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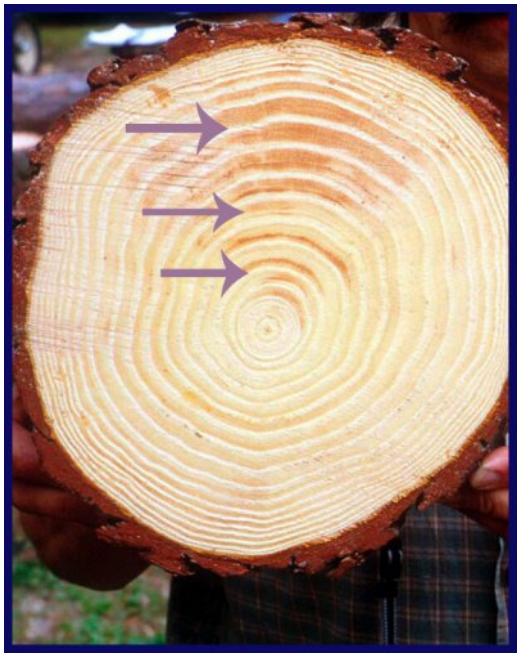
Does thinning influence compression wood development in pine?



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What is compression wood?

- compression wood (CW) => serious defect in sawn timber
- differential longitudinal shrinkage => battens may warp and check
- tends to be brittle => tensile and elastic properties may be inferior to those of normal wood

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What is compression wood?

- forms in conifers on underside of leaning stems
- forms in leeward side of trees exposed to strong winds
- function associated with restoring displaced stems to their original vertical position

Thinning

- associated with the development of CW
- probably result of increasing stem sway during the period following thinning until canopy closure
- generally, greater stem sway occurs with

  - increasing thinning intensity
  - time interval between thinnings
  - time delay until the first thinning

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Study site

- p1969 Corsican pine (YC14) located in Sherwood and Lincolnshire Forest District
- sheltered with flat topography dominated by clay soils

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Methods
Study stand

Thinned stand

- one line (20 years) and two selective thinnings (approx. 70% Max MAI) (25 & 30 years)
- current stocking => 580 trees/ha (BA = 31 m^2/ha)

Unthinned stand

- current stocking => 1200 trees/ha (BA = 55 m^2/ha)

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Methods

Sampling

- 40 trees randomly selected; 20 each from thinned and unthinned stands
- only sawlog sized stems selected (16 cm DBH or greater)
- trees felled => DBH, tree height and depth of live crown measured
- 10 cm thick section removed at 2 m from base (mid point of main butt log)

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Methods

Measurements

- cross-sectional area of CW measured on 3 mm thick slices using a transmitted light method
- basic density
- bark to pith ring width

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Results

Stem and crown characteristics

Table 1 Mean stem and crown characteristics of sample trees from thinned and unthinned stands of Corsican pine (ns = not significant at P=0.05).

	Number of samples	Height (m)	DBH (cm)	Slenderness ratio (height/ DBH)*	Canopy depth (m)
Thinned	20	16.7 (0.24)	22.4 (0.49)	75.1 (1.44)	7.6 (0.35)
Unthinned	20	14.9 (0.16)	20.4 (0.63)	74.0 (2.11)	6.2 (0.23)
		P<0.001	P<0.05	ns	P<0.01

* measured in metres

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Results

Wood properties

Table 2 Mean values of wood properties of sample trees from thinned and unthinned stands of Corsican pine (ns = not significant at P<0.05).

	Sample disc diameter (cm)	Annual ring width (mm)	Basic density (g/cm^3)	Cross-sectional area of compression wood (cm^2)	Cross-sectional proportion of compression wood (%)*
Thinned	18.3 (0.42)	3.23 (0.069)	0.40 (0.008)	18.1 (4.01)	7.6 (2.12)
Unthinned	16.6 (0.56)	3.05 (0.085)	0.39 (0.007)	59.2 (15.47)	23 4 (4.67)
	P<0.05	ns	ns	P<0.01	P<0.005

* analysis carried out using arcsine transformation

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Results

Correlations

Table 3 Correlations between % CW and tree height, DBH, stem slenderness, crown depth, annual ring width and basic density, from trees from thinned and unthinned stands of Corsican pine.

	Correlation coefficients (r) for % compression wood	
	Thinned	Unthinned
Tree height (m)	-0.12	0.63**
DBH (cm)	-0.45*	0.60**
Slenderness (height/diameter)(m)	0.45*	-0.36
Crown depth (m)	-0.19	0.24
Sample disc diameter (cm)	-0.47*	0.55**
Ring width (mm)	-0.60**	0.51*
Basic density (g/cm^3)	-0.28	-0.15

* P<0.05, ** P<0.01

Results

Correlations – growth rate

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Results

Correlations - slenderness

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Conclusions

Three times more CW is observed in stems from unthinned stands than thinned stands!

But this appears to be contrary to published findings!

This may in part be a result of differing levels of competition within two stand types

Conclusions

Unthinned stands

- lack of thinning => intense competition within canopy => possible phototropic movements in response to competition for light

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Unthinned stands

- lack of thinning => intense competition within canopy => possible phototropic movements in response to competition for light
- high inter-tree competition => forces trees to invest resources into height growth => result is tall slender trees that are inherently unstable
- trees are known to lean as a result of phototropic movements => more CW to negate imbalance

Conclusions

Thinned stands

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Thinned stands

- more space for trees to sway => encourages strengthening features (> diameter, > taper, > structural roots)
- > stability results in < stem sway, < stem lean, < CW
- > CW in thinned stands associated with > stem slenderness => more likely to lean due to thin stems and less mutual support in canopy

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Conclusions

- results consistent with theory that thinning reduces phototropic necessity in trees => propensity to lean is reduced due to less competition for space in canopy => less CW

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Conclusions

- results consistent with theory that thinning reduces phototropic necessity in trees => propensity to lean is reduced due to less competition for space in canopy => less CW
- but, earlier studies indicate that thinning is the cause of CW development!
- however, these studies involved major openings of canopy => result is instability for an extended period of time until canopy closure => more CW

Conclusions

Take home message

- timely selective thinnings at relatively short cycles limits CW formation => gradual canopy openings allow trees to slowly adapt to forces acting upon them
- relatively high incidence of CW observed in unthinned trees => associated with inherent instability and stem lean => result of high levels of inter-tree competition