Pythium and Cold Storage: An Update on Seedling Survival

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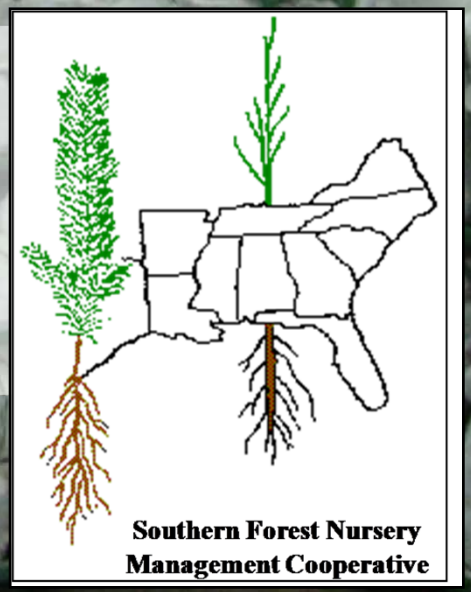
SFNMC Contact Meeting

June 23, 2009



"Too few experiments have been made with cold storage of southern pine nursery stock to warrant recommendations concerning it".

-Philip Wakeley (1954)

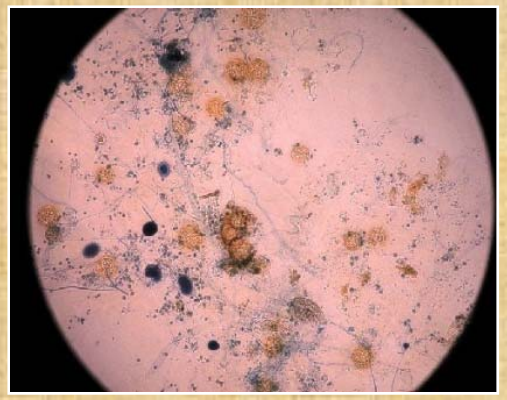
Today, we are still challenged with the questions:

1. Why do bareroot seedlings store poorly from October to mid-December?

2. Why do container-grown seedlings store better than bareroot seedlings?

A Theory to Explain Poor Storability

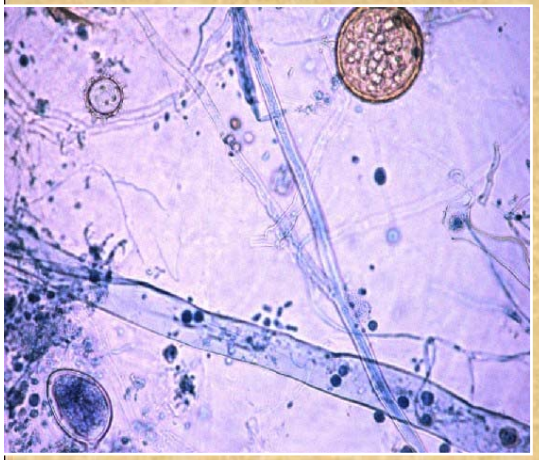
At lifting, bareroot seedling roots are torn and wounded



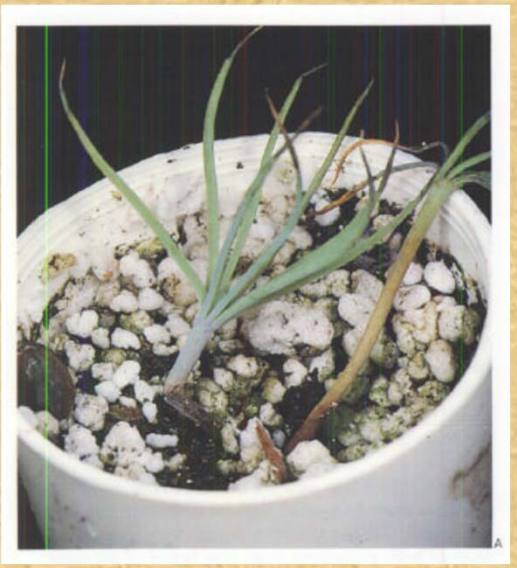
Pythium infects roots through the wound

Pythium multiplies in the moist, cool storage conditions and causes seedling death after outplanting

Pythium in Nurseries: A Review

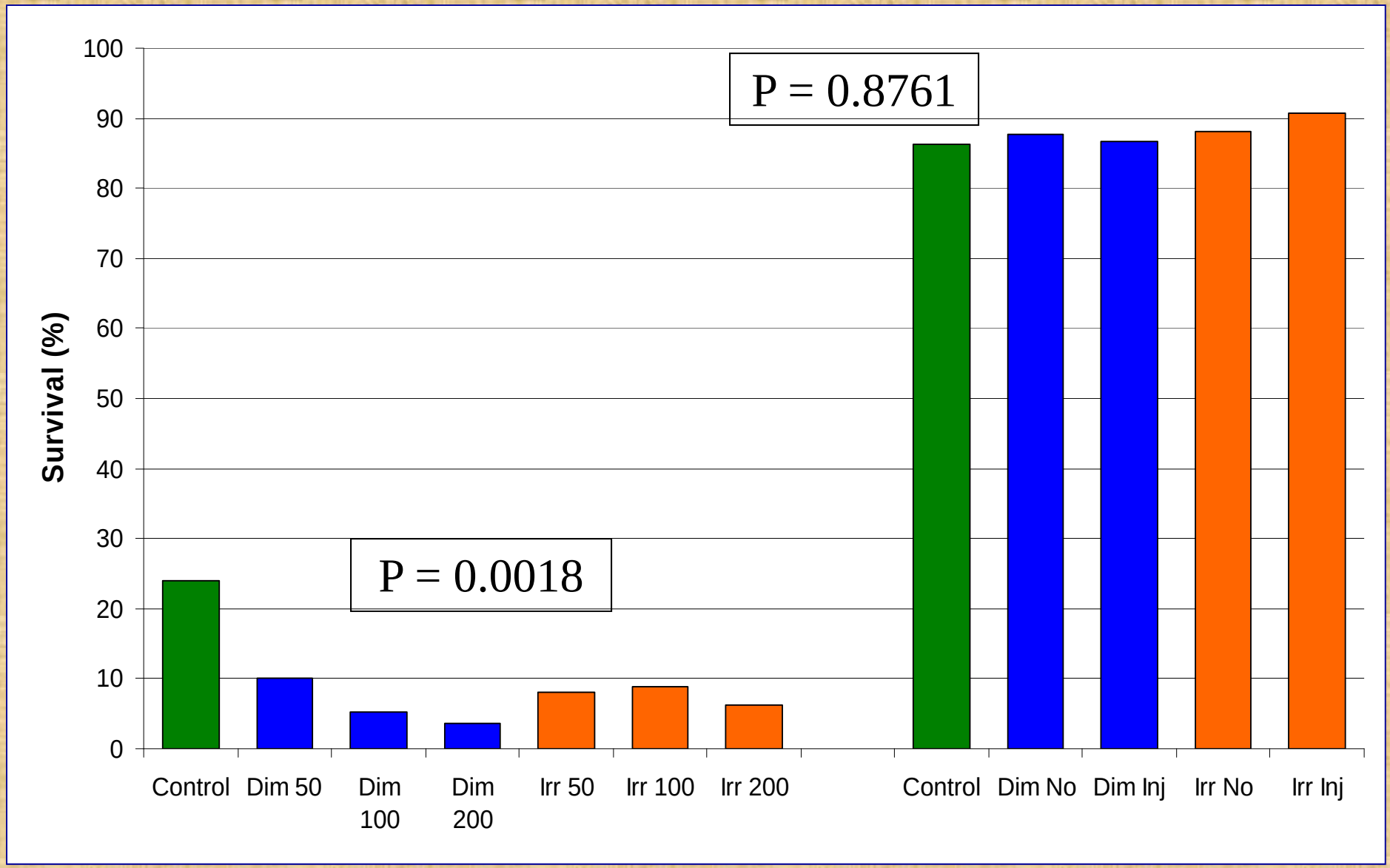


- *Pythium* can lay dormant in soil for years feeding on dead organic material
- Irrigation & rain can stimulate colonization and movement throughout nursery beds
- Root exudates provide nutrients for fungal growth



- *Pythium* causes pre and post-emergence damping off
- Root rot can develop after *Pythium* attacks the fine feeder roots of young seedlings

Pythium Reduced Survival of Cold Stored Longleaf Pine



Bareroot

Container

Loblolly Pine Packed in Peat Moss: Survival after Cold Storage

Experimental Design:

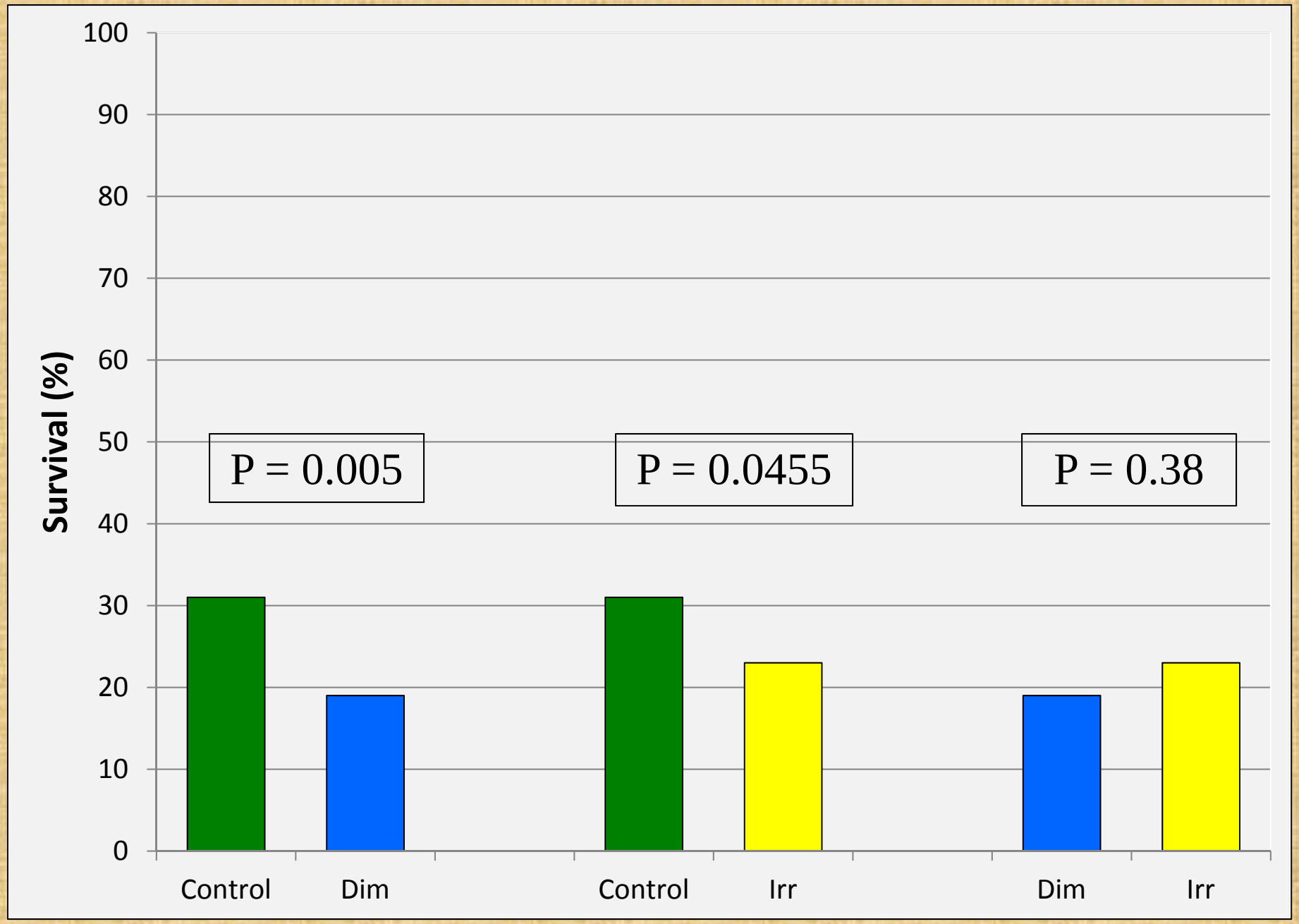
- Roots inoculated with 0 or 200 g of *P. dimorphum* and *P. irregulare*
- Packed in peat moss or no peat moss
- Storage periods: 4, 8,and 12 wks (6 trts; 4 reps of 30 seedlings/trt)
- Seedlings outplanted after each storage period and survival monitored for 4 months

ANOVA Results:
Loblolly Pine Seedling Survival

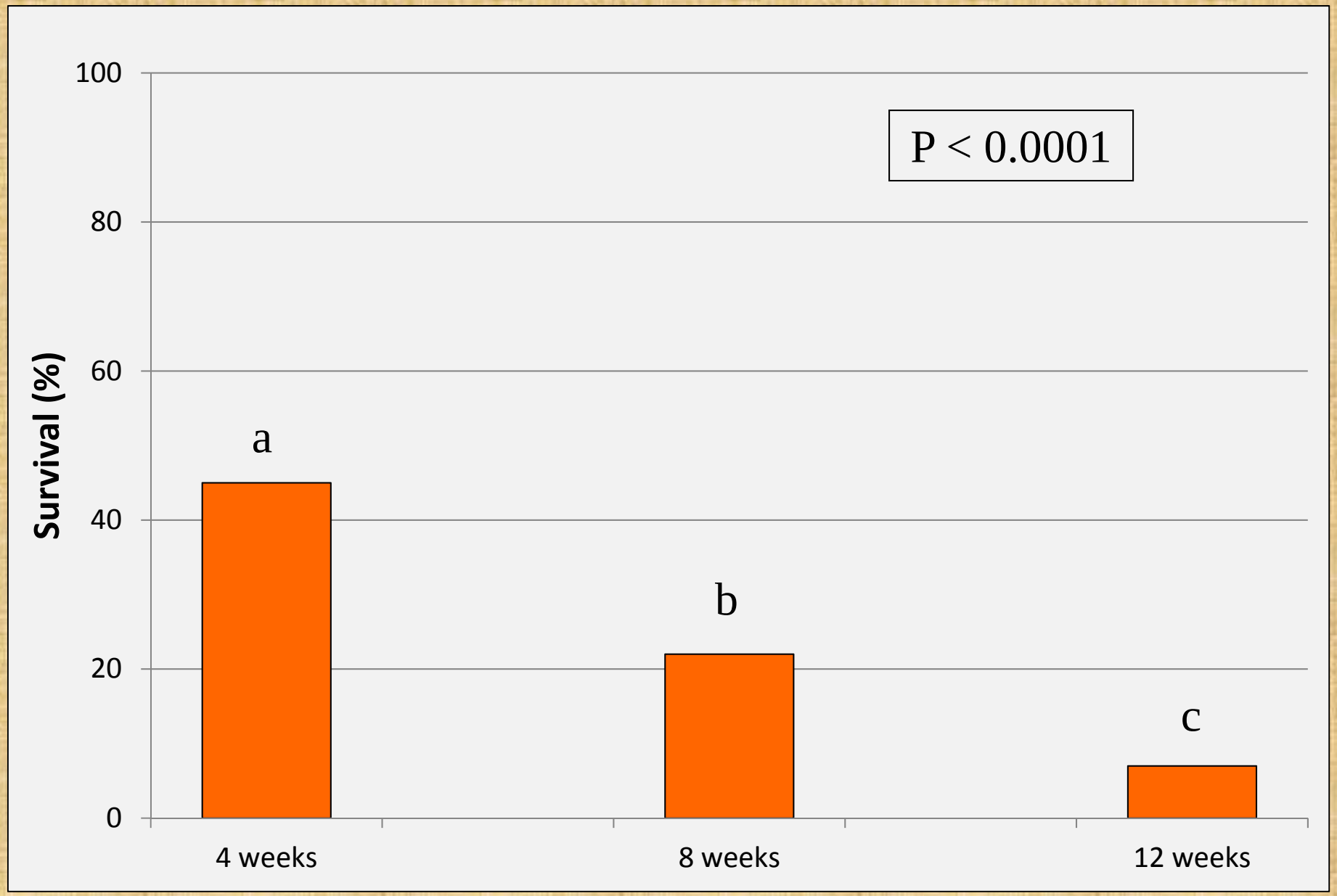
Source	F-Value	P-Value
Pythium	4.54	0.0154
Weeks in Storage	43.76	< 0.0001
Packing Media	2.89	0.0953
*Pythium**Weeks	2.4	0.1013
*Pythium**Media	0.98	0.4254

alpha = 0.05

Contrast Analysis: Survival Between *Pythium* Treatments



Loblolly Pine Survival: All Storage Periods



Loblolly/Packing in Peat Survival Summary

- Seedling survival was reduced by *P. dimorphum* and *P. irregulare*
- Packing loblolly seedlings in peat moss did not improve survival
- Survival declined with time in storage

Loblolly, Slash, & Shortleaf Pine Seedling Survival After Cold Storage

Bareroot Loblolly & Slash

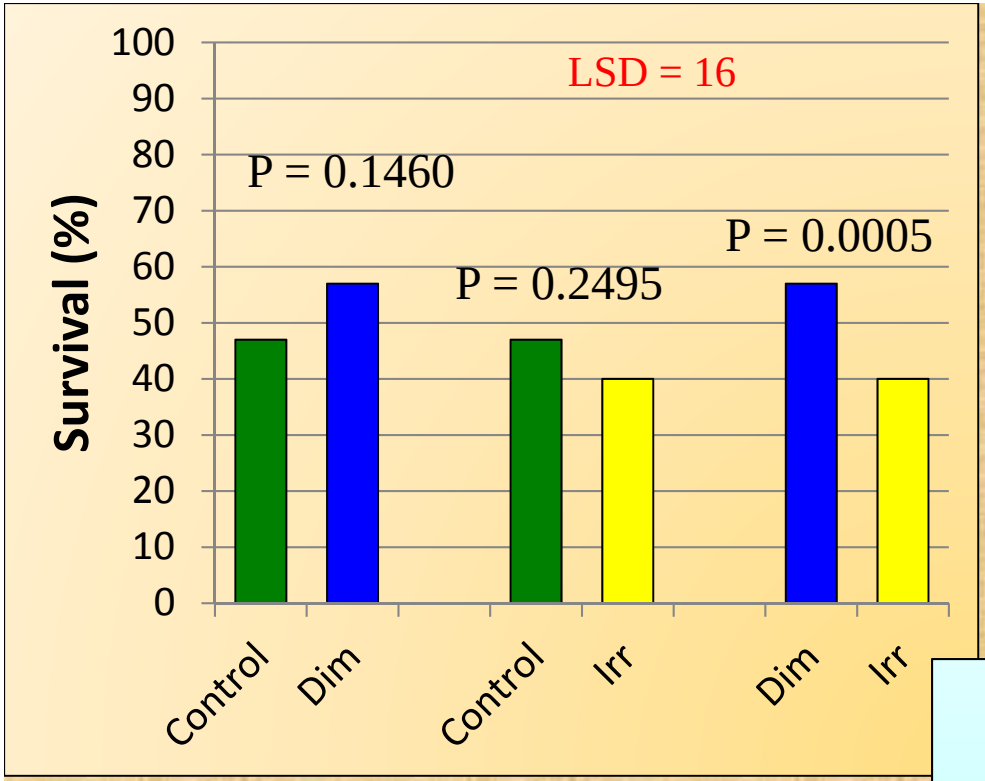
- Inoculated with *P. dimorphum* and *P. irregulare*
- Three levels: 50, 100, & 200 g
- Control dipped in water

Container Loblolly, Slash, & Shortleaf

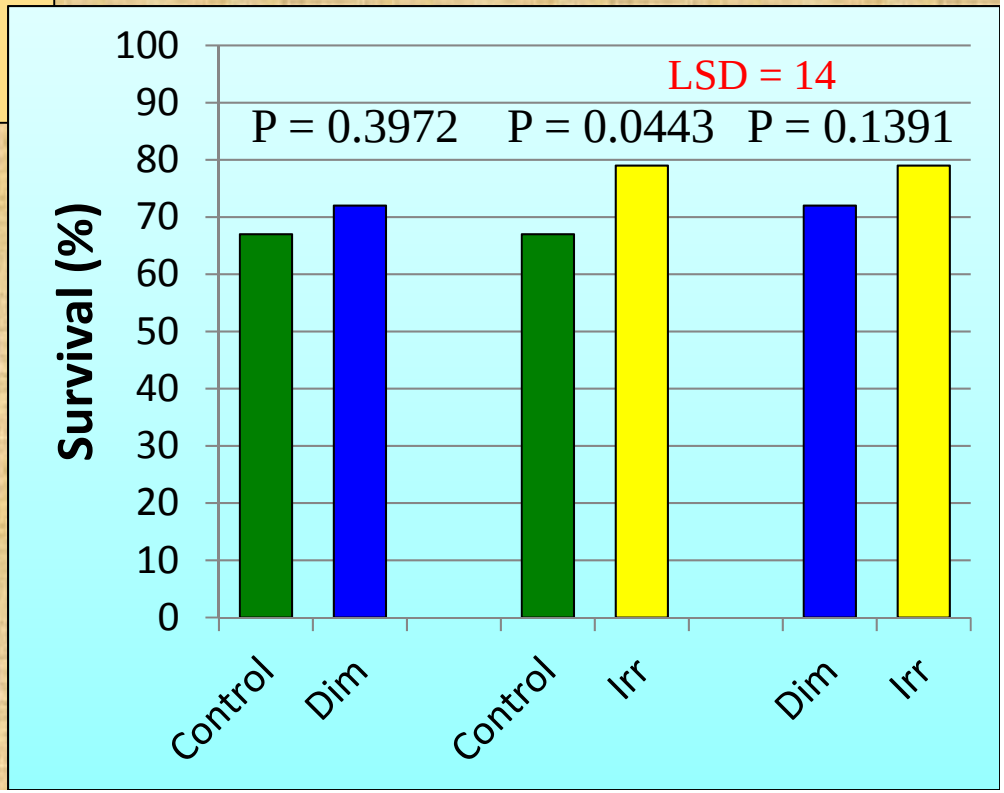
- Inoculated with *P. dimorphum* and *P. irregulare*
- One level: 200 g
- Root plug wounded or not wounded
- Control dipped in water

- Storage Periods: 4, 6, and 12 weeks in plastic bags at 4-5°C (3 reps of 20 seedlings/treatment; except for container shortleaf (15 seedlings/rep))
- Survival: seedlings outplanted after each storage period and monitored for 6 months

Contrast Analysis: Survival of Loblolly Seedlings



Bareroot



Container

Outplanting Dates:

4 wk stored: January 22

6 wk stored: February 5

12 wk stored: March 19

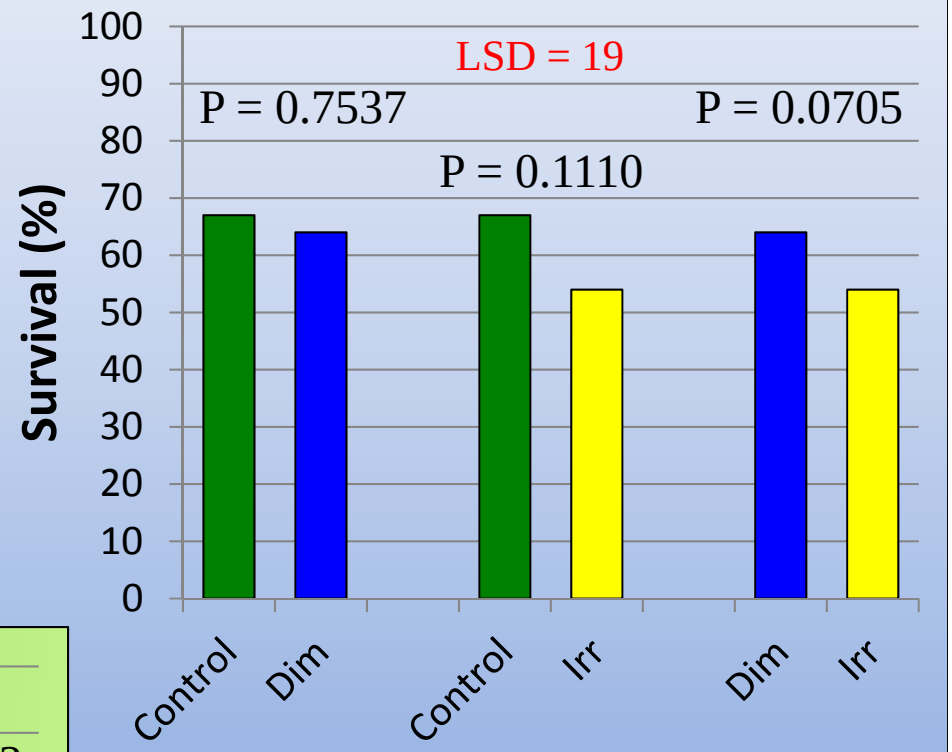
Contrast Analysis: Survival of Slash Pine Seedlings

<u>Outplanting Dates:</u>

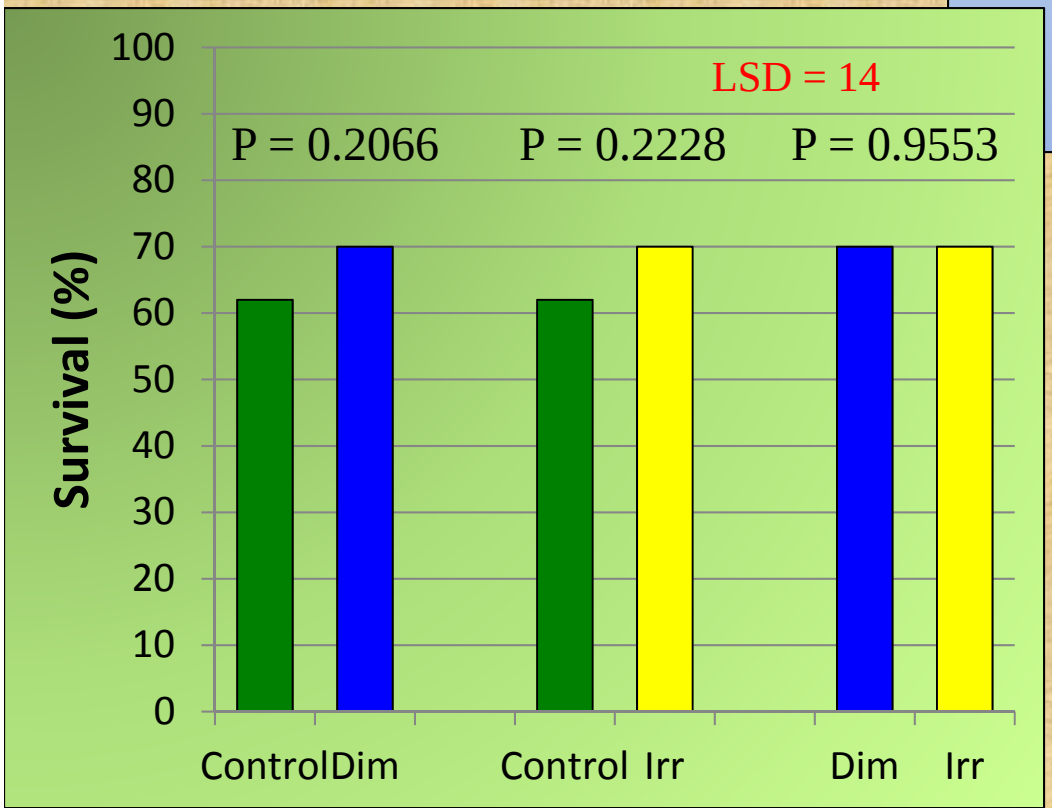
4 wk stored: January 22

6 wk stored: February 5

12 wk stored: March 19

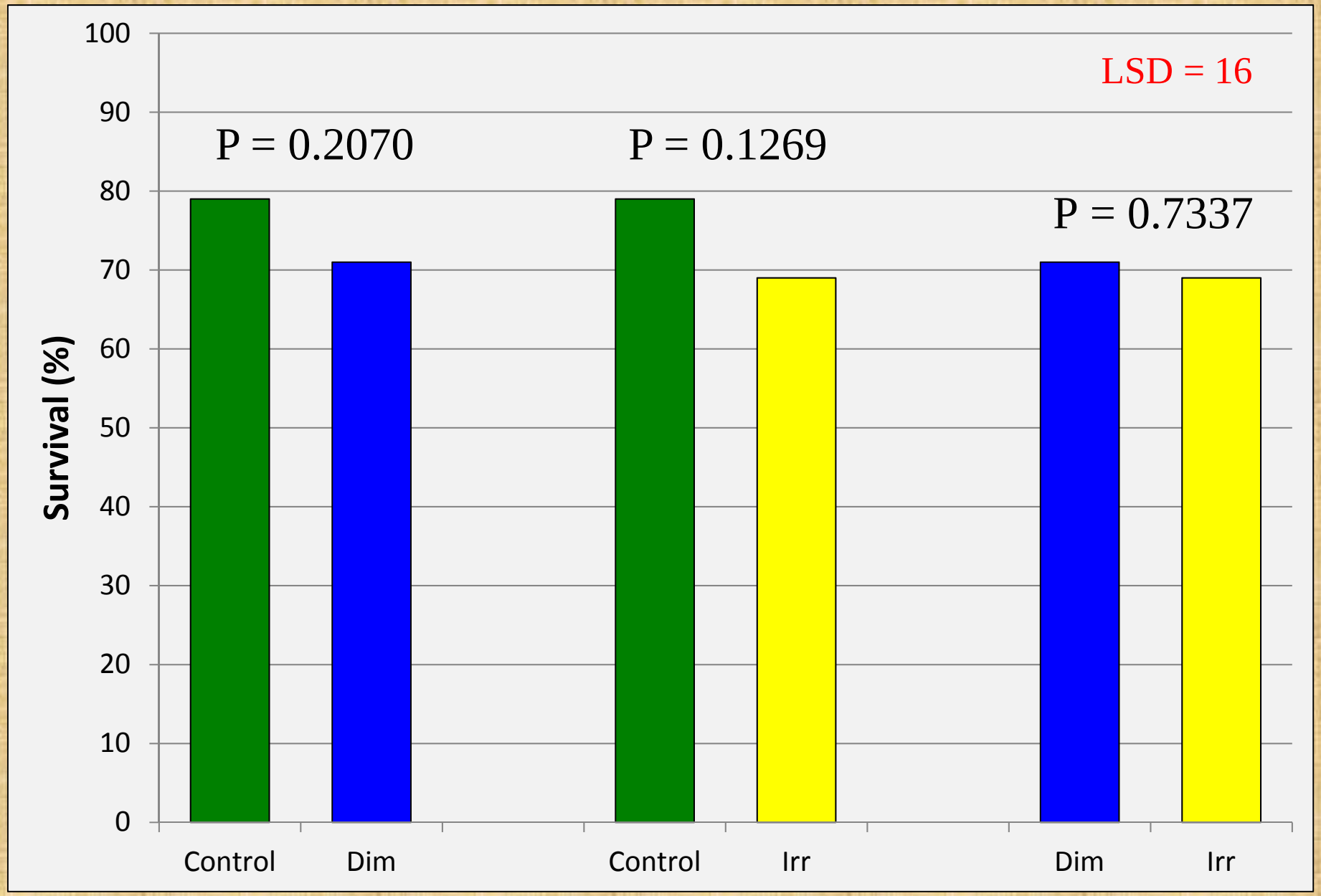


Bareroot

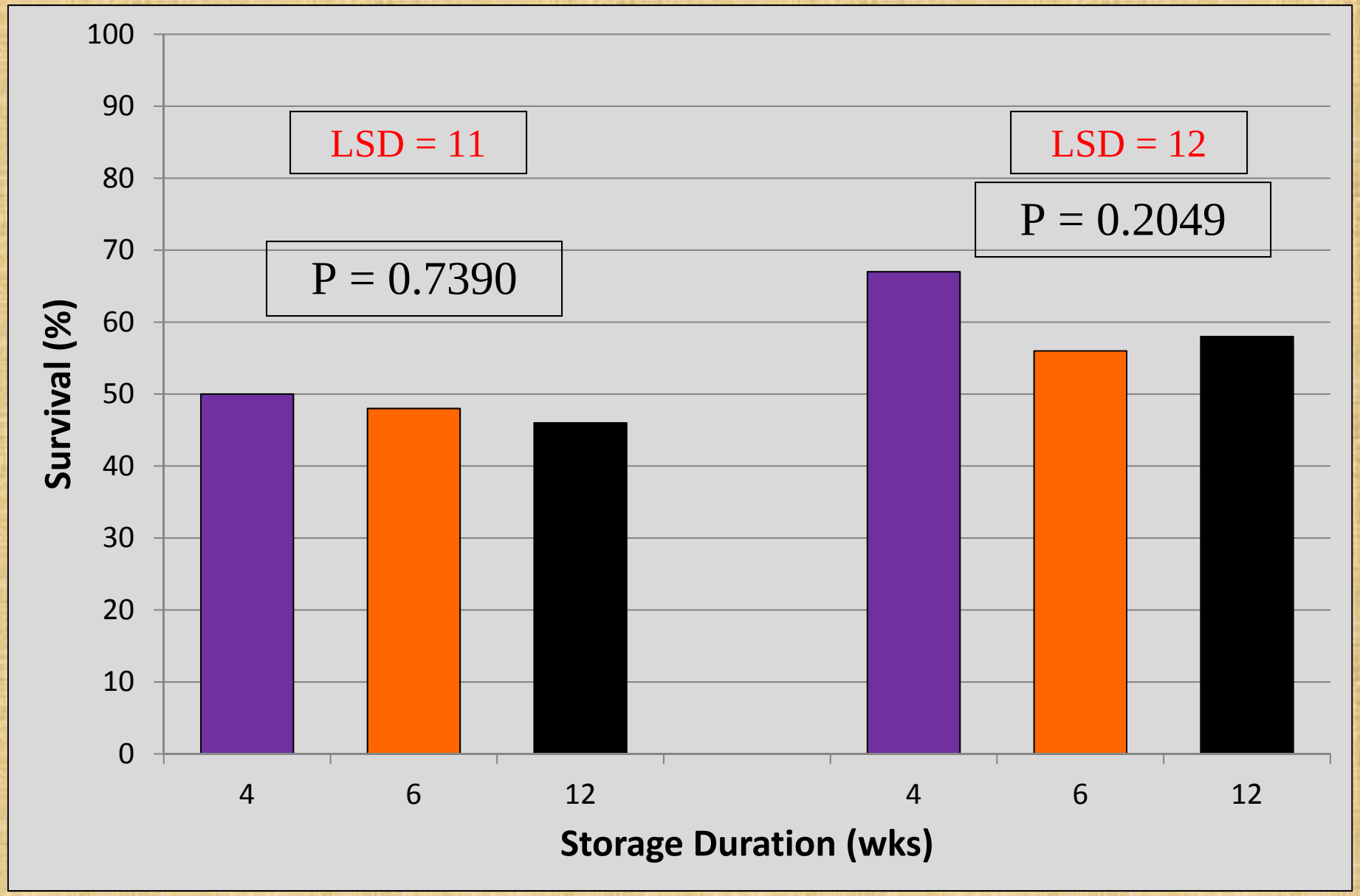


Container

Contrast Analysis: Survival of Container Shortleaf Seedlings



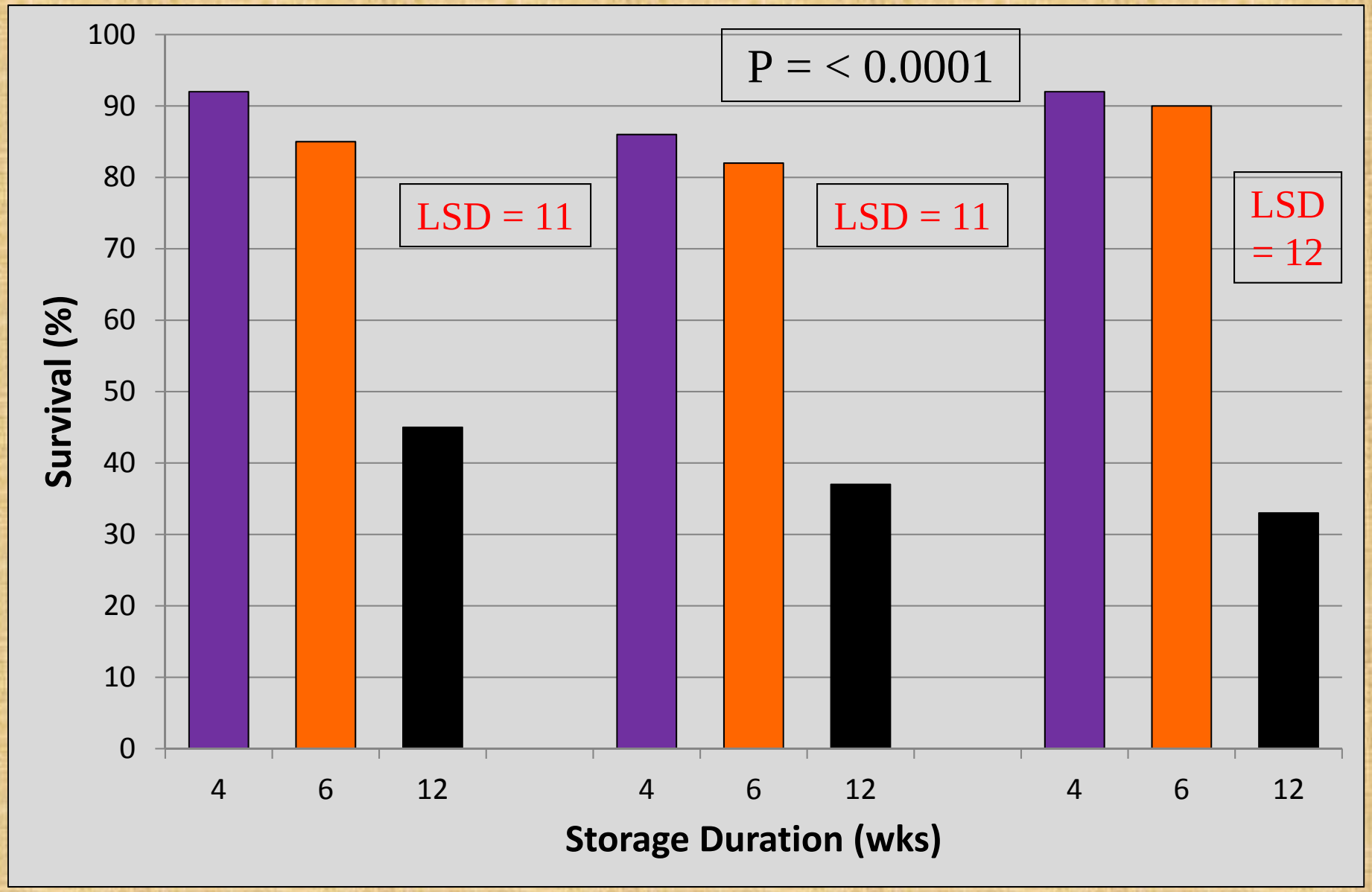
Bareroot Seedling Survival by Storage Time



Loblolly

Slash

Container Seedling Survival by Storage Time



Loblolly Slash Shortleaf

Bareroot and Container Seedling Survival Summary

- *P. irregulare* reduced bareroot loblolly survival
- Bareroot slash survival was not affected by *Pythium*
- Container loblolly, slash, and shortleaf were not affected by *Pythium* or root wounding
- Bareroot seedling survival was similar for all storage durations
- Storing container seedlings 12 weeks and outplanting them in March caused a drastic decline in survival

Bareroot Loblolly and Slash Seedling RGP after Cold Storage

Experimental Design:

- Two pine species: loblolly and slash
- Inoculated with *P. dimorphum* and *P. irregulare*
- Three levels: 0, 50, and 200 g
- Cold stored for 3 weeks in plastic bags at 4-5°C
- Seedlings placed in aerated aquariums for 28 d (hydroponics)
- 15 seedlings/trt; 3 reps/trt (15 aquariums); completely randomized block design

Measurements:

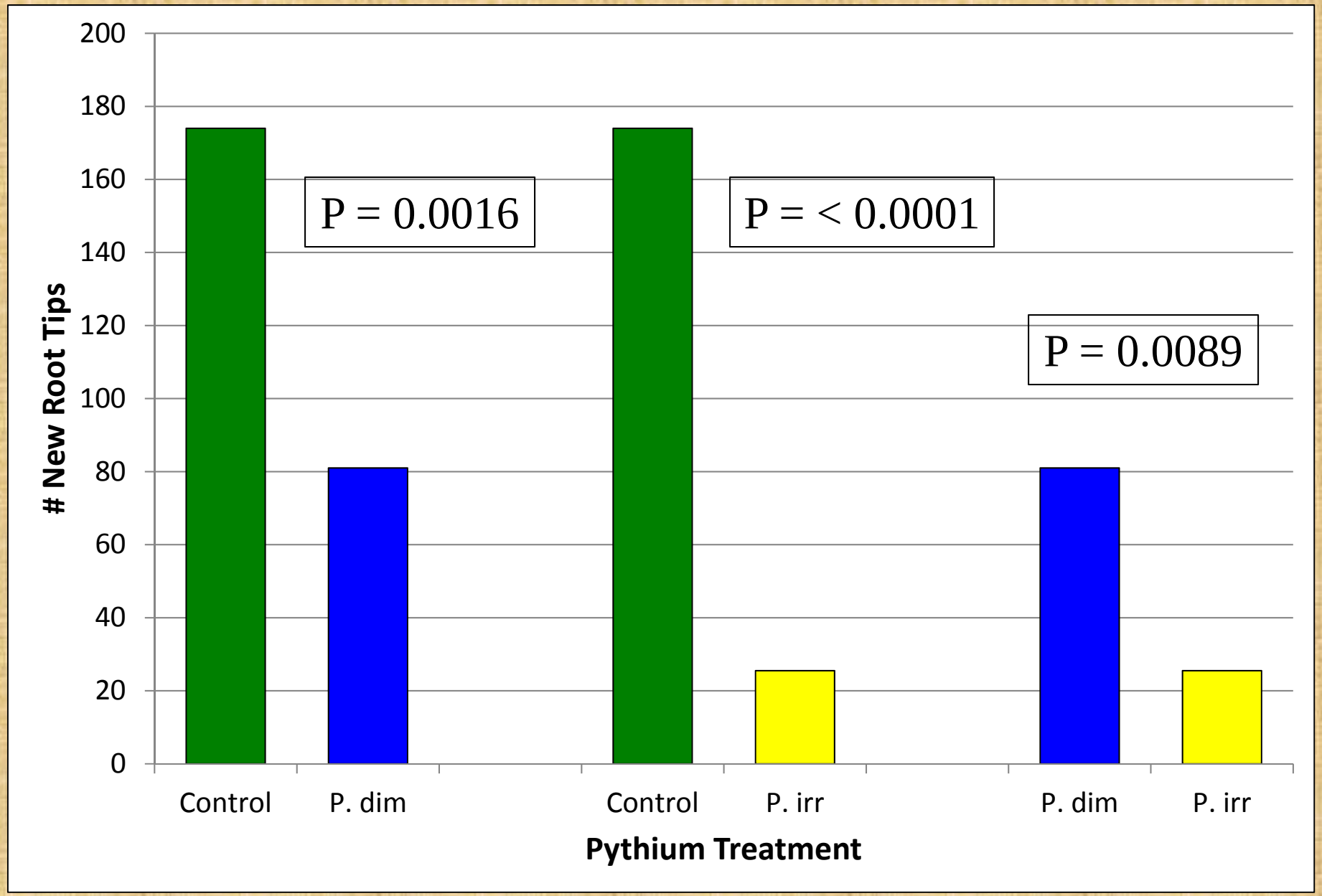
- Root length, diameter, volume, surface area, & number of new white tips measured using a scanner and software (WinRhizo)
- RCD on day 1 and 28
- All seedlings were outplanted on day 34 to monitor survival for 4 months

Contrast Analysis: Slash Pine Root and RCD Data

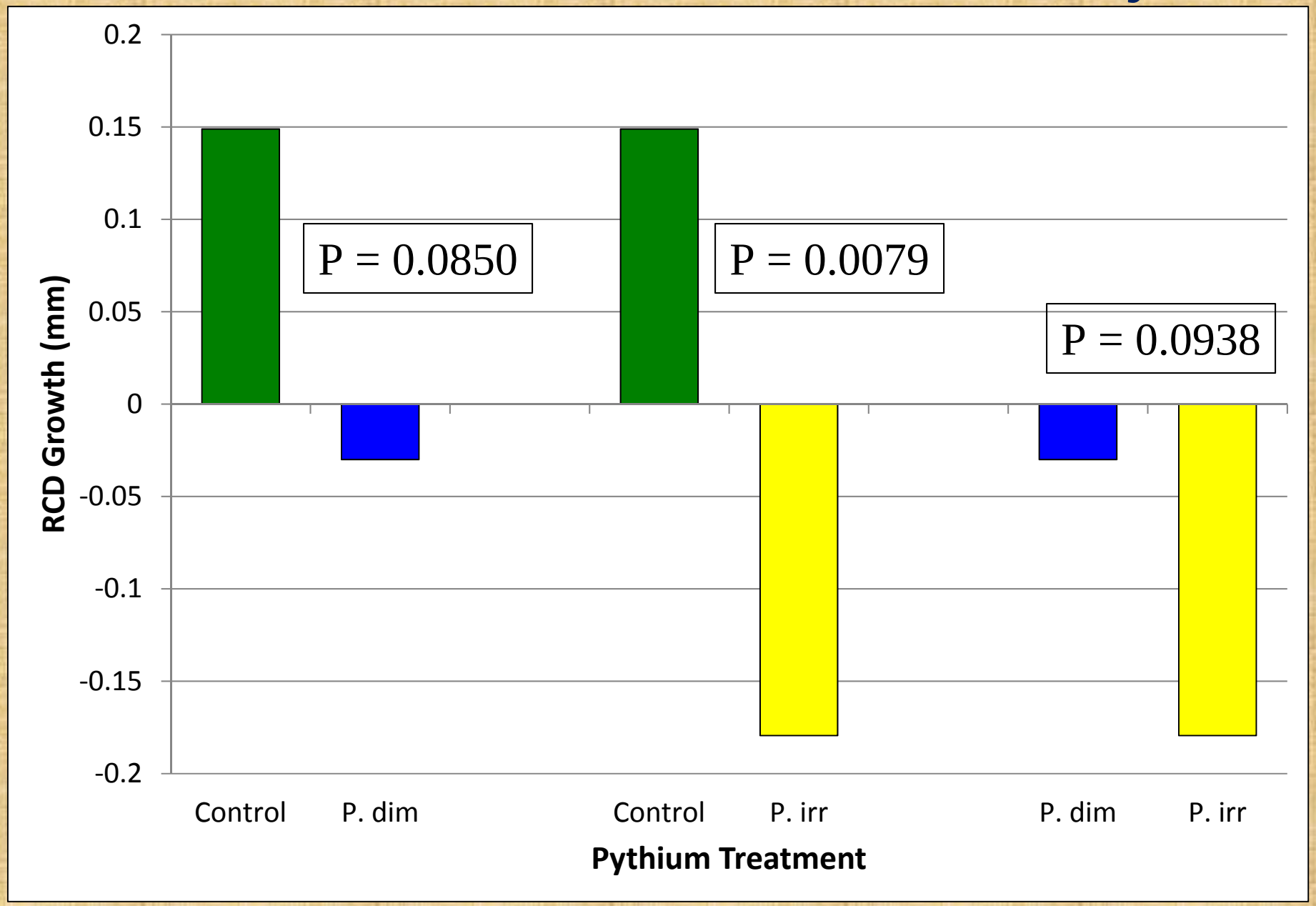
Contrast	Root Length (cm)	Root Volume (cm^3)	Root Surface Area (cm^2)	Root Diameter (mm)	# new root tips	RCD growth (mm)
control vs *dimorphum*	0.0009	0.0035	0.0012	0.4627	0.0016	0.0850
control vs *irregulare*	< 0.0001	0.0001	< 0.0001	0.9254	< 0.0001	0.0079
dimorphum vs *irregulare*	0.0096	0.0079	0.0070	0.3188	0.0089	0.0938

alpha = 0.05

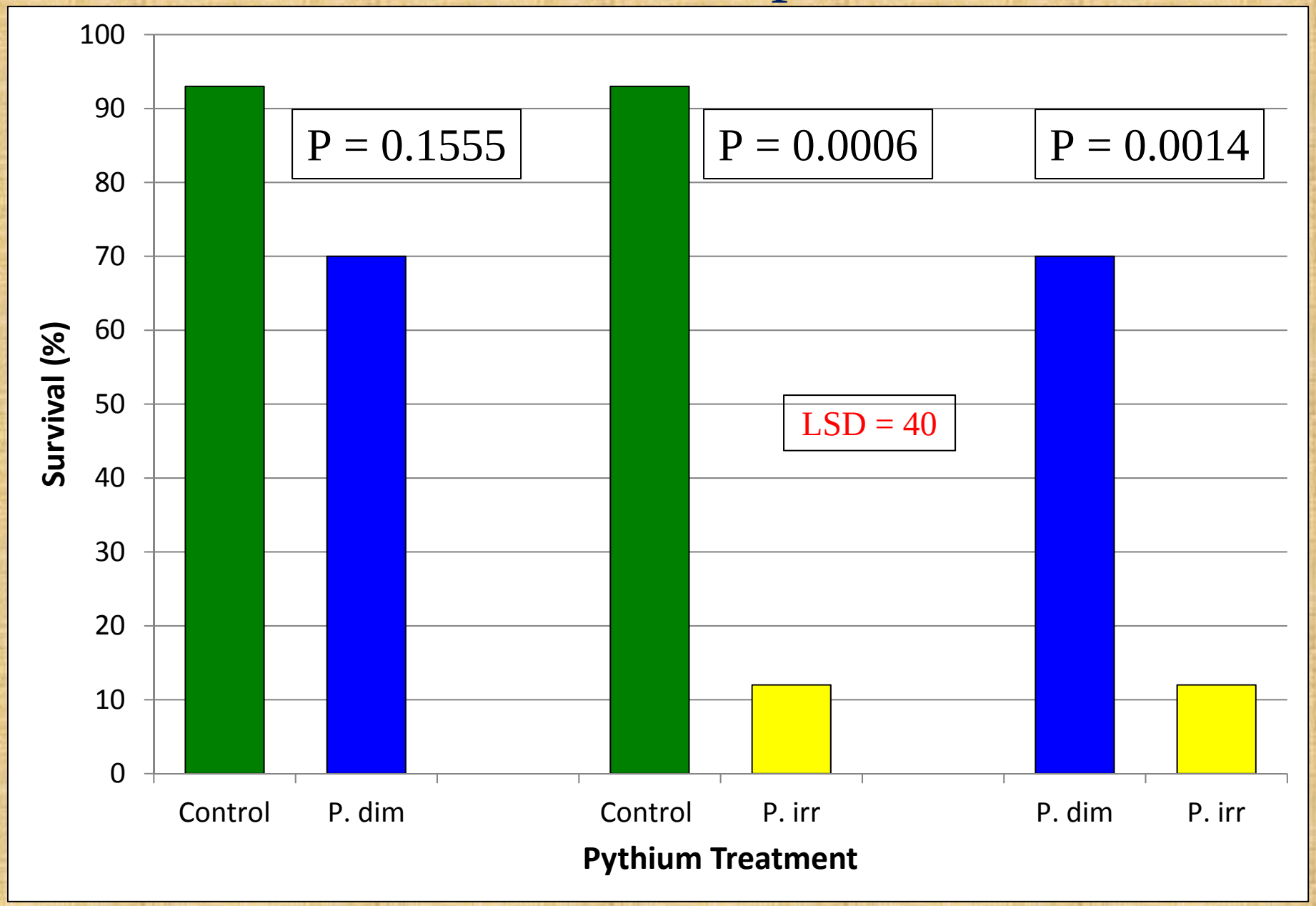
Contrast Analysis: # of New Slash Root Tips



Slash Pine RCD Growth after 28 Days



Slash Pine Survival: Outplanted 8 Weeks

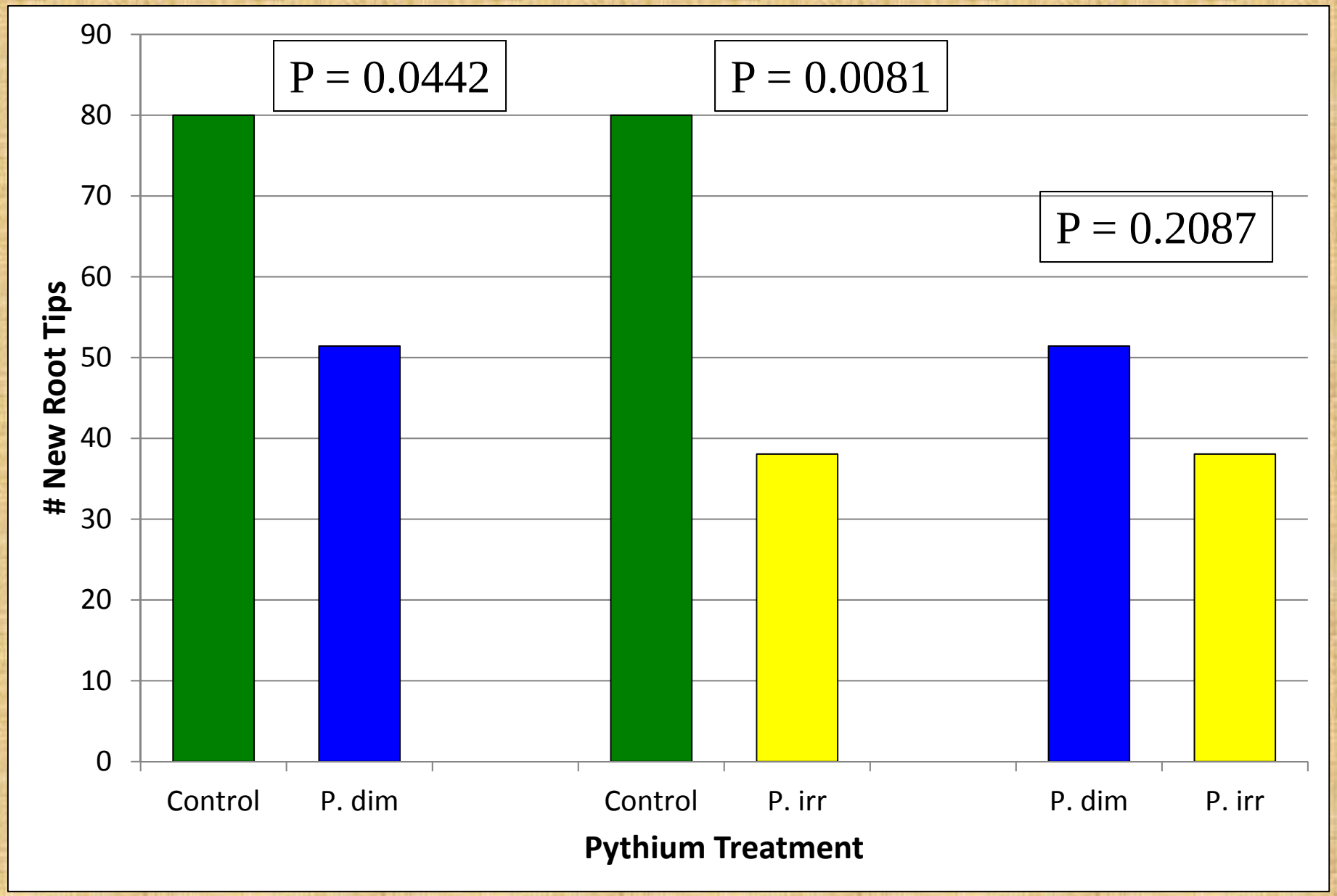


Contrast Analysis:
Loblolly Pine Root and RCD Data

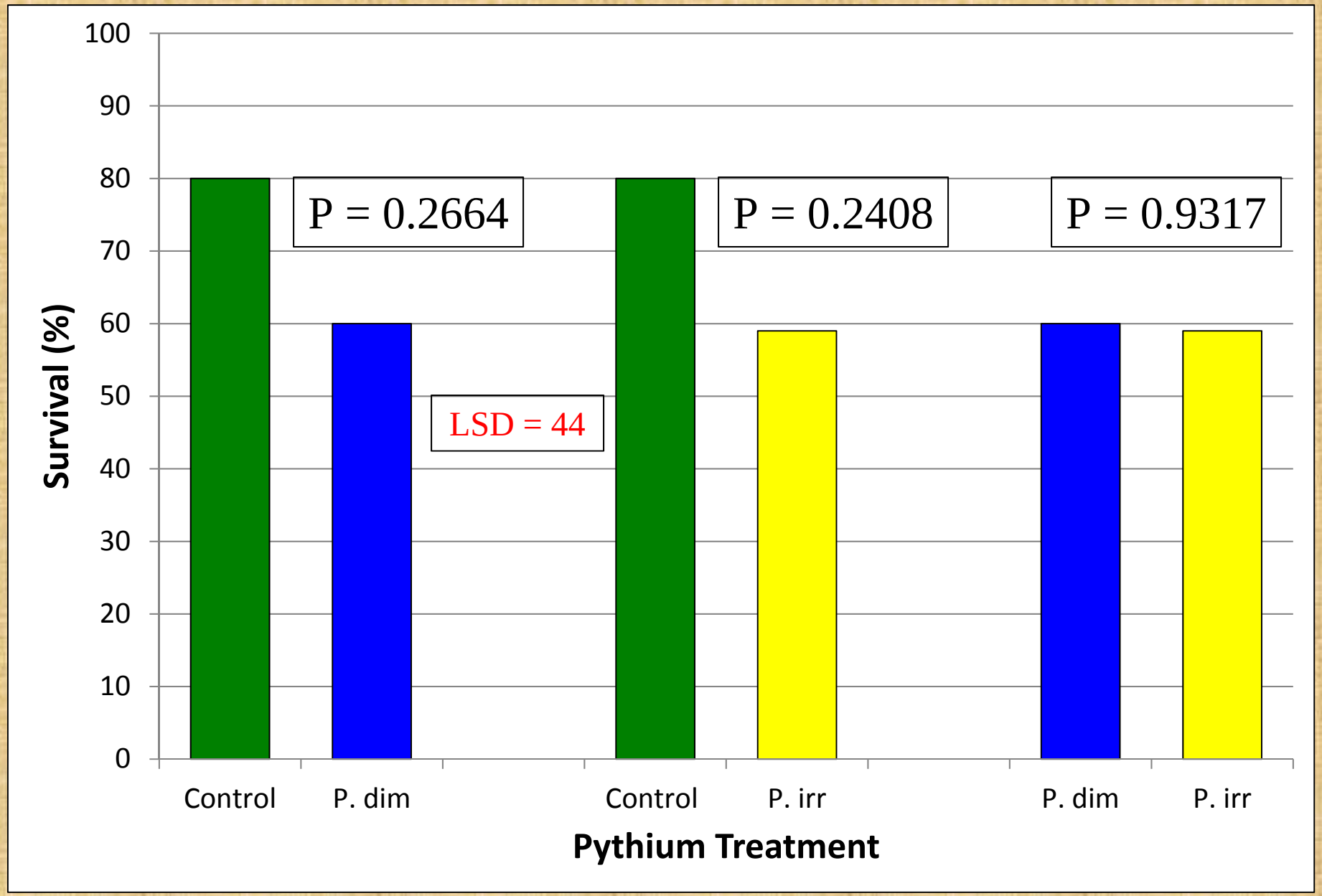
Contrast	Root Length (cm)	Root Volume (cm^3)	Root Surface Area (cm^2)	Root Diameter (mm)	# new root tips	RCD growth (mm)
control vs *dimorphum*	0.1141	0.6412	0.2950	0.1351	0.0442	0.2206
control vs *irregulare*	0.0254	0.1555	0.0622	0.2848	0.0081	0.1095
dimorphum vs *irregulare*	0.2704	0.2209	0.2362	0.5454	0.2087	0.5792

alpha = 0.05

Contrast Analysis: # of New Loblolly Root Tips



Loblolly Pine Survival Outplanted 8 Weeks



Loblolly and Slash Pine RGP Summary

- *P. irregulare* reduced new root tip growth in slash and loblolly pine
- *P. dimorphum* reduced new root tips of slash but not as severely as *P. irregulare*
- *Pythium* did not affect loblolly RCD but caused slash RCD to shrink
- *Pythium* did not affect loblolly pine survival
- *P. dimorphum* and *P. irregulare* reduced slash pine survival

- BARRY IS AWESOME!!

Soil Surveys

- Fall and winter soils have been surveyed for *Pythium* spp.

- Results will be presented at the Advisory Meeting in the fall.

Thank you!!

- SFNMC Members
- Rayonier-Kelly Dougherty
- Smurfit-Stone-Doug Shelburne
- International Forest Co.-Wayne Bell & Mike Coyle
- Drs. Scott Enebak & David South
- Co-op Staff: Tommy Hill, Marietjie Quicke, Barry Brooks, Patrick Jernigan, Rena Miller, & Dr. Tom Starkey

QUESTIONS?

(Then two more slides)

One day, my wife asked me……

- Do you love me more than Chick-Fil-A?

I said, yes!

- Do you love me more than football?

I said, yes!

- Do you love me more than the Boston Celtics?

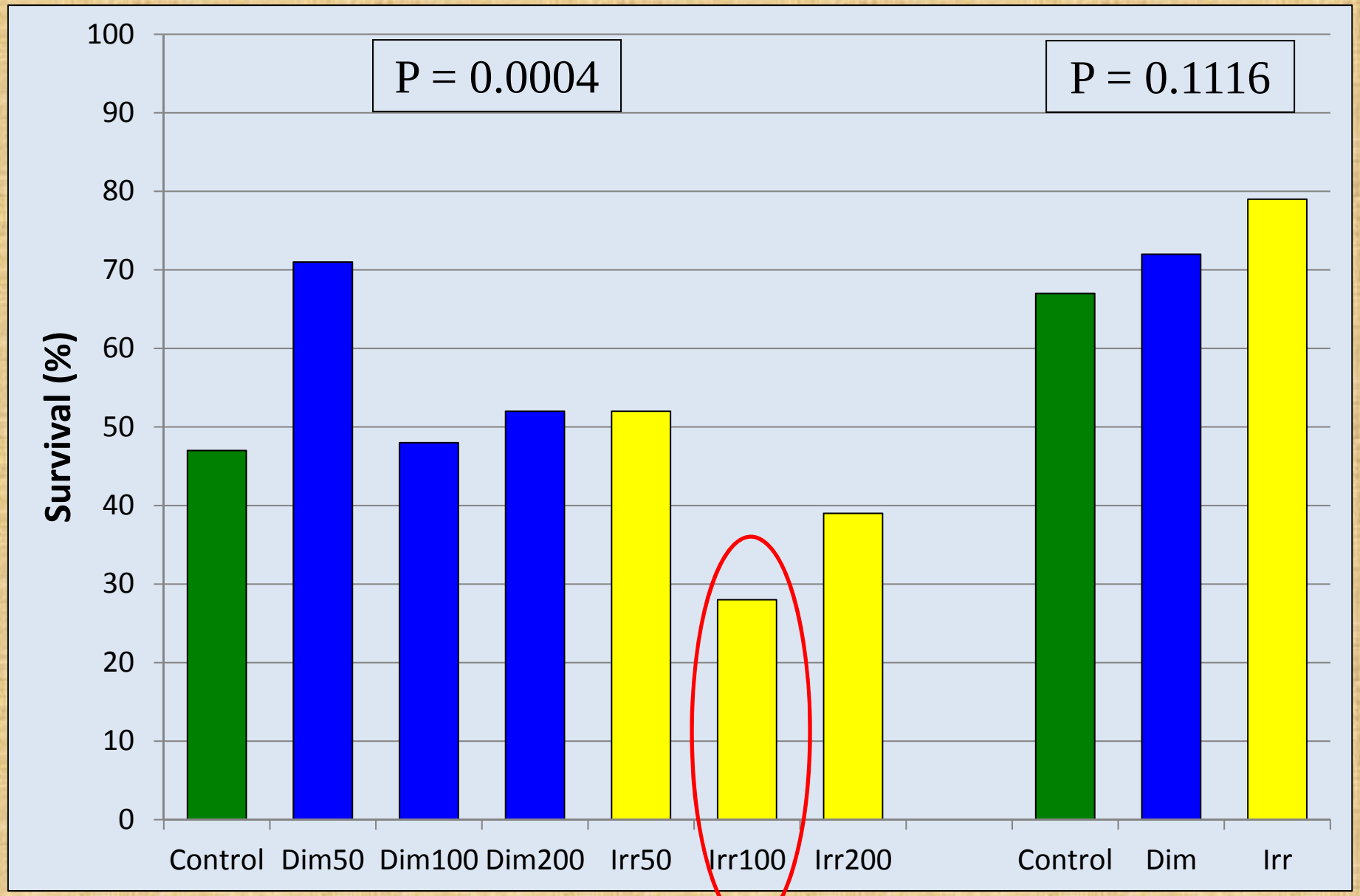
I said, yes!

- Do you love me more than pine seedlings?

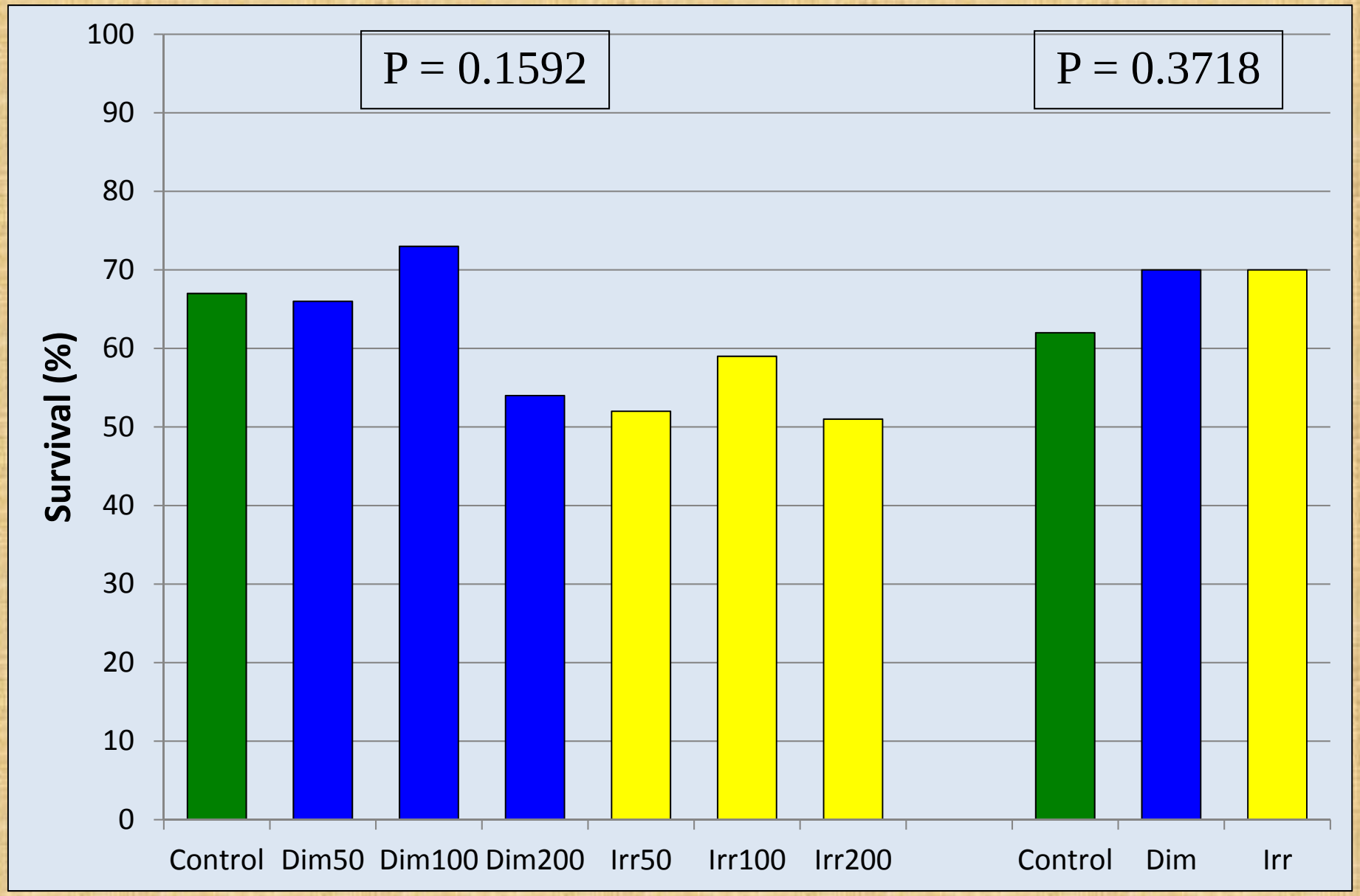
I said, well, you see, I mean, you have to understand, just wait a minute, but……YES!

Today Marks 2 Years of Marital Bliss

Loblolly Survival for All Storage Periods: Outplanted 12-20 wks



Slash Pine Survival for All Storage Periods



Container Shortleaf Survival for All Storage Periods