Impact of Silvicultural Practices on Loblolly Pine Wood Quality

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Overview

- The Wood Quality Consortium (WQC)
- Sampling standing trees
- Densitometry
- Competition control at planting
- Mid-rotation thinning and fertilization

Premise

• Industry will rely increasingly on fast-growing plantations to furnish the raw material for solid wood and fiber products in the South

Highly productive plantations =

- Merchantable at younger ages
- Shorter rotation lengths
- Higher proportion of juvenile wood
- Wood and fiber properties?

WQC – formed in 1999

A research partnership between the University of Georgia, Warnell School of Forestry and Natural Resources and the USDA Forest Service, Southern Research Station

- R. F. Daniels and L. R. Schimleck (UGA)
- A. Clark III (USDA Forest Service, retired)

- Multiple industry partners: Arborgen
  Huber
  Rayonier
  Smurfit-Stone
  Weyerhaeuser

WQC – formed in 1999

Initial goals of the WQC were:

1) to establish a regionwide baseline for wood properties in loblolly pine plantations;

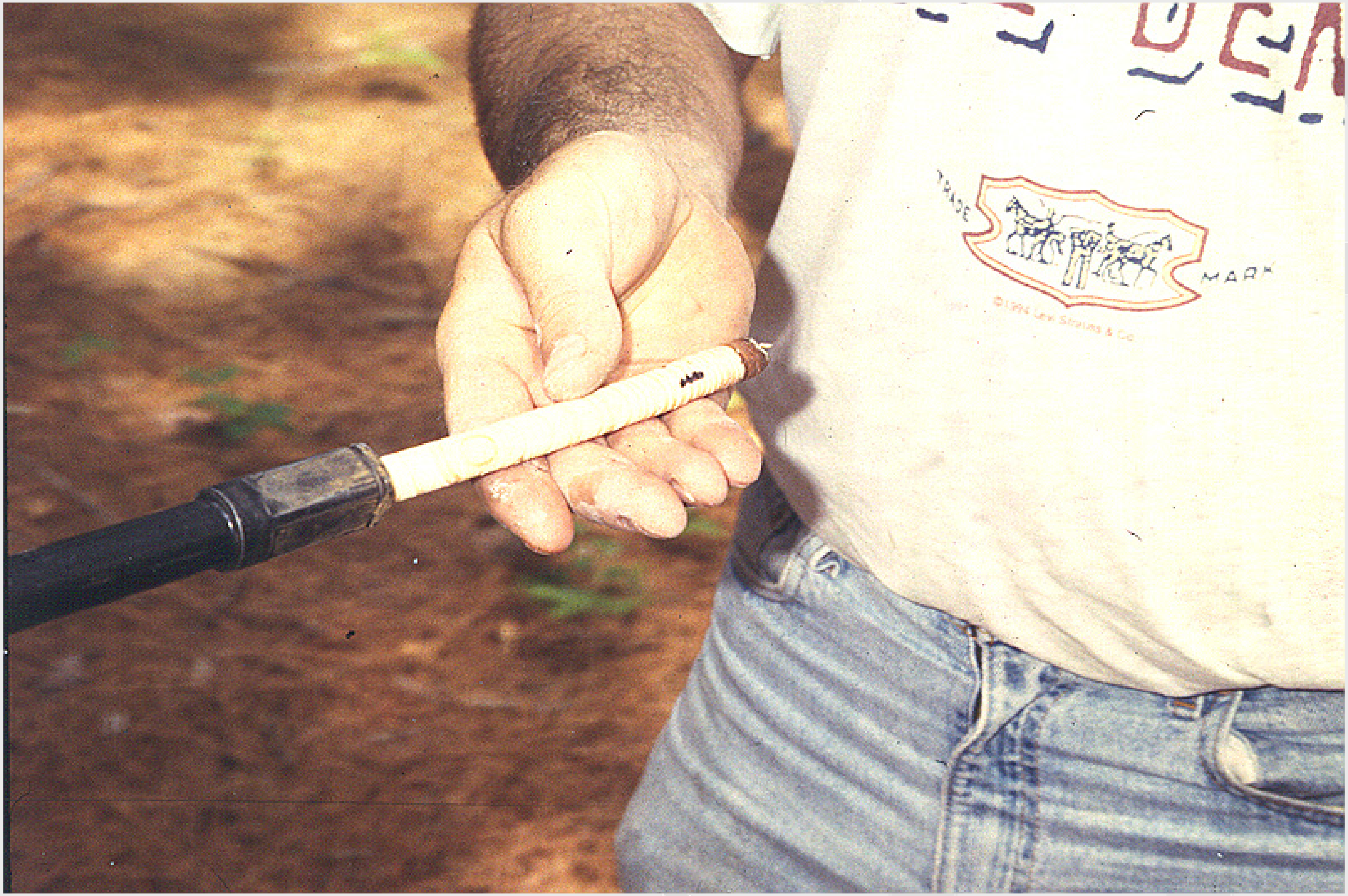
2) to estimate the effects of intensive silvicultural practices on wood properties; and

3) to develop predictive models to predict wood properties at the tree, stand and regional levels

This presentation will discuss research conducted to assess the effects of intensive silvicultural practices on wood properties

Hydraulic borer used to remove cores

12 mm increment cores



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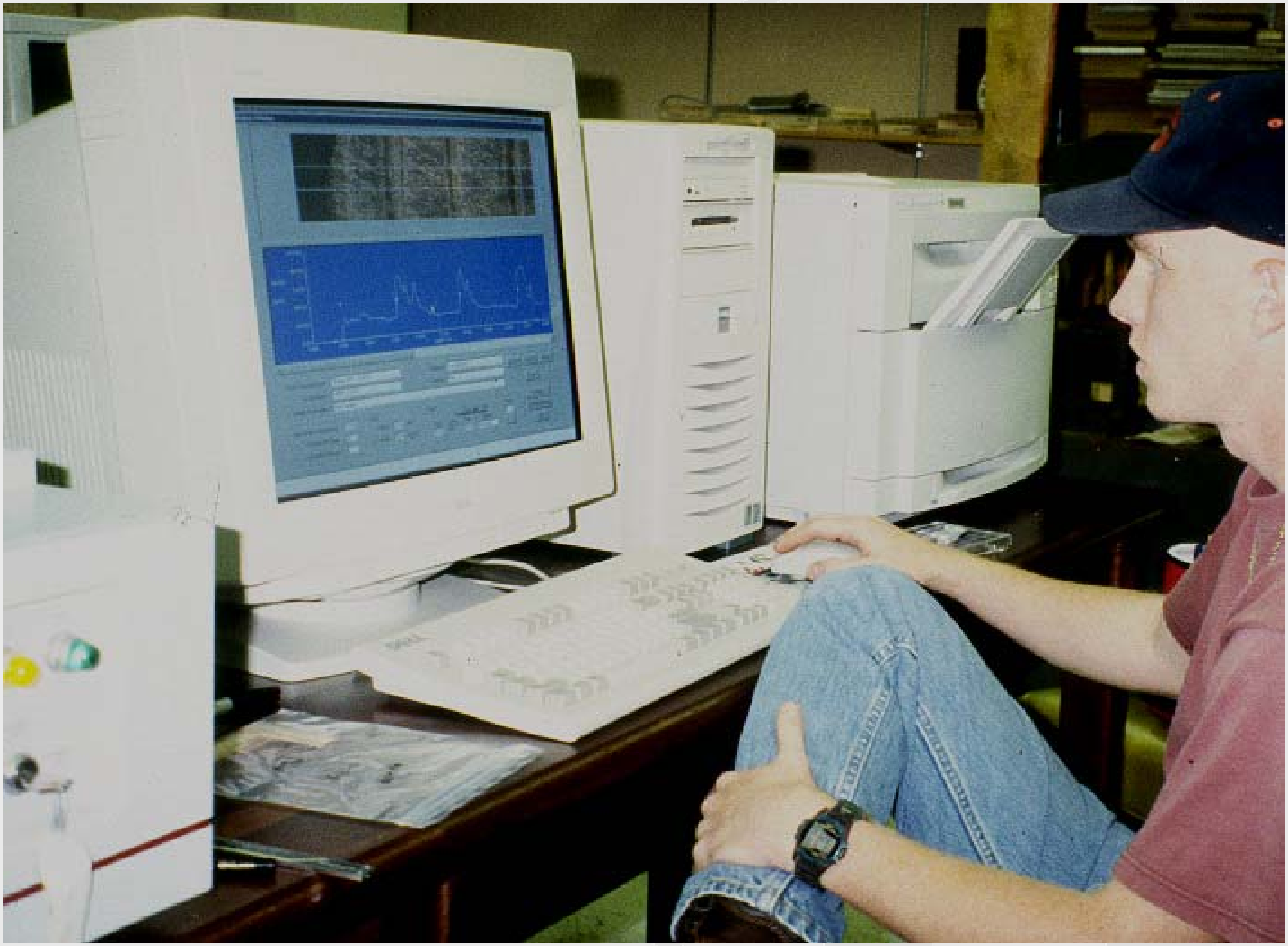
X-ray densitometry



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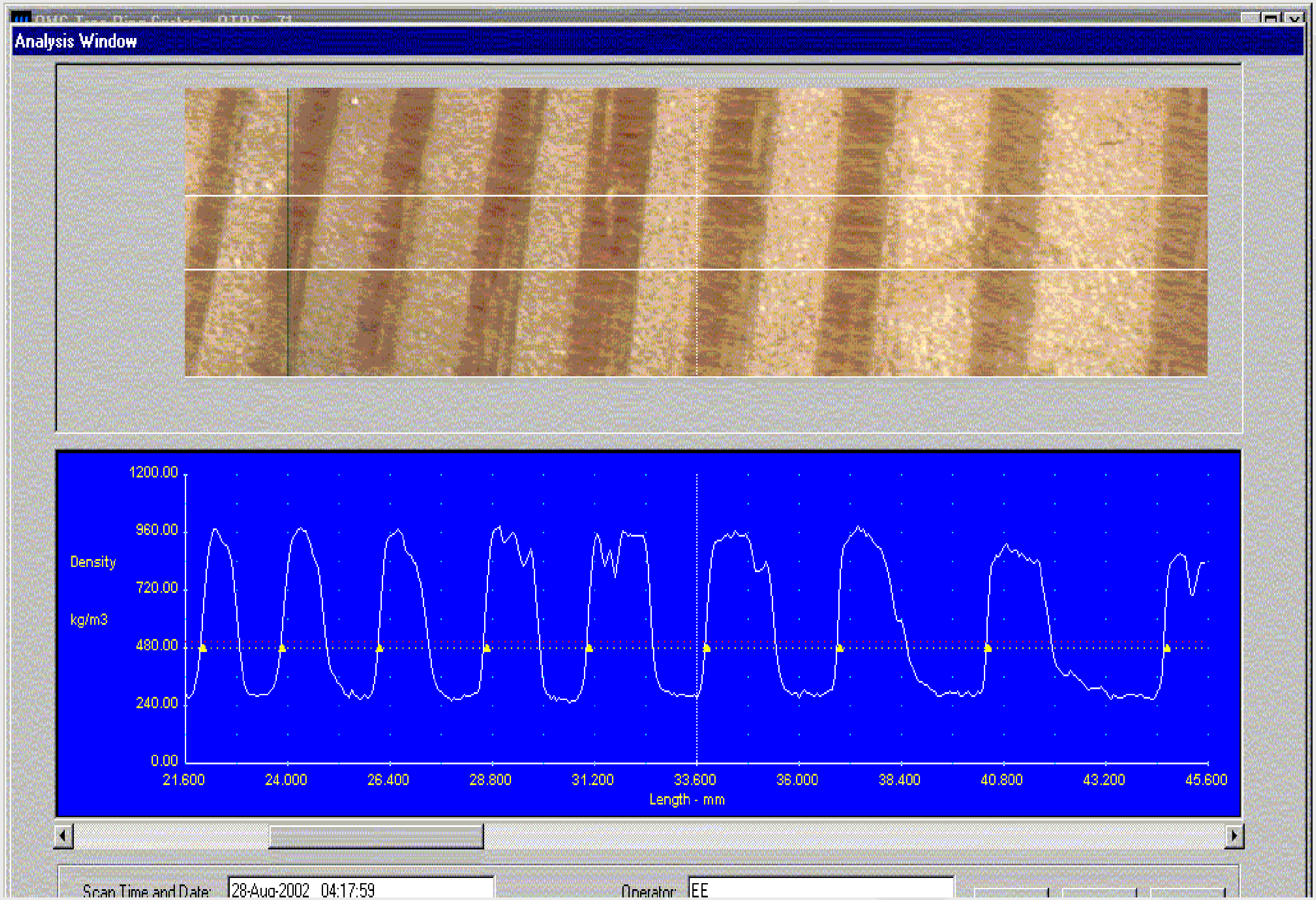
Example of x-ray densitometer simultaneous video and x-ray



Intensive silviculture at establishment

Aim: to reduce herbaceous and woody competition, and improve growth owing to increased availability of moisture and nutrients (improved by fertilization)

Treatments:

1) Competition control (herbaceous and woody)

2) Fertilization (N and P if required)

3) Intensity of site preparation

Important in the southern USA where competing weeds and hardwood vegetation can inhibit growth of plantation trees

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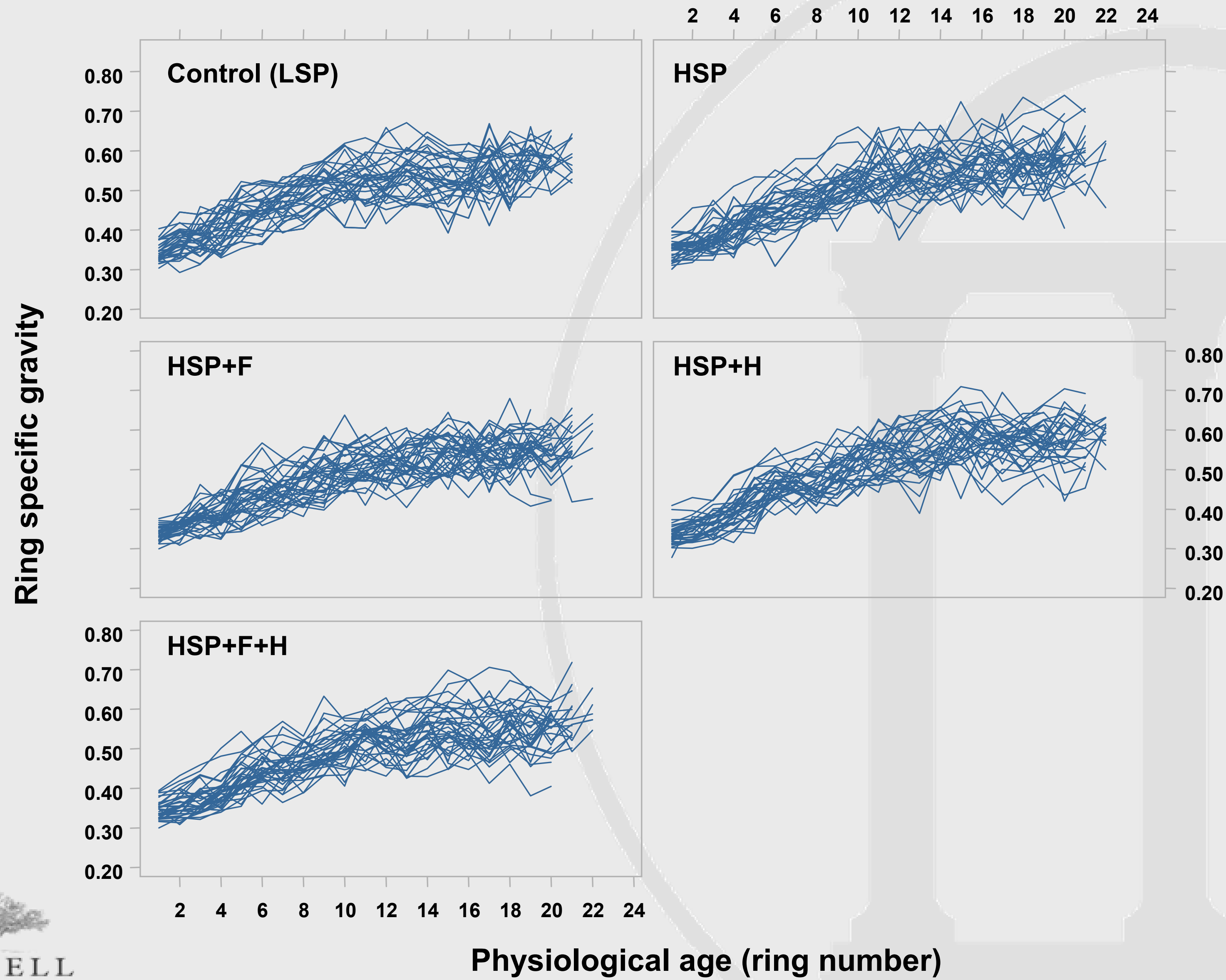
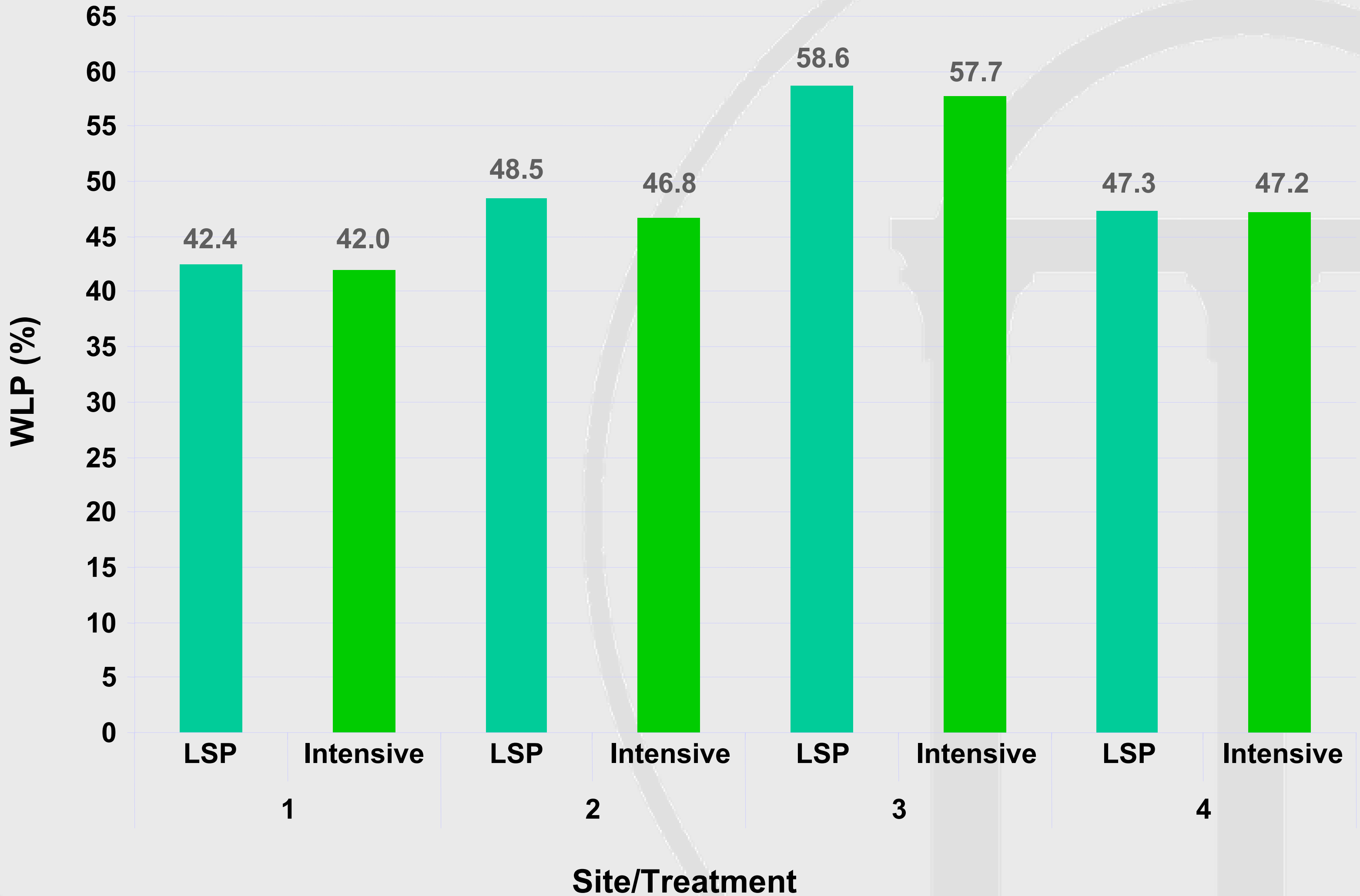
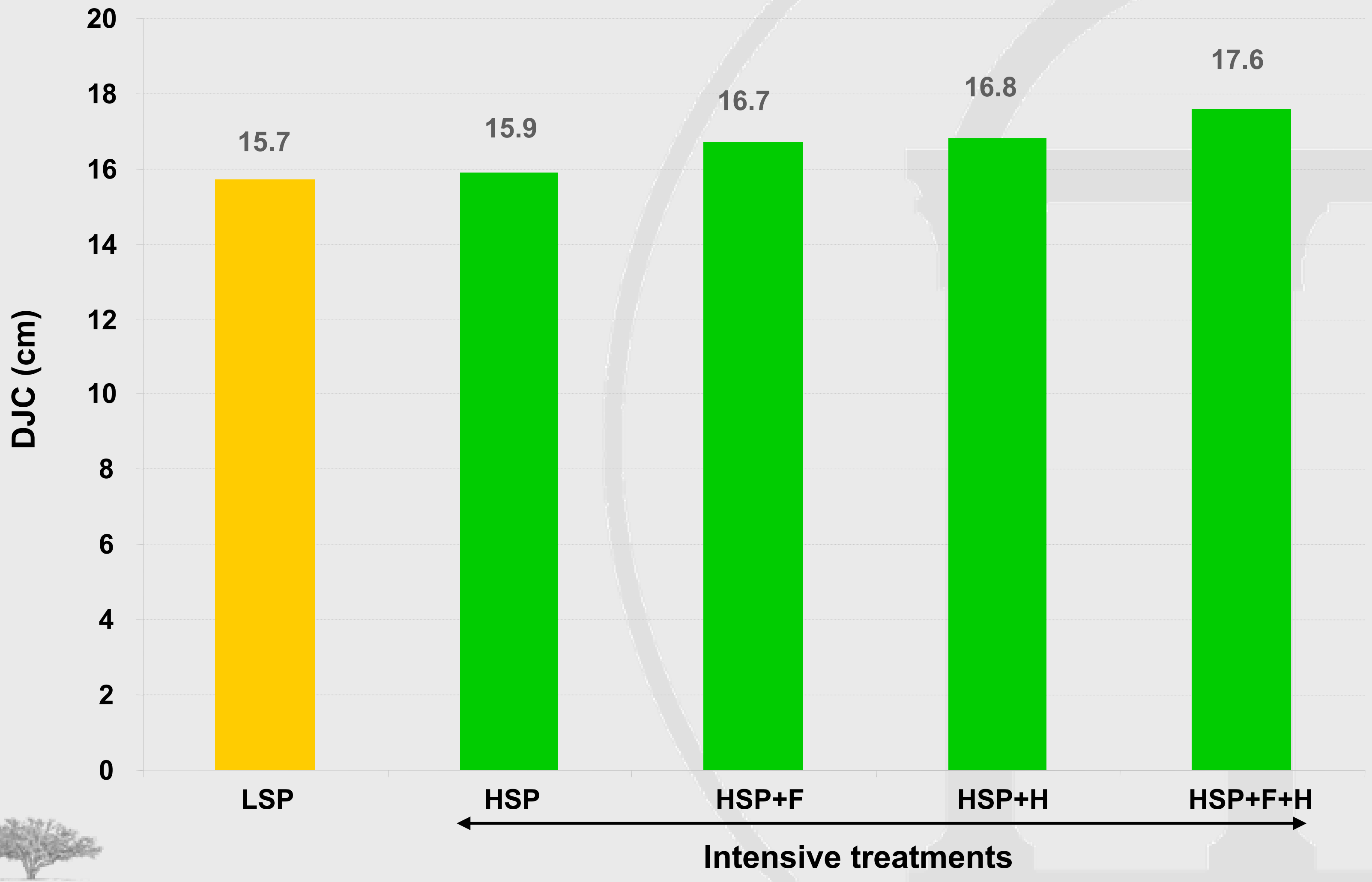
Ring specific gravity profiles



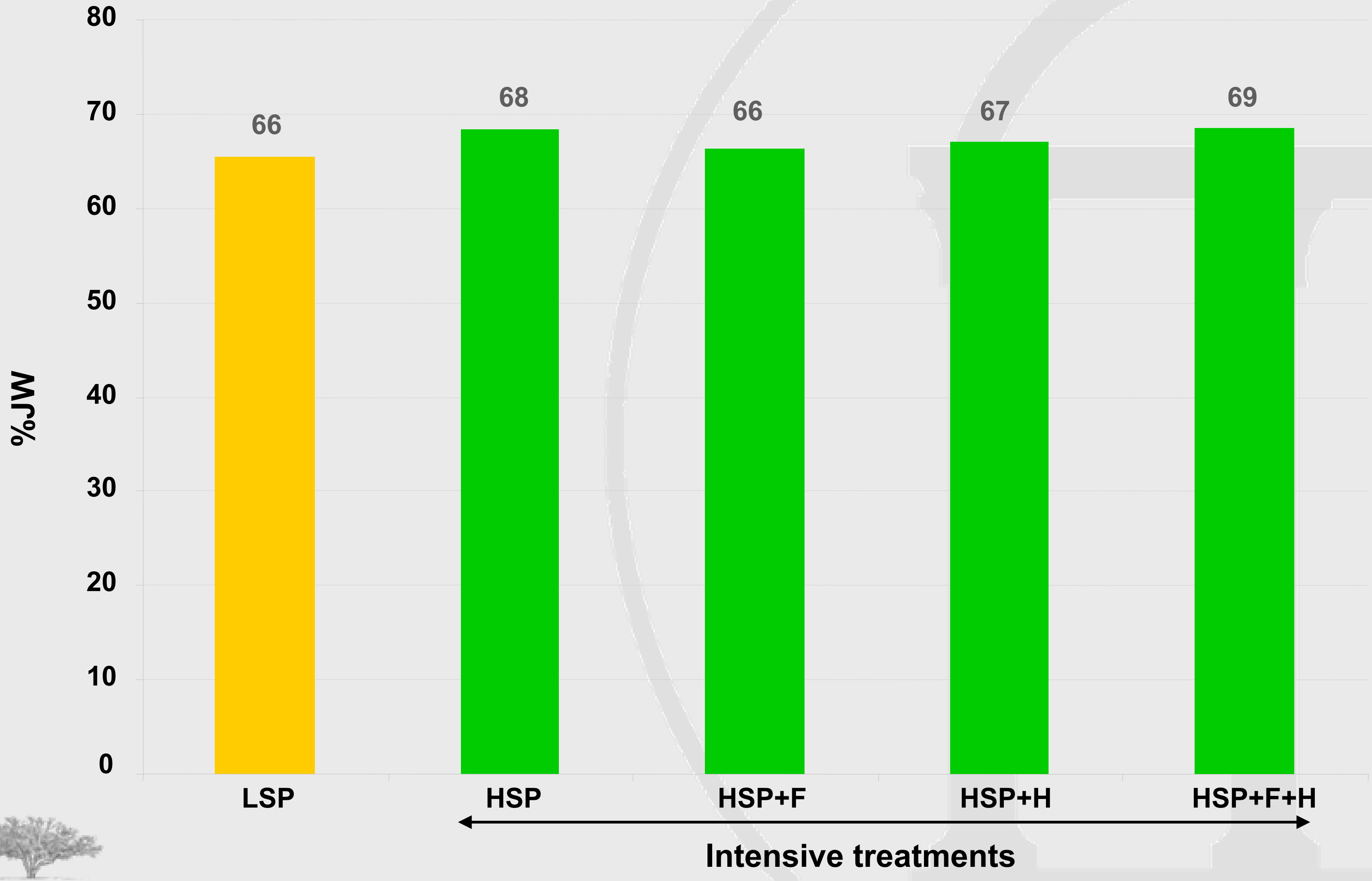
Weighted LW proportion



Diameter of the juvenile core (DJC) for each treatment (all sites)

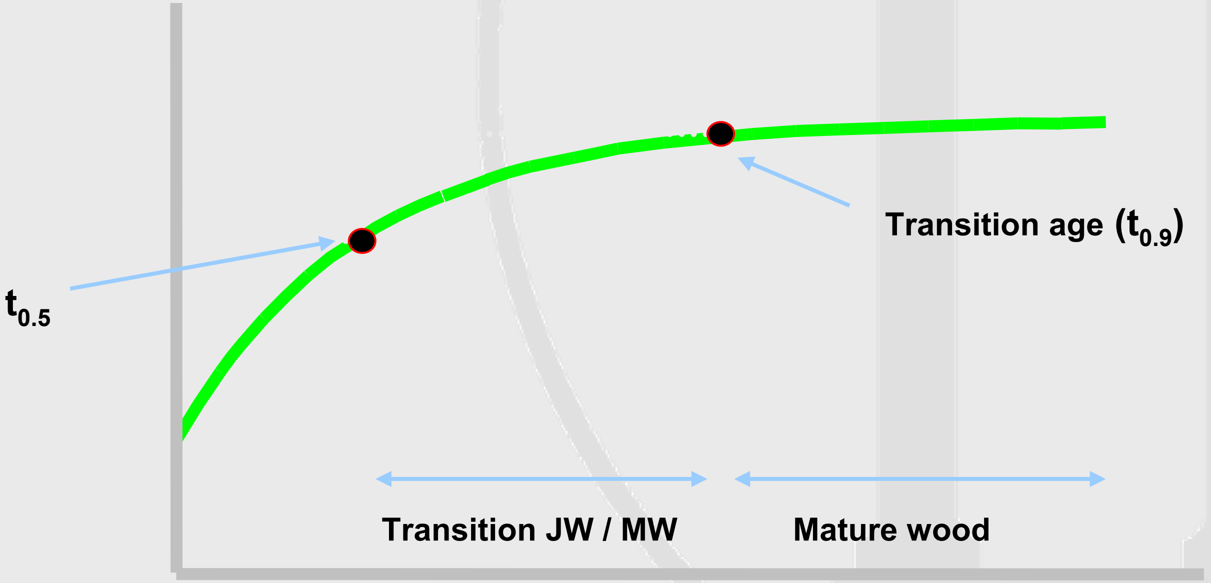


Proportion of juvenile wood (%JW) for each treatment (all sites)



Estimated transition zone/age for each site-treatment combination

Site	t	LSP	HSP	HSP+F	HSP+H	HSP+F+H
1	0.5	5	4	4	4	5
	0.9	17	14	13	14	17
2	0.5	5	5	5	5	5
	0.9	15	15	15	15	15
3	0.5	3	4	4	4	4
	0.9	10	12	12	12	12
4	0.5	4	4	4	4	4
	0.9	14	14	14	14	14



Intensive silviculture at establishment

Summary of main findings:

1) Significant growth responses observed (competition control = more resources for crop trees)

2) Earlywood SG, latewood SG, ring SG and latewood percent not significantly different from controls

3) Owing to improved growth when young the diameter of the juvenile core was increased, while density was decreased slightly

4) Competition control does not effect density at a given age or the length of the juvenile period

5) Herbaceous control ceases to influence stand at crown closure, woody control can influence growth for life of stand

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Mid-rotation fertilization and thinning

Aim: remove small or diseased trees, therefore improving stand quality (retain best trees), also improves growth of remaining trees (aided by fertilization) and maintains stand vigor

Treatments include:

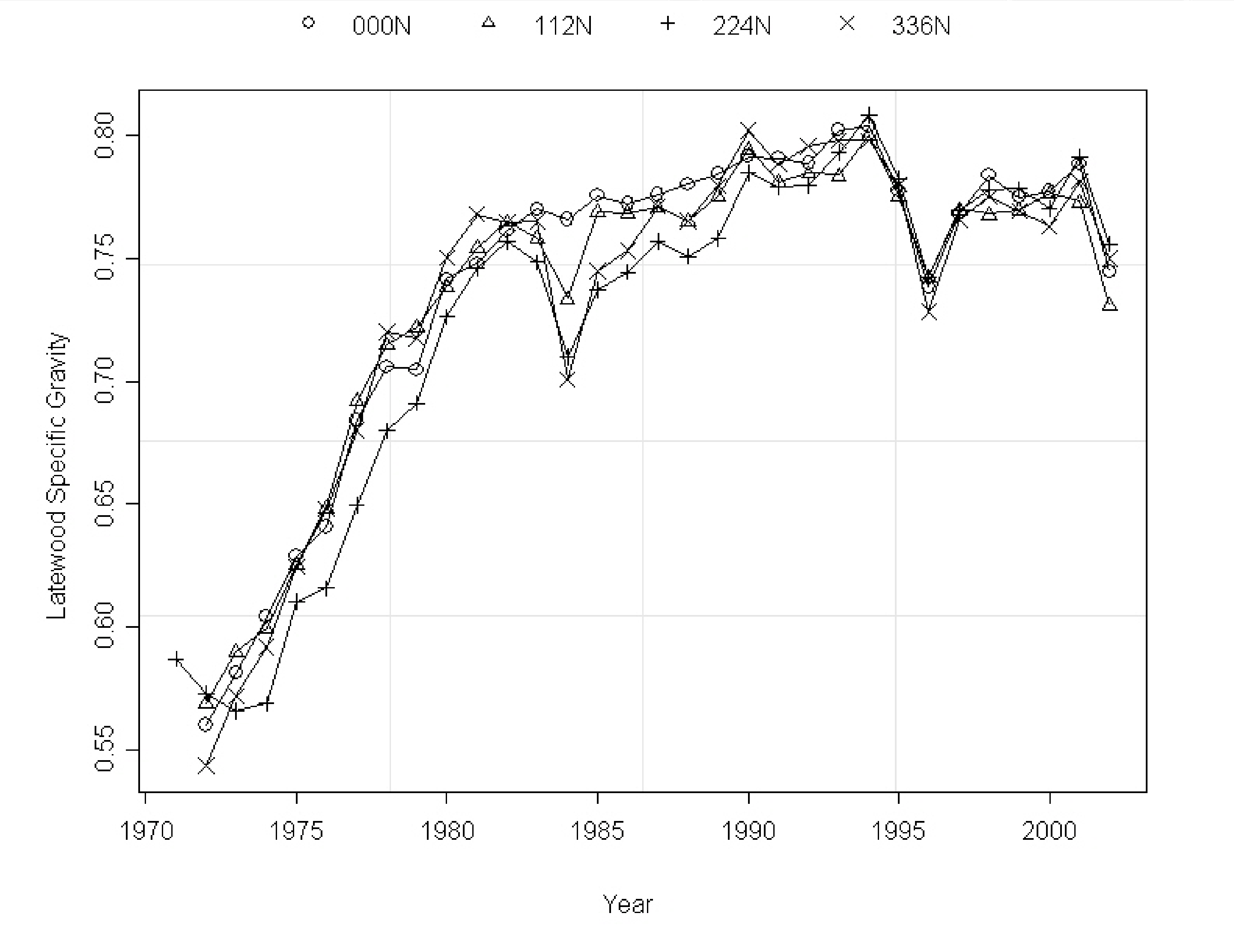
1) Thin at ages 12-14 years, or 2 years after crown closure to ensure that trees are producing mature wood

2) Fertilization (N and P if required) to enhance growth rates of mature wood

3) Second thin at approximately 20 years, fertilize

Mid-rotation fertilization has been rapidly adopted for southern pine plantations, area fertilized at mid-rotation has increased from 81,000 ha (1997) to 0.6 million ha (2002)

Influence of mid-rotation fertilization and thinning on latewood SG



Mid-rotation fertilization and thinning

Summary of main findings:

1) Mid-rotation fertilization post thinning produces a significant growth response

2) Only the highest rate of fertilization significantly reduced both ring SG and latewood SG for the 4 years following fertilization

3) Lower density corresponded to an increase in tracheid radial diameter and a reduction in tracheid wall thickness

4) The effect is transient and wood properties return to levels similar to untreated trees within a few years

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Planting density

Planting density is important as it determines the management regime that will be applied to the stand.

Presently in the southern USA trees are being planted at wider spacing's in conjunction with weed control and fertilization

= sawtimber sized trees in shorter rotations

Current practice in response to weak demand to small diameter loblolly pine

It is recognized that planting at wide-spacing stimulates crown and diameter growth resulting in larger diameter branches

Average DBH and total height of trees on measurement plots by spacing at age 21

		DBH		Total Height	
Spacing	Trees/ha	Average	Range	Average	Range
(m)	(No.)	- - - - (mm) - - - -		- - - - (m) - - - -	
1.8x2.4	2244	196	71-351	21.9	7.6-27.1
1.8x3.0	1794	213	117-325	23.2	15.8-27.7
1.8x3.6	1495	221	104-333	22.9	12.8-27.7
2.4x3.0	1344	236	135-394	23.5	15.8-27.4
2.4x3.6	1122	246	102-366	24.4	11.0-28.7
3.0x3.6	897	259	145-345	24.7	16.8-28.7
3.6x3.6	746	279	81-417	24.7	8.8-28.0

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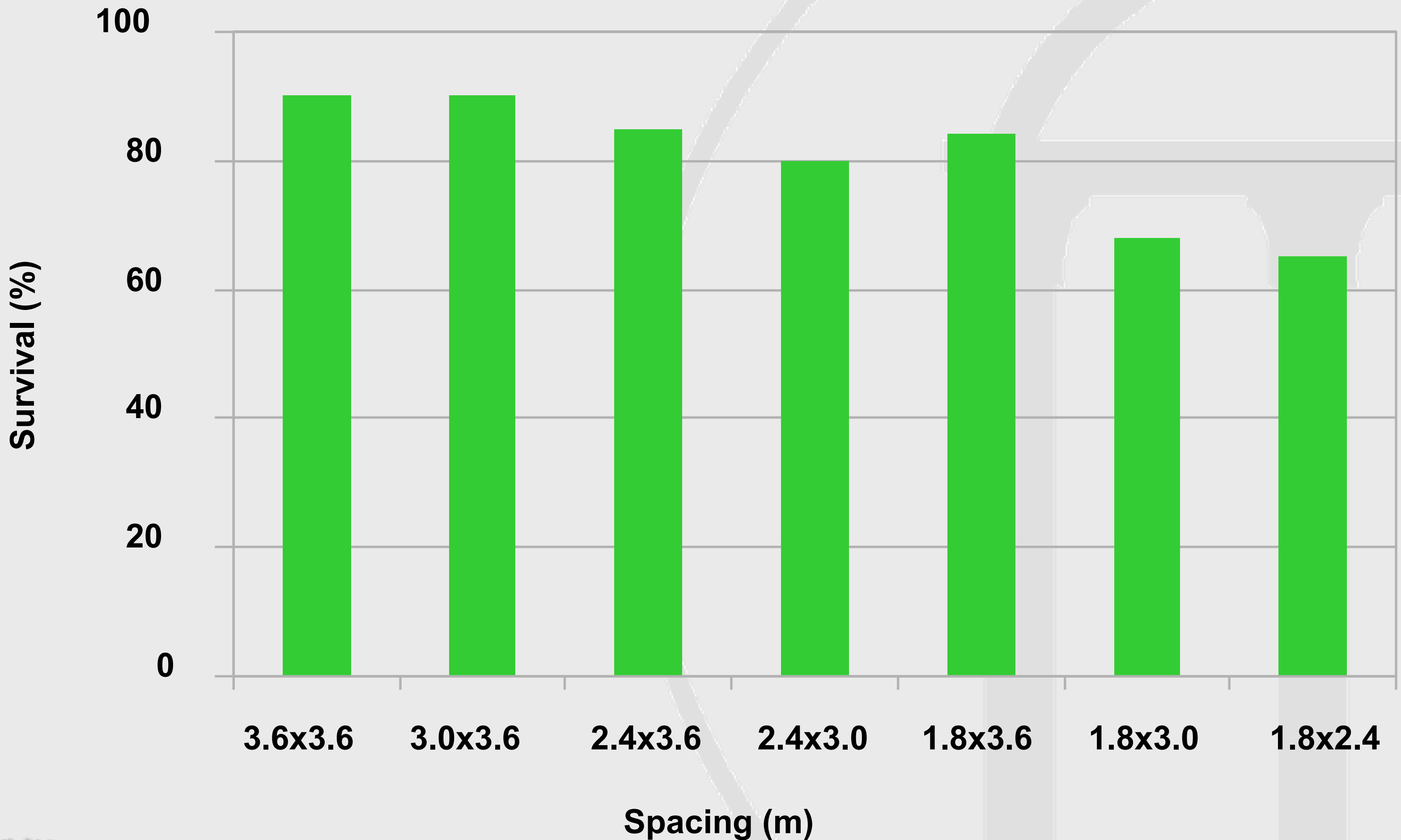
Impact of initial spacing on survival of unthinned loblolly pine at age 21



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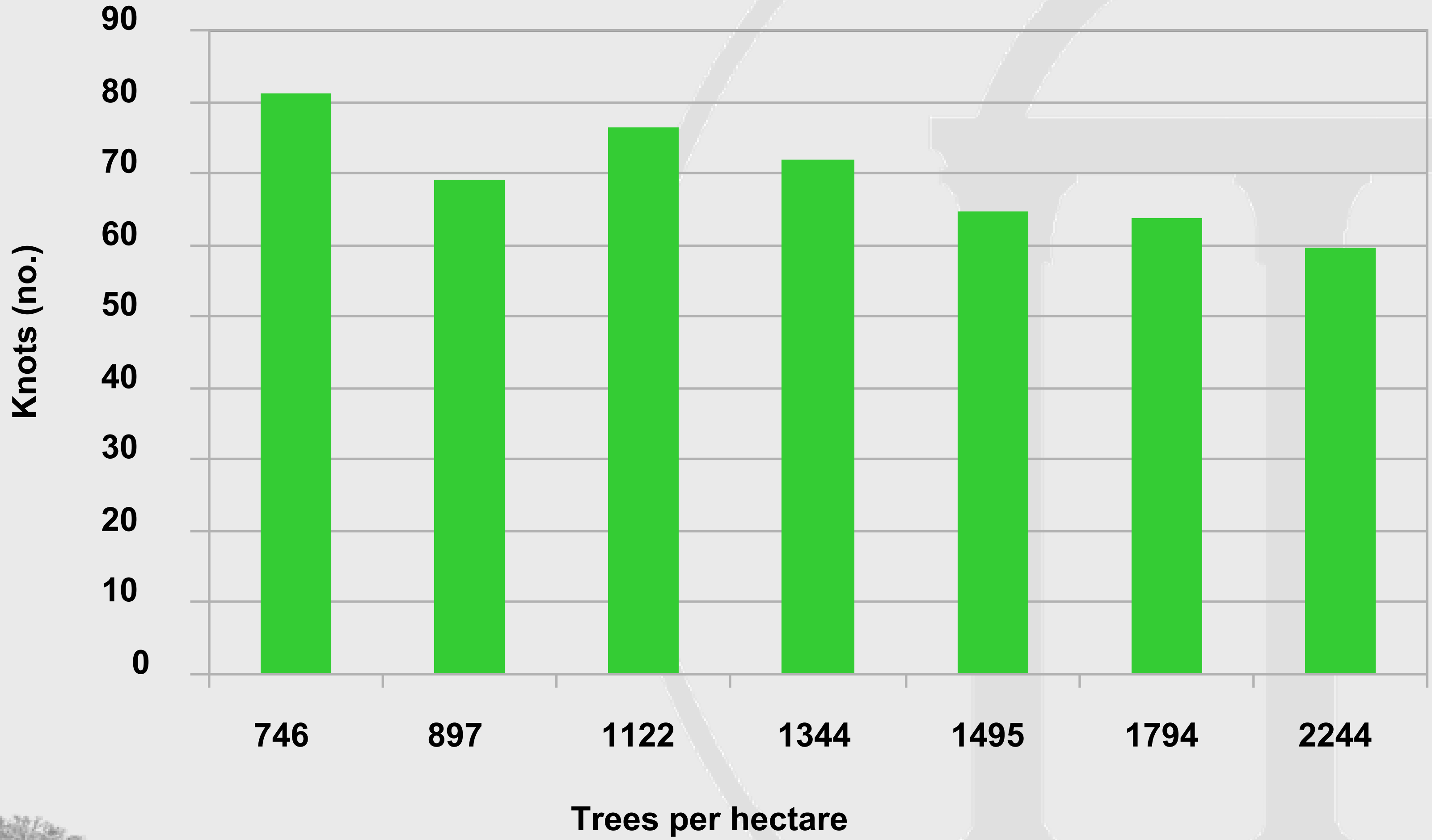
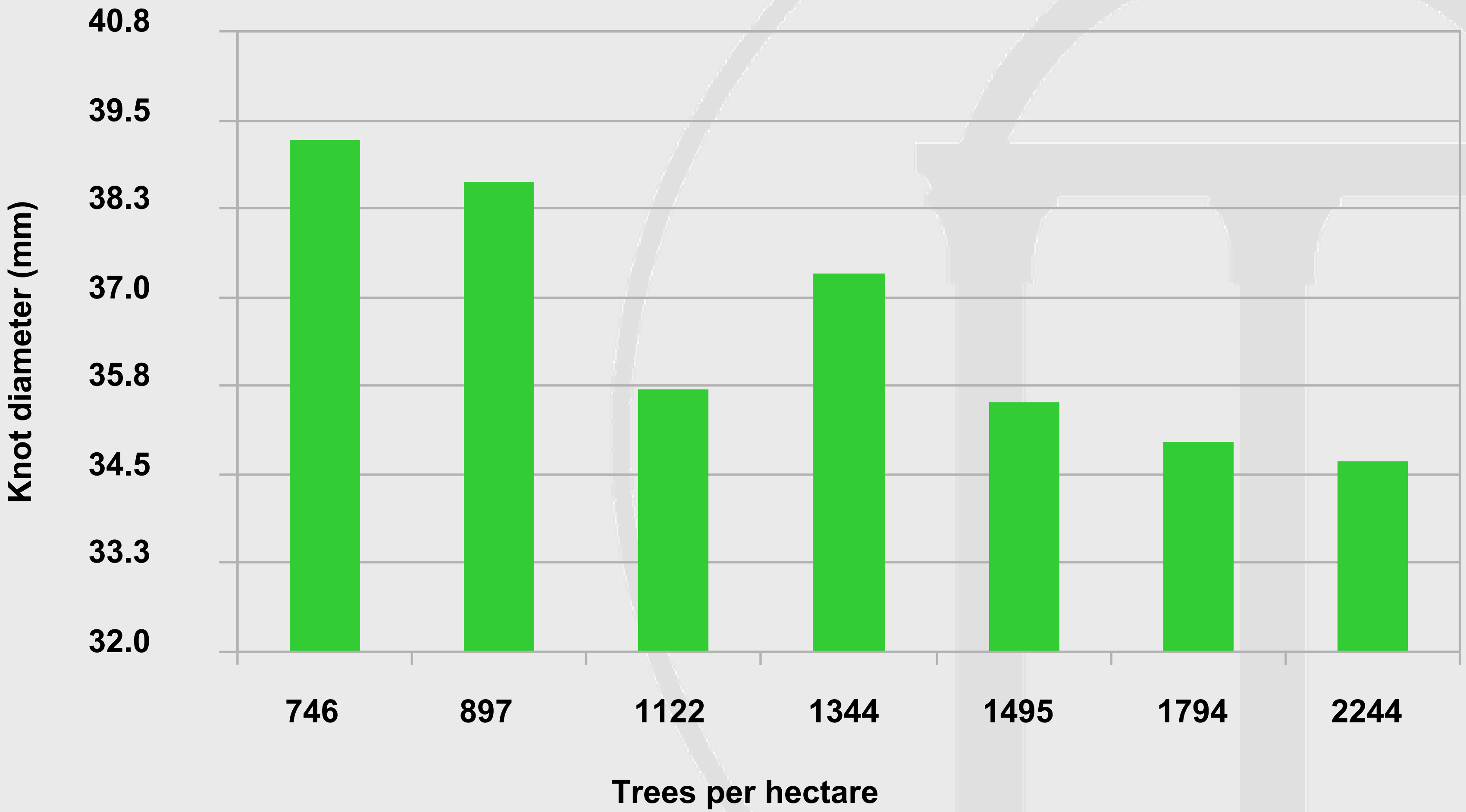
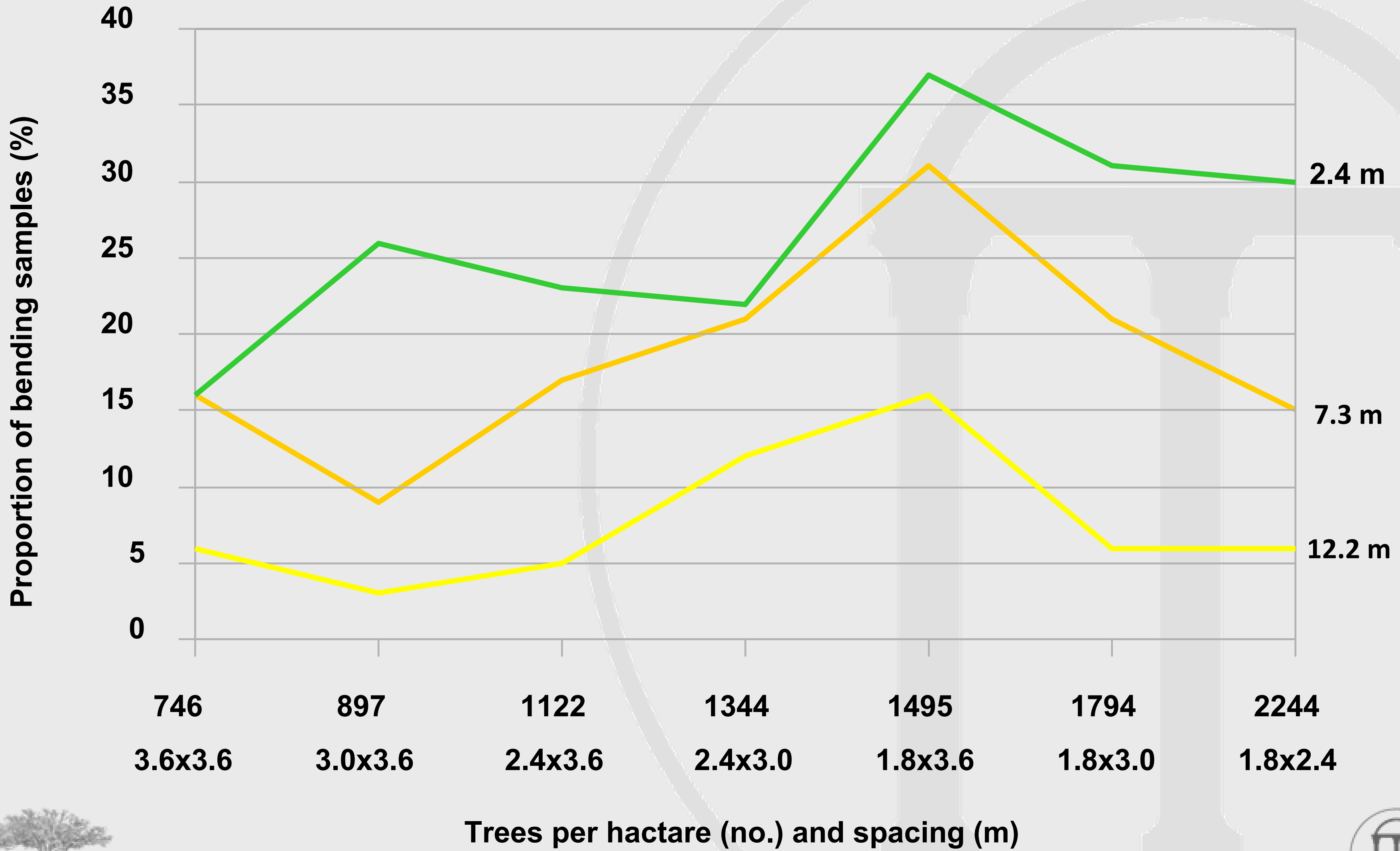
Effect of initial planting density on av. number of knots (live, dead and overgrown)



Effect of initial planting density on av. knot diameter (live, dead and overgrown)



Effect of initial planting density on proportion of static bending samples with MOE ≥ 11 GPa



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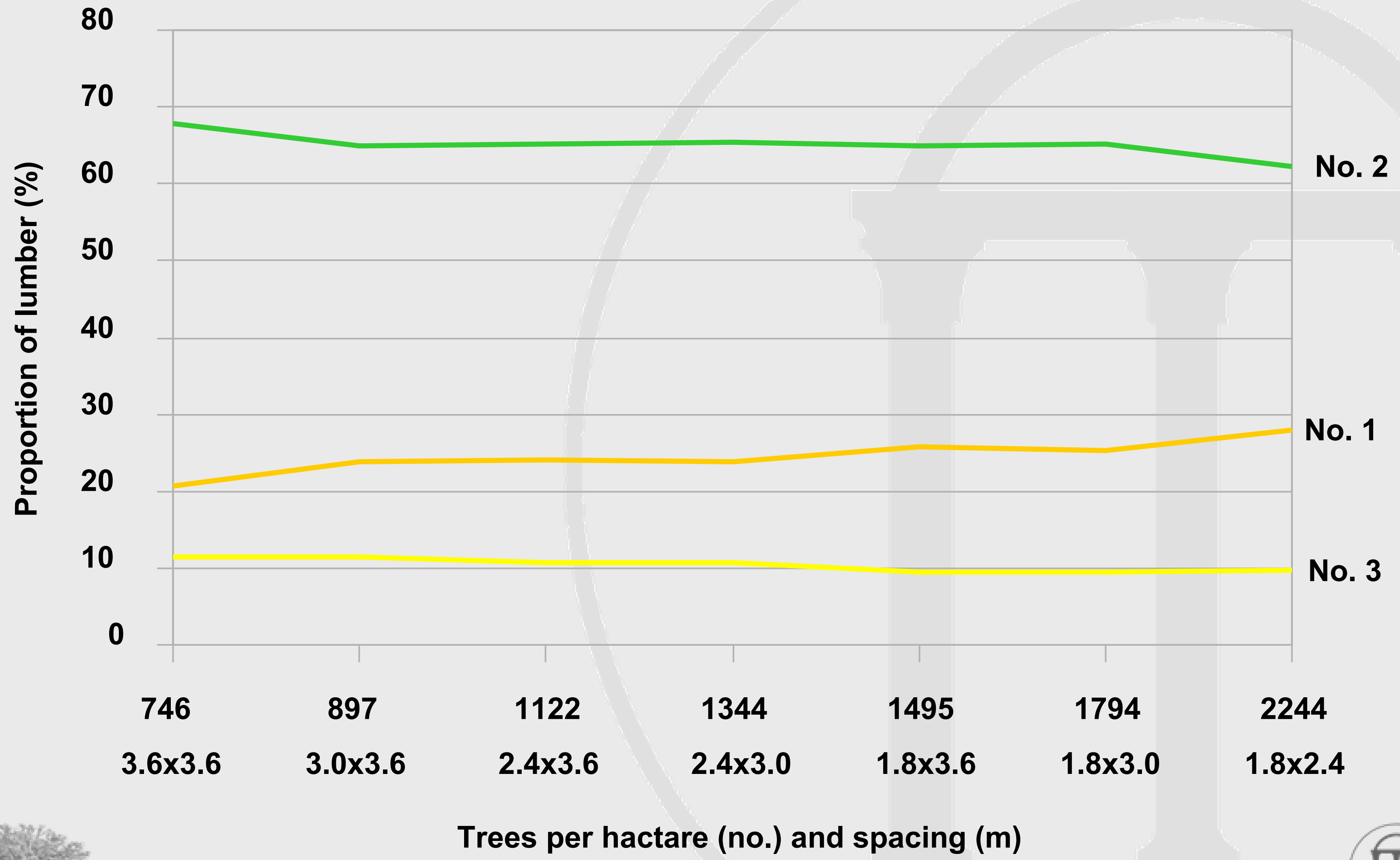
Estimated proportion of lumber in grade number 1, 2, and 3 by spacing



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Planting density

Summary of main findings:

1) Spacing's ranging from 1.8×2.4 m (2244 trees/ha) to 3.6×3.6 m (746 trees/ha) were sampled, average DBH and height increased with increased spacing

2) Average number of knots, knot diameter and average maximum knot diameter increased with increased spacing

3) Highest proportion of high stiffness samples came from 1.8x3.6m spacing

4) Total stem green weight/ha (wood and bark) to a 75mm dob top was highest in the 1.8×3.6 m, 2.4×3.0 m and 2.4×3.6 m spacing's

Other WQC studies

The WQC has been involved in range of other studies examining effects of fertilization and other silvicultural practices that are not practiced operationally, including:

1) Annual fertilization and complete competition control

2) Fertilization and irrigation

3) Fertilization at different rates and intensities

Acknowledgements

Past and current industry members of the Wood Quality Consortium

Research partners of the Wood Quality Consortium

Students (undergraduate, M.S. and PhD), and UGA / WQC and USDA FS research staff

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Past and current industry members of the WQC

ArborGen
Huber Engineered Woods
Rayonier
Smurfit-Stone
Weyerhaeuser
Boise
Georgia-Pacific
International Paper
MeadWestvaco
Plum Creek
Temple
A Temple-Inland Company

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