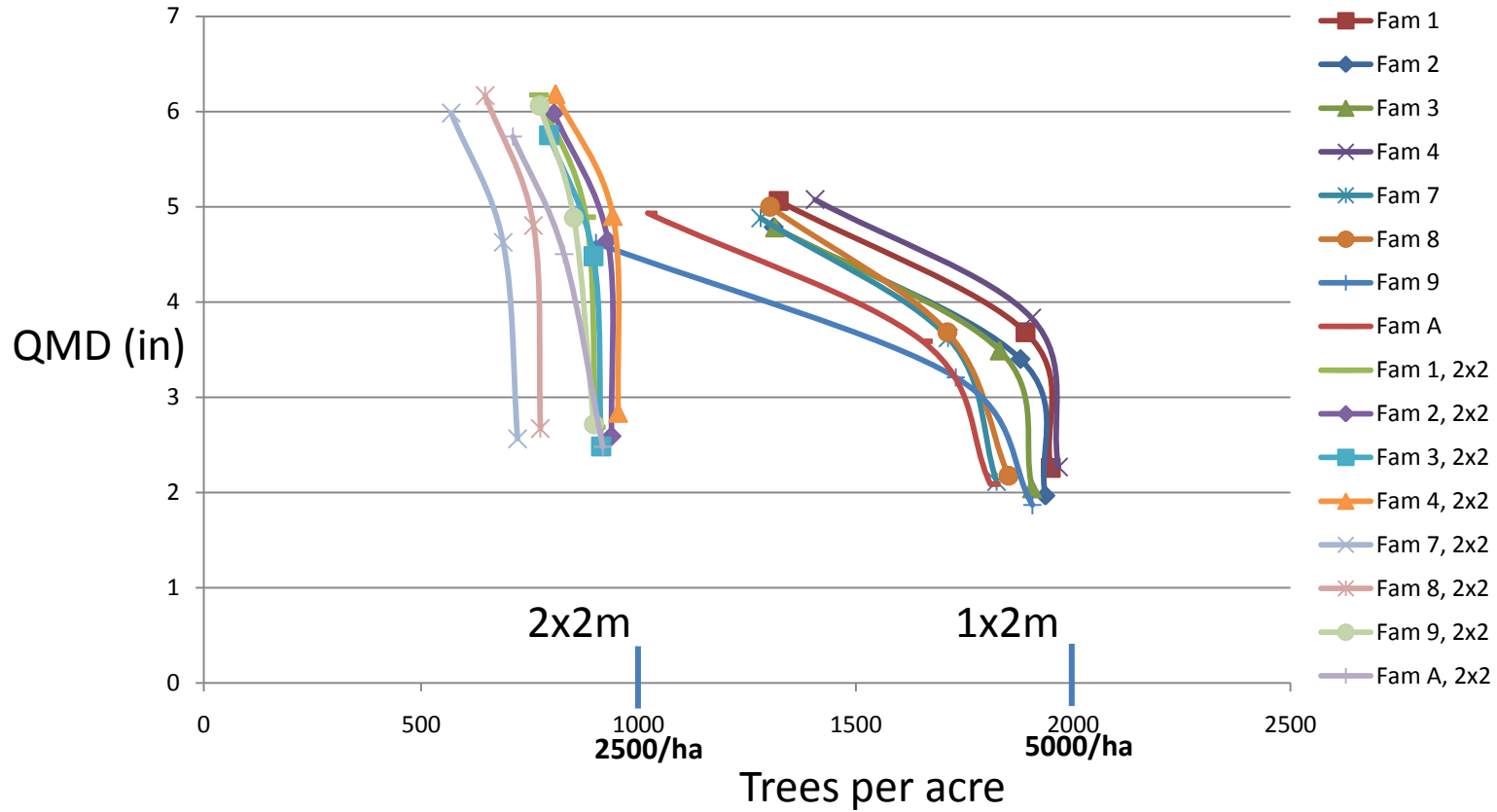
The MIXING Study

- Data
 - Trees measured at ages 5, 10, 15 years
 - Height and DBH; Fusiform Rust; Survival
 - Tree stem volume calculated
 - Plot Yields calculated, scaled to acre
 - Add up volumes of living trees (dead tree=0)
 - Survival adjusted volume (tree volume * family survival in same block and plot type)
 - Square root transformation, very effective

Self-thinning Line Site LA, Pure Plots



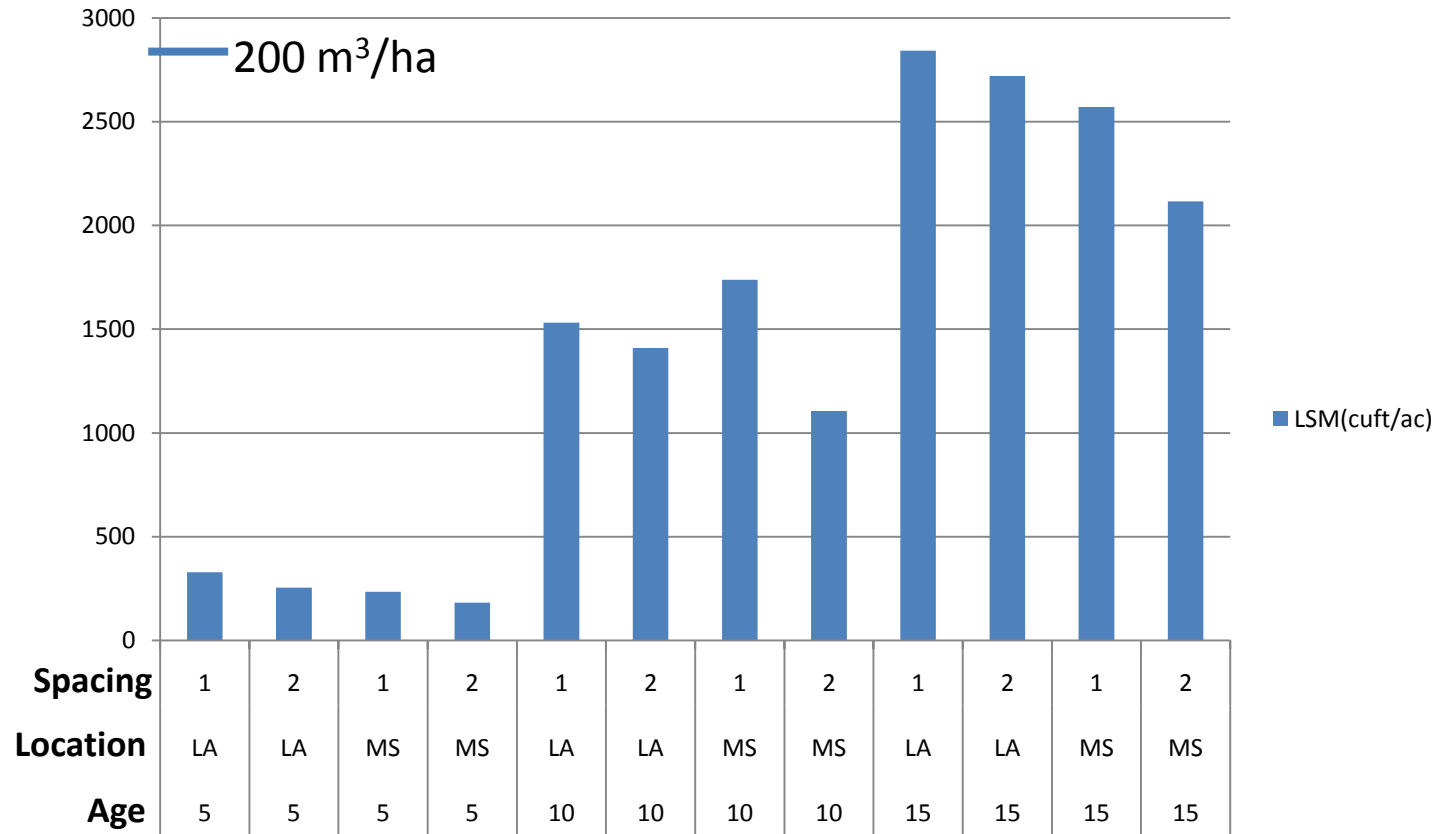
Self-thinning Line Site LA, Mixed Plots



Full ANOVA, Fixed Effects, (ft³/ac)^{0.5}

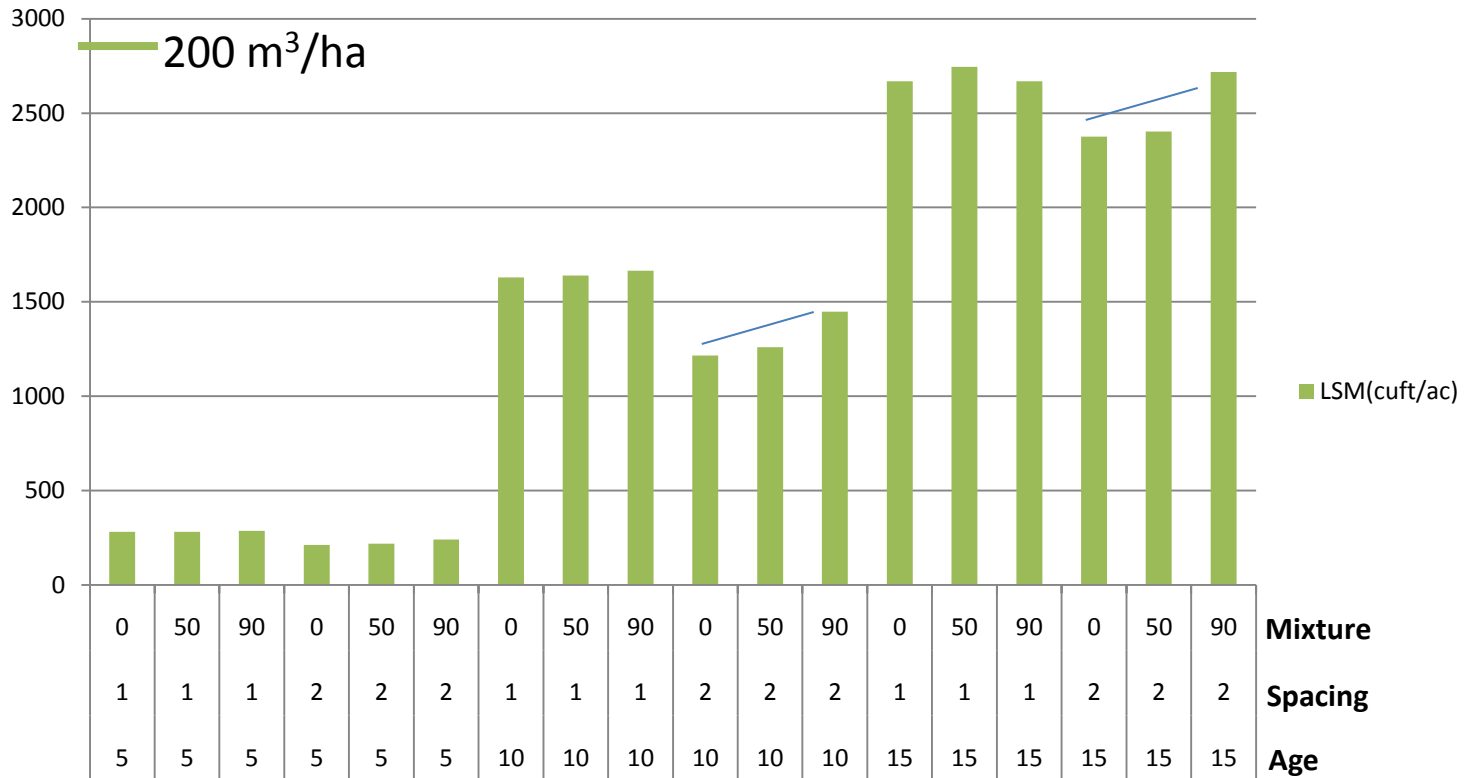
Source	DF	F-value	Pr > F (Age15)	Pr > F (Age10)	Pr > F (Age5)
Location	1	59.2	<.0001	<.0303	<.0001
Spacing	1	23.3	<.0001	<.0001	<.0001
Loc *Spcg	1	17.4	<.0001	<.0001	0.0023
Block(Loc*Spcg)	7	18.2	<.0001	<.0001	<.0001
Family	7	15.9	<.0001***	<.0001***	<.0001***
Loc*Fam	7	4.4	<.0001***	<.0347*	0.0023**
Spcg*Fam	7	16.3	<.0001***	<.0001***	<.0001***
Loc*Spcg*Fam	7	1.3	0.2615	0.3279	0.1795
Mixture	3	2.6	0.0542~*	<.0001***	0.0550~*
Loc*Mix	3	0.5	0.7090	0.0353*	0.0003**
Spcg*Mix	3	3.3	0.0204*	0.0005**	0.0623
Fam*Mix	21	2.8	<.0001***	<.0001***	<.0001***
Loc*Fam*Mix	21	1.8	0.0158*	0.0016**	<.0001***
Spcg*Fam*Mix	21	2.0	0.0036**	<.0001***	<.0001***
Loc*Spcg*Fam*Mix	24	2.4	0.0001**	<.0001***	<.0001***

LSM (ft³/ac), All Families



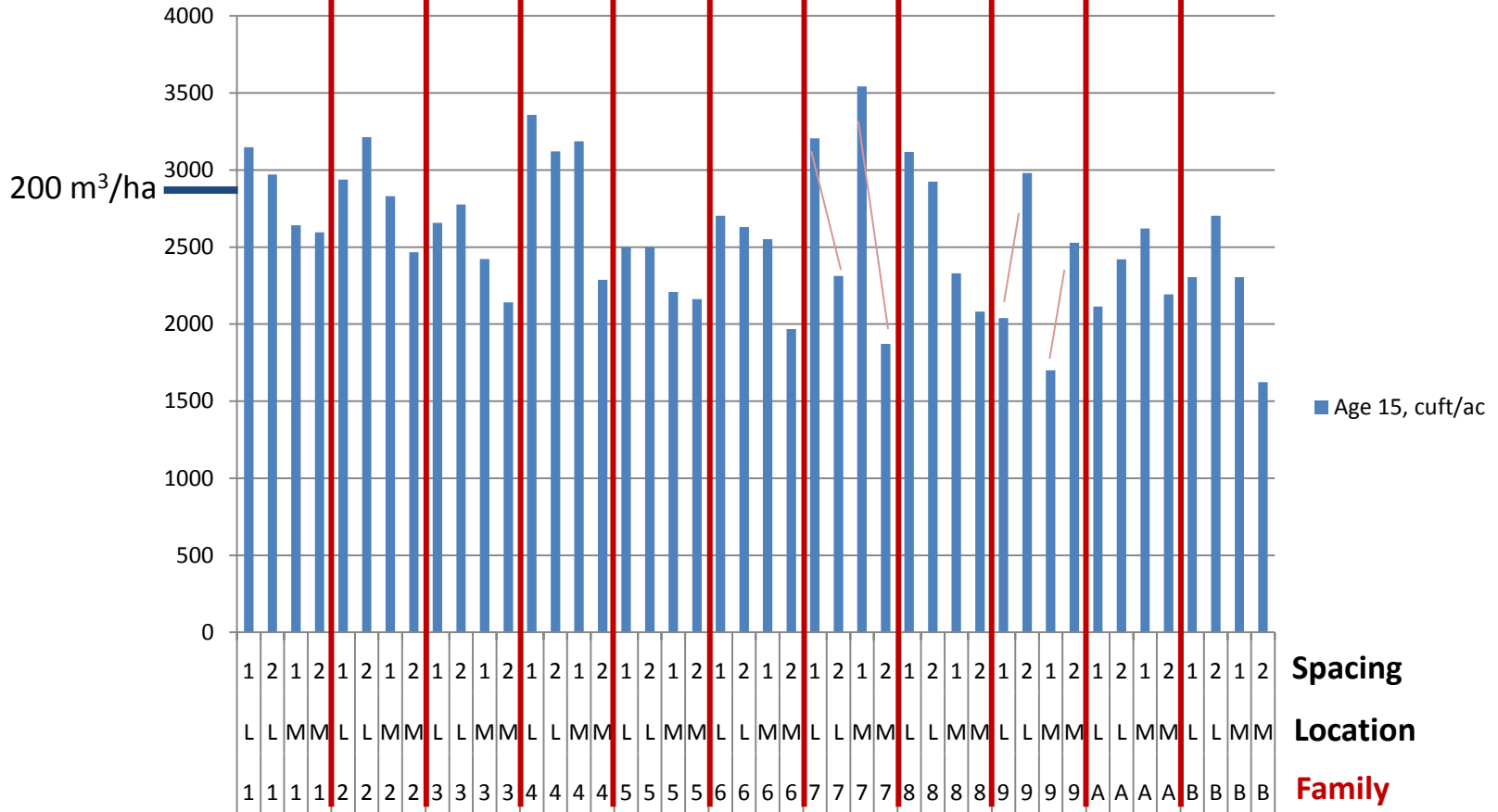
Spacing: 1=1 x 2 m; 2=2 x 2 m
Location: LA=Louisiana; MS=Mississippi
Age: 5 yrs; 10 yrs; 15 yrs

LSM (ft³/ac) LA & MS Sites, All Families



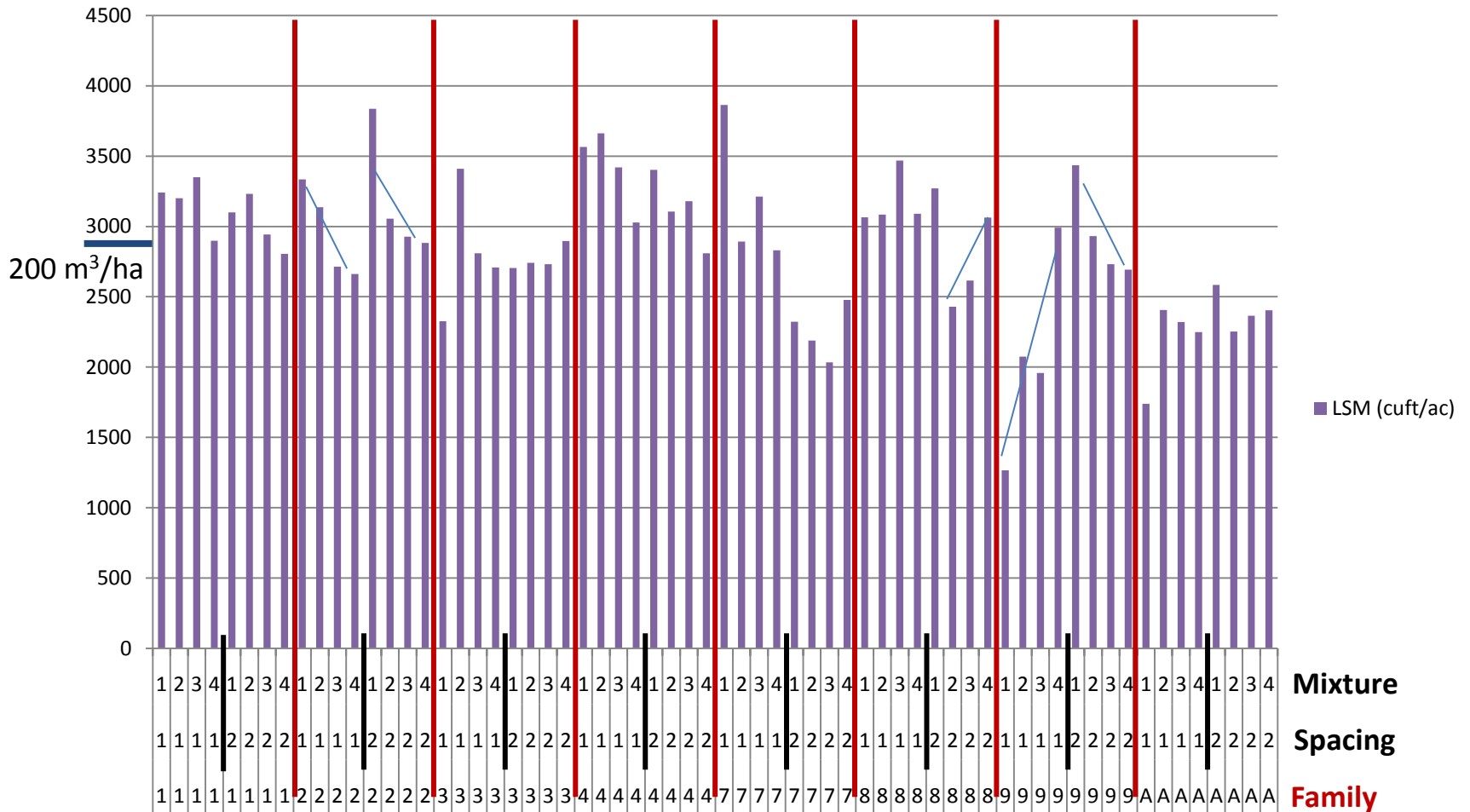
Mixture: 0=Pure; 50=Binary; 90=Blend
Spacing: 1=1 x 2 m; 2=2 x 2 m
Age: 5 yrs; 10 yrs; 15 yrs

LSM (ft³/ac) Age 15, All Plot Types



Spacing: 1=1 x 2 m; 2=2 x 2 m
Location: L=Louisiana; M=Mississippi
Family: 1; 2; 3; 4; 5; 6; 7; 8; 9; A ; B

LSM (ft³/ac) Age15, Site LA



Mixture: 1=10%; 2=25%; 3=75%, 4=100%
Spacing: 1=1 x 2 m; 2=2 x 2 m
Family: 1; 2; 3; 4; 7; 8; 9; A

Family LS Means (ft³/ac)

Age 15, Spacing = 1

Family	Louisiana	Mississippi	Mean over Locations	Obs Rank	Exp Rank
1	3183.9	2832.9	3008.4	3	1
2	2816.2	2686.7	2751.5	5	6
3	2845.0	2253.7	2549.4	7	4
4	3350.7	3001.9	3176.3	1	2
5	2718.1	2263.8	2491.0	8	7
6	2752.0	2665.7	2708.9	6	5
7	2978.1	3040.9	3009.5	2	3
8	3152.5	2534.7	2843.6	4	9
9	2207.9	1808.4	2008.2	11	10
10	2310.7	2623.8	2467.3	9	8
11	2546.9	2254.0	2400.5	10	11

Family Mean (ft³/ac) correlations between Ages & Plots Types

	Pure5	Row5	Mix5	Pure10	Row10	Mix10	Pure15	Row15	Mix15
Pure5	1.0	.495	.415	.789	.279	.254	.747	.228	.189
Row5		1.0	.414	.441	.829	.338	.466	.591	.201
Mix5			1.0	.267	.283	.860	.327	.261	.584
Pure10				1.0	.460	.329	.804	.345	.156
Row10					1.0	.371	.383	.684	.192
Mix10						1.0	.306	.315	.720
Pure15							1.0	.383	.300
Row15								1.0	.272
Mix15									1.0

The MIXING Study

- Conclusions

- SRWC, Loblolly pine

- Yields in this study were respectable, considering site quality and intensity of silviculture
 - Planting density will impact rotation length
 - >1000 TPA for 10 or less year rotations
 - Family mixes were higher yielding than single family plots
 - Although some binary mixes of families may provide higher yields

The MIXING Study

- Conclusions

- Genetics & Tree Improvement

- OP families show significant variation in G&Y traits
 - Rankings differ based on progeny tests for Height growth
 - Row plots better than Mixed plots for predicting Pure plot performance
 - Family x Spacing and Family x Mixture are significant sources of variation