

Wind and trees: what we learned

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Tree defect lessons learned

- Trees with one trunk did best
- Bark inclusions and co-dominant stems fail
- Preventive pruning reduces damage
- Broken trees often fail again
- Double trunked trees fall over
- Topped or sheared trees fail
- Lions-tailed (over-lifted) trees fail
- Large pruning cuts lead to breakage
- Apparently healthy trees can be hollow
- Trees planted as small nursery stock fair better
- Roots rot on apparently healthy trees

Influence of pruning on trunk movement in gale-force winds

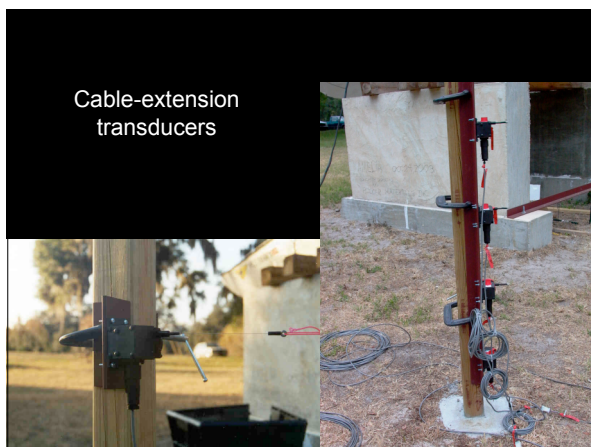
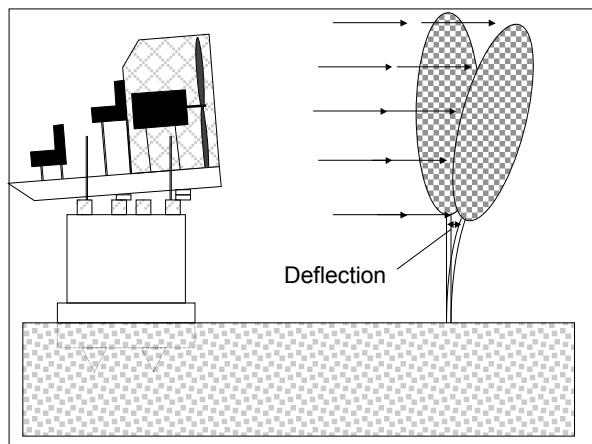
Ed Gilman

Scott Jones

Chris Harchick

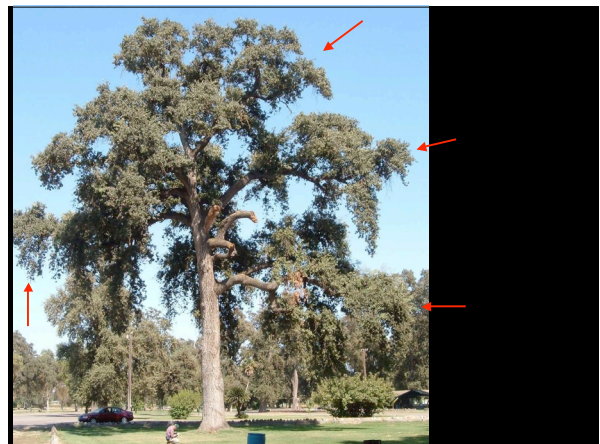
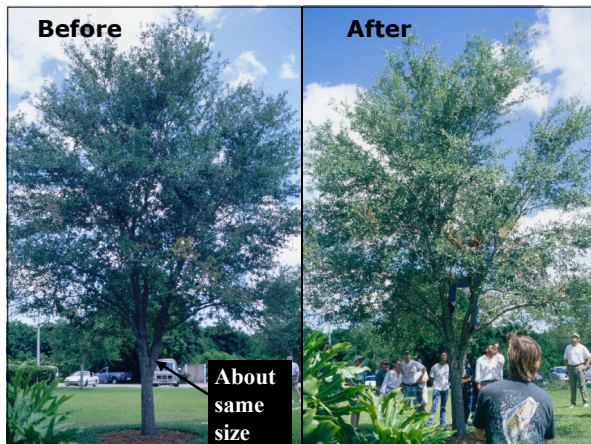
Assumption: **increased canopy movement increases likelihood of damage**

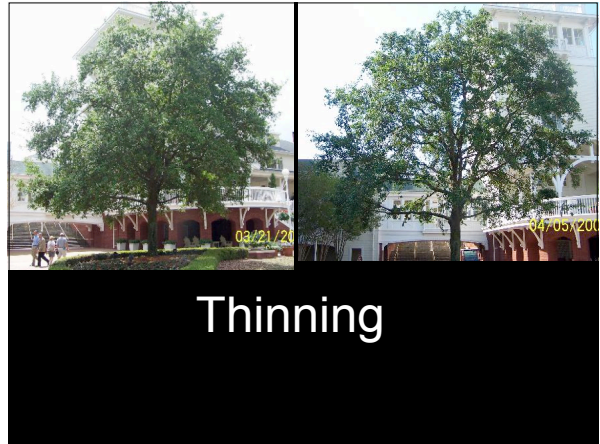
Supported by James et al. 2006 and others



Pruning types tested

- Structural
- Reduce
- Thin
- Raise
- Lions-tail

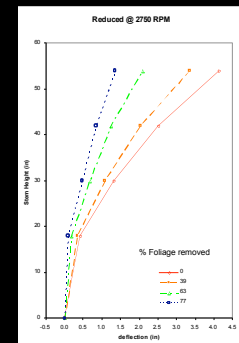




Procedure

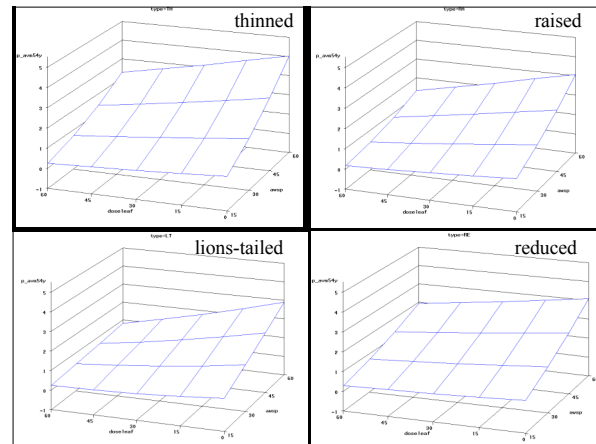
- Blow tree to 60mph, back to rest
- Remove 15% foliage and blow again
- Remove 30% foliage and blow again
- Remove 45% foliage and blow again
- Remove 60% foliage and blow again

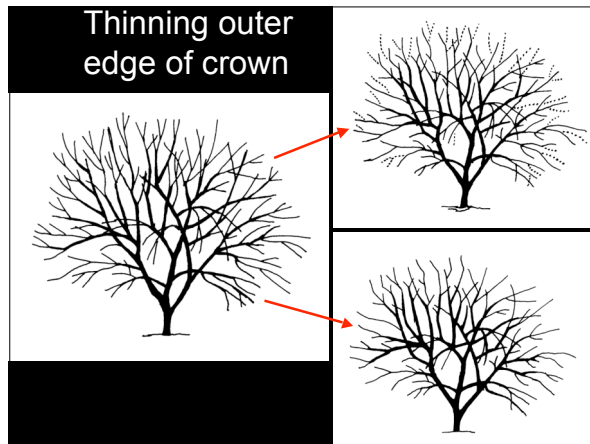
For all pruning methods, increasing pruning dose reduced canopy movement



Trunk movement in wind following five pruning types

Pruning method	15mph	30mph	45mph	60mph
Structural	NS	NS	1.3 a	2.1 a
Raised	NS	NS	1.5 a	2.3 a
Lions-tailed	NS	NS	1.5 a	2.4 a
Reduced	NS	NS	1.7 ab	2.7 a
Thinned	NS	NS	2.0 b	3.3 b





Results in a nutshell:

- Thinning the edge of the crown appeared least effective at reducing movement
- Other pruning types were about equal at reducing canopy movement

structural raising reducing thinning

Effects of pruning on trees in wind up to 120 mph

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Question: Does pruning impact trees in hurricane-force winds

Assumption: increased canopy movement increases likelihood of damage

Supported by James et al. 2006 and others

Cooperative effort



How we did this

- Trees
- People
- Funding
- Pruning types
- Equipment
- Setup
- Execution
- Data

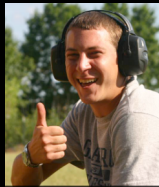


Spaced Cathedral Oak® 32 feet apart



People

- Dr. Forrest Masters, UF engineer
- Dr. Ed Gilman, UF
- Dr. Jason Grabosky, Rutgers
- Dr. Kurt Gurley, UF
- Chris Harchick
- Ryan Eckstein
- Alison Boydston
- Dustin Meador



Funding

- Department of Community Affairs through International hurricane research center, FIU – \$85,000+
- University of Florida Environmental Horticulture department – \$15,000
- Great Southern Tree Conference - \$20,000
- TREE Fund - \$25,000

Pruning treatments

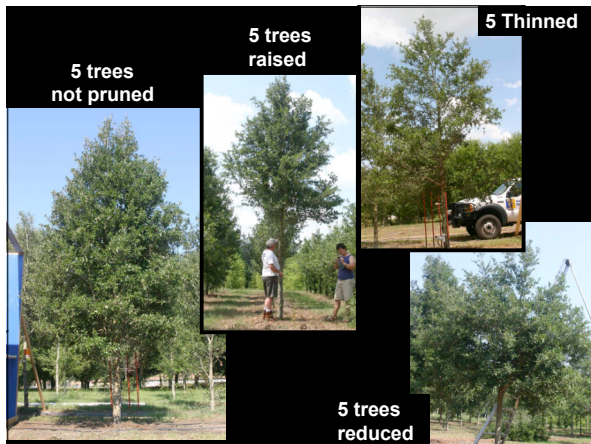
- Not pruned
- Raised crown
- Thinned crown
- Reduced crown

Attempting to mimic pruning younger parts of larger trees



Not pruned vs. thinned

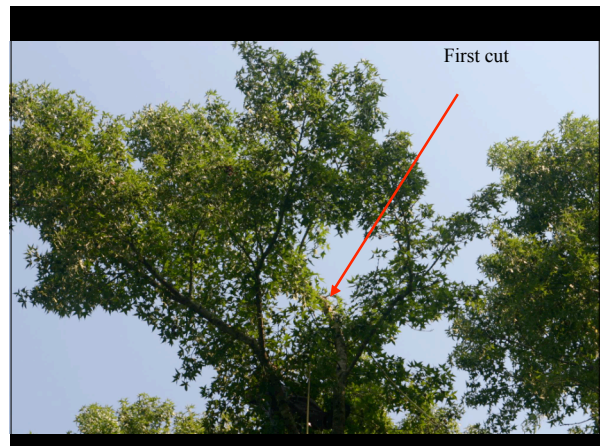
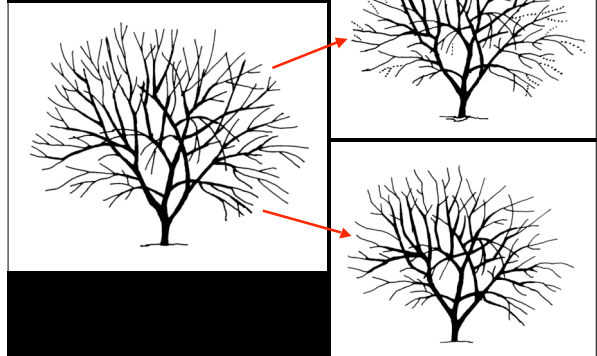


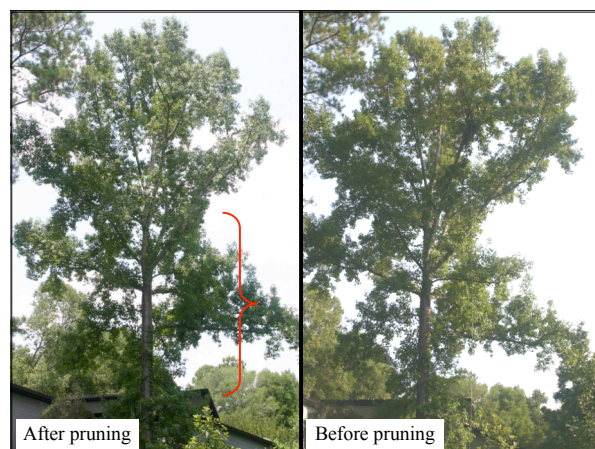


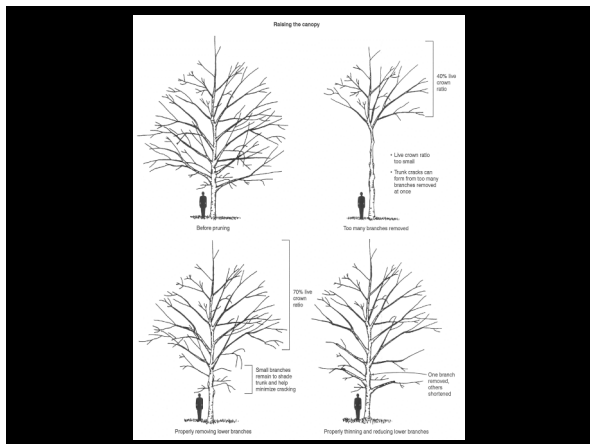
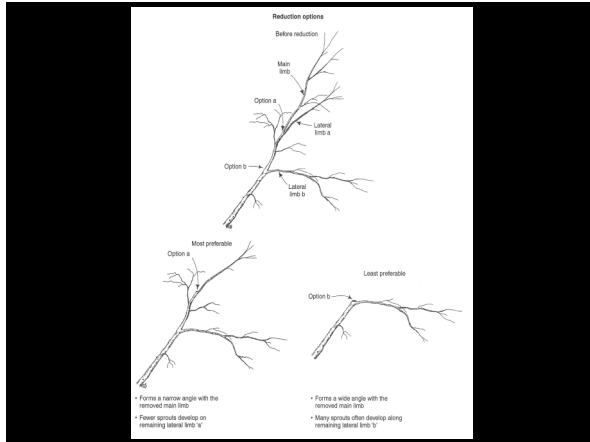
Over lifted trees did poorly in hurricanes



The first study thinned only crown edge
Thin the canopy on outside





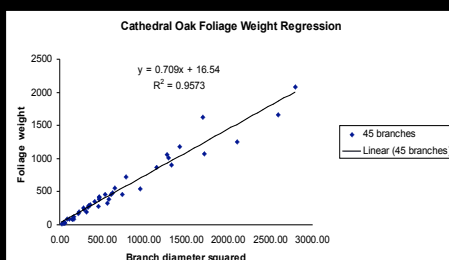


One-third of foliage removed from each pruned tree

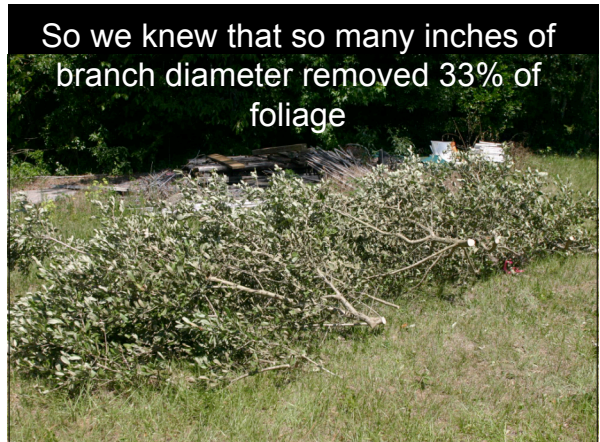
- 1) On 3 trees, we pulled all foliage from 15 branches and measured branch diameter at the trunk.
- 2) We calculated an equation (relationship) between branch diameter and foliage weight.
- 3) This was a very predictable relationship.



Relationship between branch diameter and foliage weight



So we knew that so many inches of branch diameter removed 33% of foliage



Big machines and tiny devices

The big machine: **Wall of Wind!**



The Wall of Wind

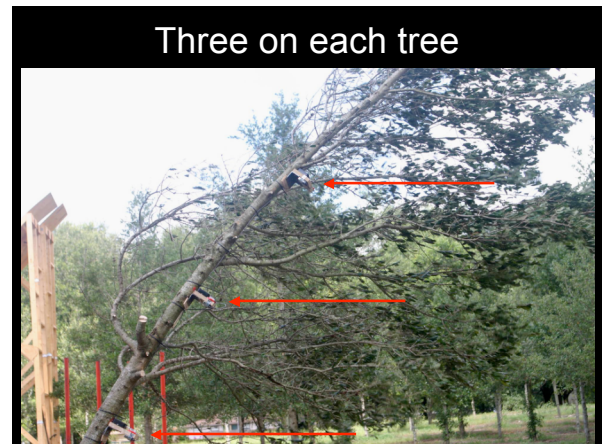
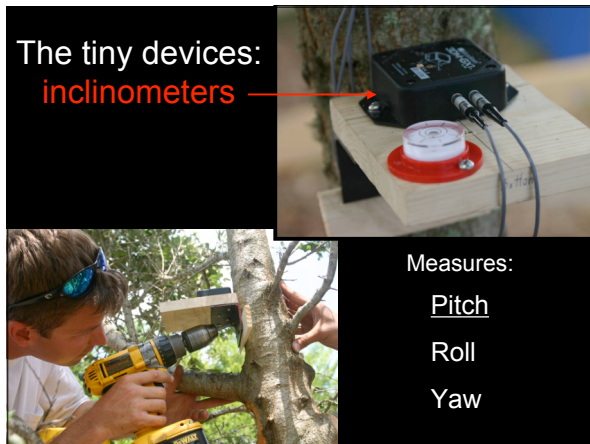
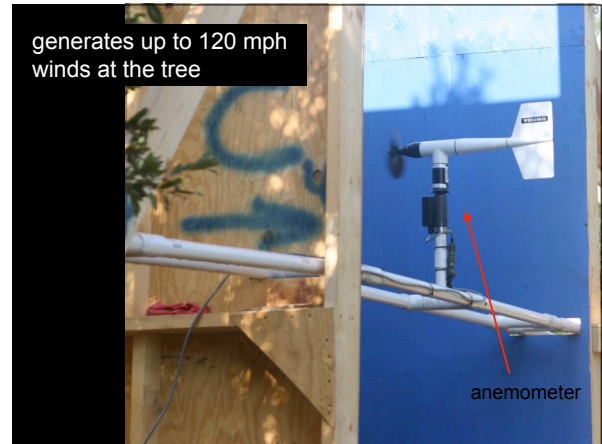


880 horsepower



deflector





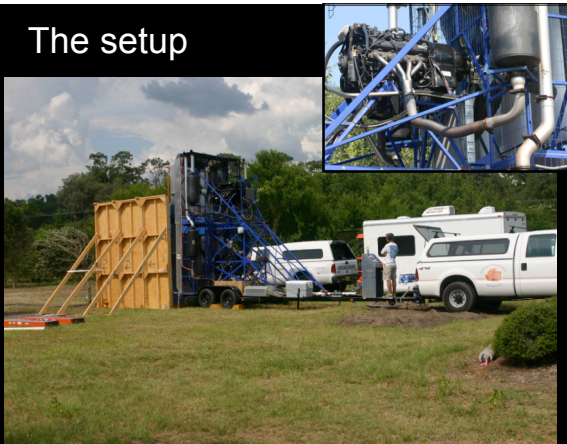
Trees irrigated to field capacity



Wired up and ready to blow



The setup



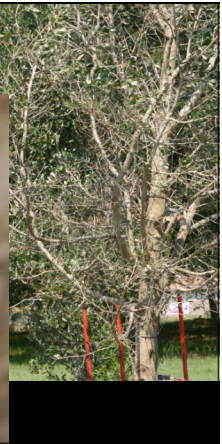
880 horsepower is very, very loud



Execution of project

- Show video of treatments

We did some damage



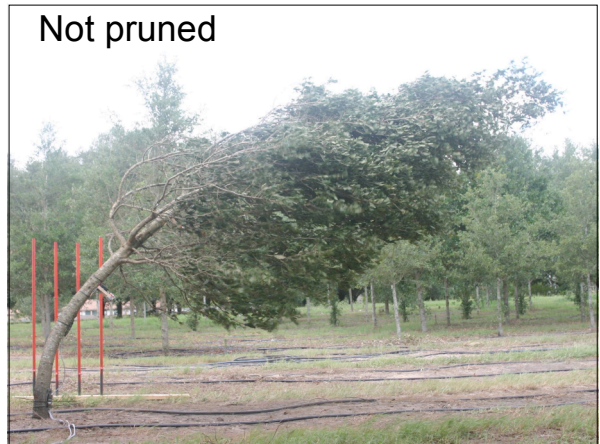
Oh yea baby



The trunk of one tree cracked with 62 degree angle







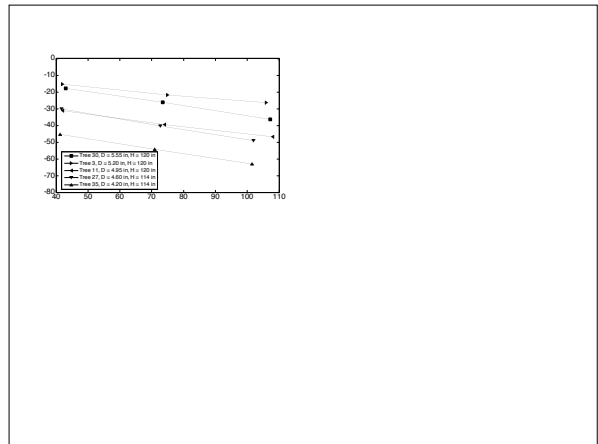
Raising

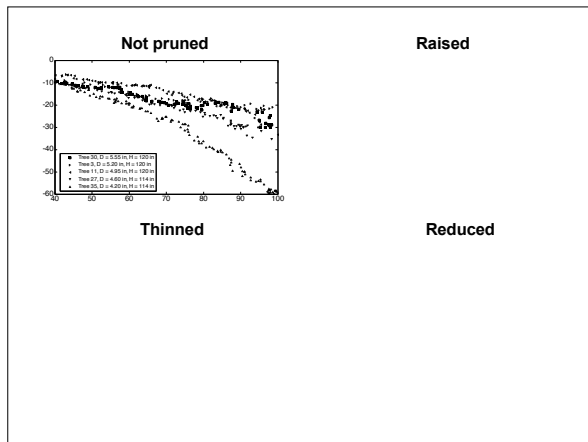


Thinning



Reducing





Bending angle by treatment

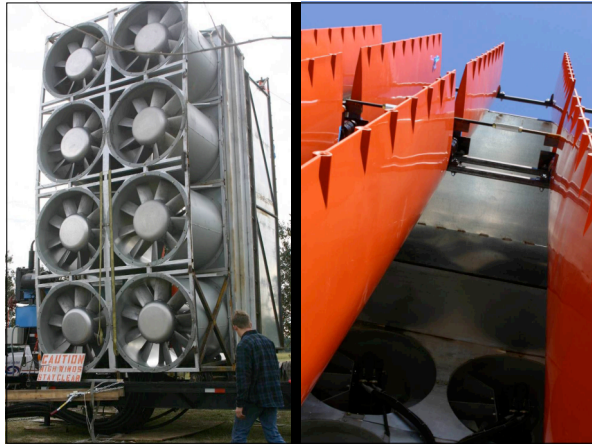
Top device

- Not pruned 46 **a**
- Raised 31 **a b**
- Thinned 23 **c b**
- Reduced 17 **c**

Bending angle by treatment

	Top device	Bottom device
• Not pruned	46 a	29 a
• Raised	31 a b	15 b
• Thinned	23 c b	12 b
• Reduced	17 c	12 b



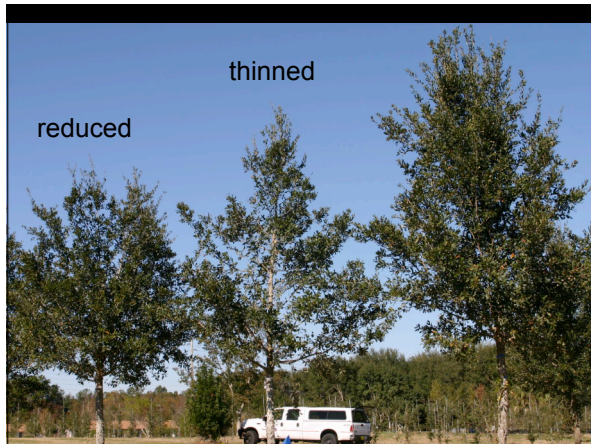




We compared pruning types in real gusty-wind conditions up to 100 mph

Wind measured in real storms

- No pruning
- Reducing
- Thinning





Show videos of gofer cam

Take home message:

- You can feel very comfortable when you say “pruning trees reduces storm damage”

Take home message:

- You can feel very comfortable when you say “pruning trees reduces storm damage”
- Also appears safe to say lions-tailing or over lifting is not good for trees in wind

So.. how should we manage trees

- Structural pruning to reduce upright codominant stems
- Reduce length of long branches, and those with defects

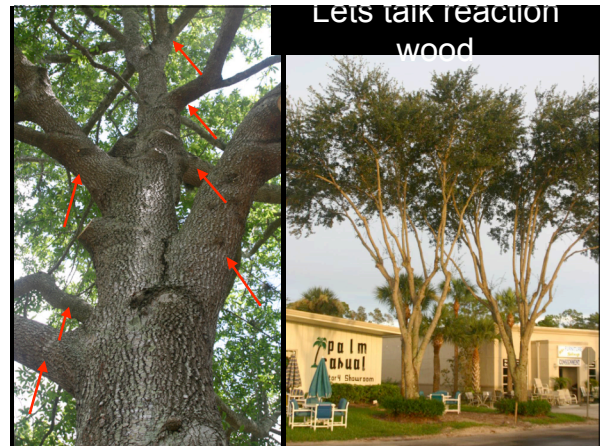
What I think

- Reducing stem length reduces stem motion
- Thinning by removing 1-2.5" branches reduces motion
- Thinning by removing smaller branches does very little

So what is this structural pruning

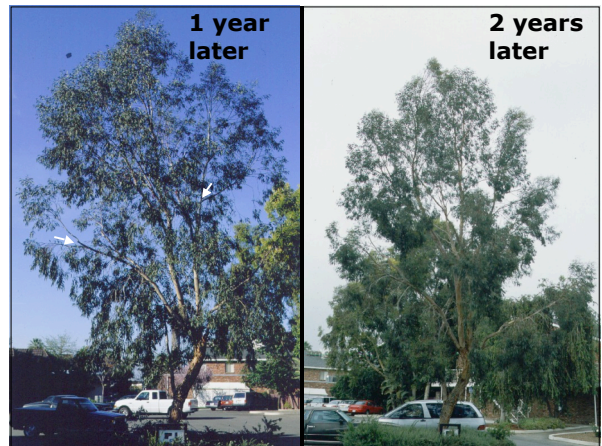
Upright broken, horizontal OK

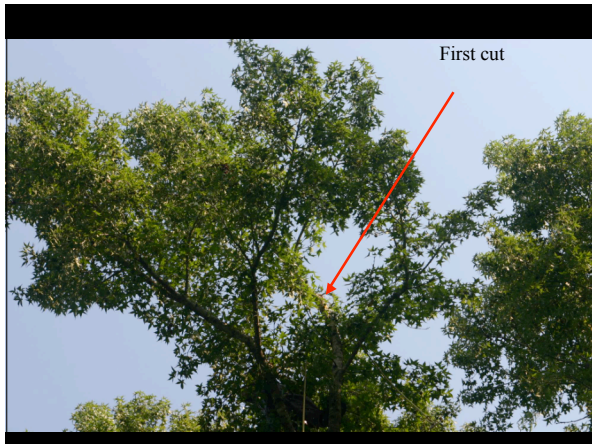


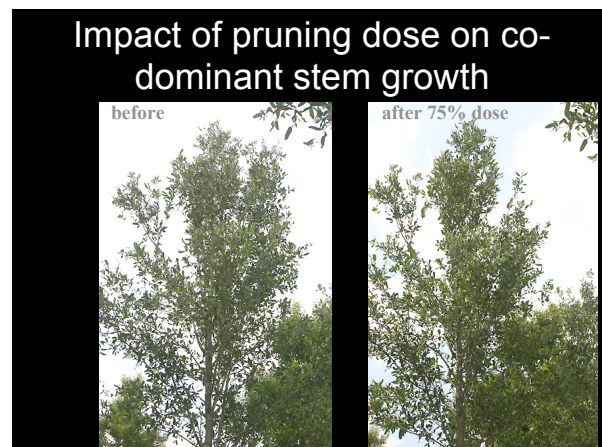
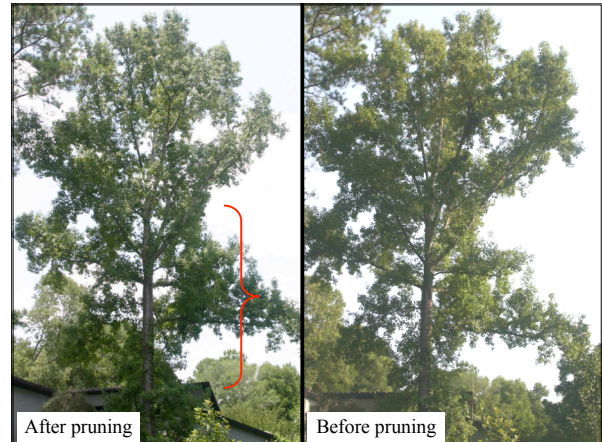


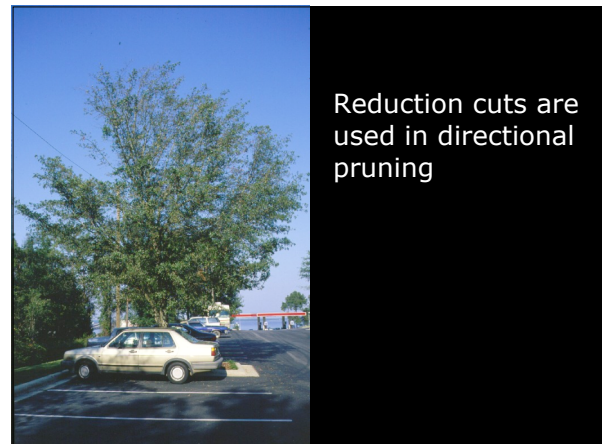
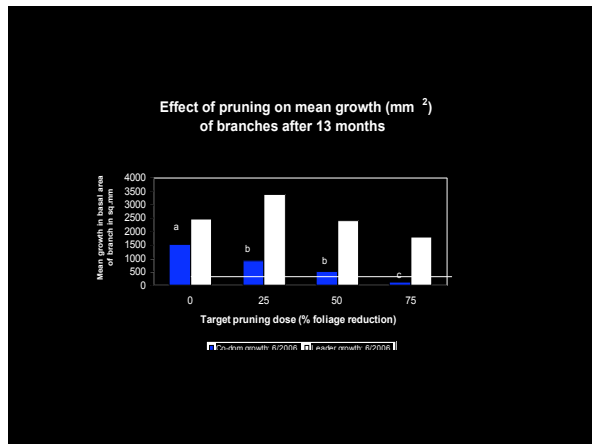










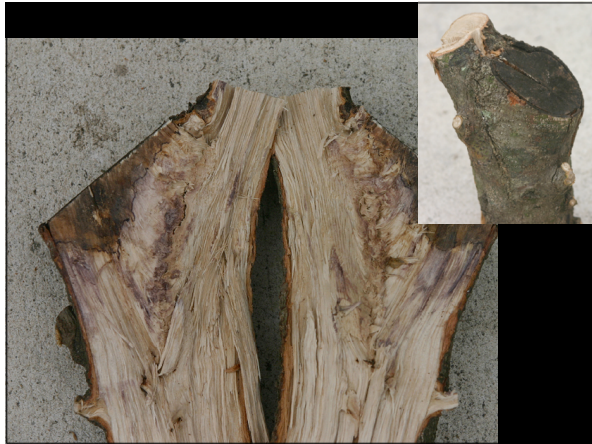


Reduction cut made 2 years ago



**Response to
reduction cuts**



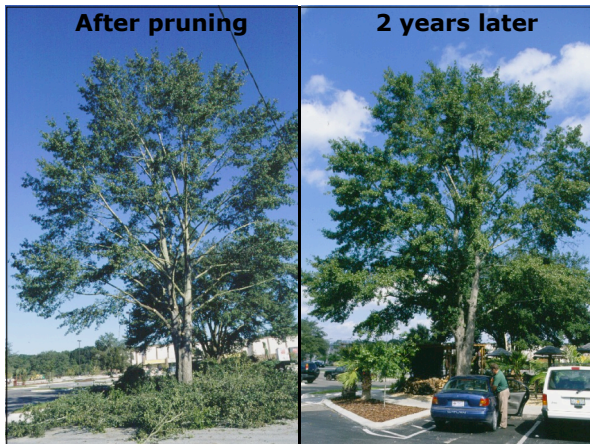


Summary of pruning types

Structural

- reduces damage in wind
- produces holes in canopy
- reduces defects
- encourages branch taper
- discourages branch drooping
- reduction cuts can cause some decay
- retains laterals which can be used for restoration

Lions-tailing





Summary of pruning types

Lions-tailing

- may reduce stem failure but not crown damage in wind
- shifts growth toward crown edge, causing breakage
- discourages branch taper
- encourages branches to droop
- removes local source of photosynthates so could increase decay following wounding
- eliminates laterals which are used for restoration

Raising

Too much removed



After
raising



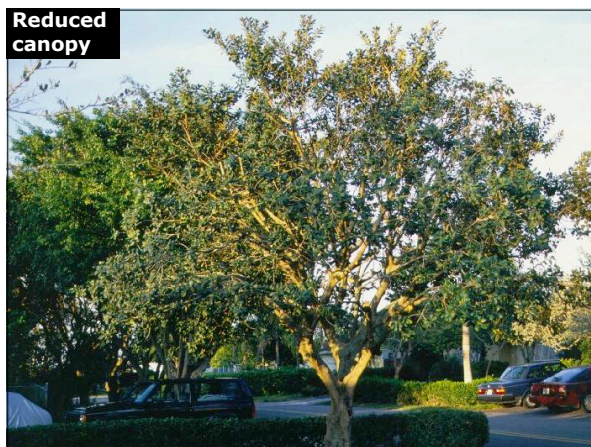
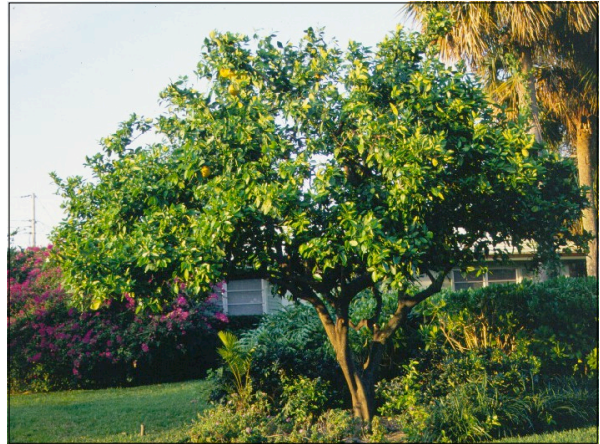
4 years
later

Summary of pruning types

Raising

- may reduce stem failure but not crown damage in wind
- may increase damage later
- shifts growth toward top of crown, which could be a problem-greater wind speed, more lever arm
- if not combined with structural, encourages weak structure
- can cause trunk decay if over done

Reduction



Summary of pruning types

Reduction

- reduces damage in wind
- produces a compact crown, reducing breakage
- encourages branch taper
- discourages branch drooping
- reduction cuts can cause some decay
- retains laterals which can be used for restoration

Thinning



Before thinning



After thinning

Not very effective

Thinned using larger
cuts (1-2")



Summary of pruning types

Thinning

- with large enough cuts - effective in reducing damage in wind storms
- produces holes in crown
- removal cuts cause little decay
- retains laterals which can be used for restoration

So what do we do?

- Structurally prune shade trees to keep branches considerably smaller than trunk
- Reduce codominant stems when raising
- Reduce or thin branches with defects
- Reduce decaying, old trees
- Raise slowly, not all at once

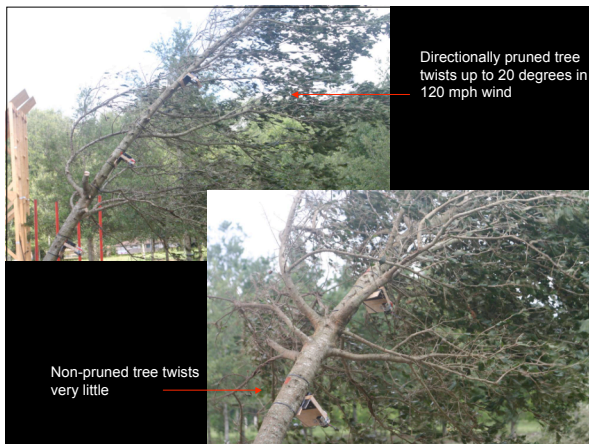
Effect of directional pruning on tree response in wind

This has not been studied at all

Before pruning

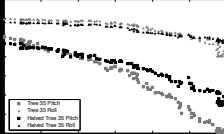


After directional pruning



Impact of directional pruning on tree twist and failure potential





Thank you!

Dr. Ed Gilman

Professor

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