Effects of Stem Inclination on **Compression Wood Formation in Young Radiata Pine Trees**

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Connection between form and compression wood in radiata







For a tree, compression wood (CW)...

8-

6

2

5

CW

Timell. 1986.

Compression

Wood in

Gymno-

sperms,

Springer.

vol. 2.

- helps branches maintain angle.
- helps branches and trunks re-establish angle.
- does so by CW cells expanding during development.

For processing and utilization, CW can cause . . .

- excessive longitudinal shrinkage and warp.
- appearance degrade.
- lower strength than expected for density.
- problems for chemical pulping due to excessive lignin.



Hypothesis 1

H1) Straight trees have less CW than crooked trees.

...presumably because crooked stems flop and then overcompensate.



Hypothesis 2

H2) Amount of CW is positively correlated with sample's inclination.



Hypothesis 3

H3) Straight trees produce more CW at a given angle than crooked trees.





Methods: Experimental Design

- Operational plantation,
 5 yr-old radiata pine.
- Two observers categorized trees with extremes of form as straight (recto) or crooked (chueco).





Methods: Three inclination treatments



Number of Trees			
form	no tether	15° tether	30° tether
straight	8	8	8
crooked	8	8	8

Methods: Stem appearance at harvest



Straight trees

Crooked trees

Methods: Angle measurements









Measured angles of each position
 6 times in 142 days (almost 5 months).

Methods: Determined location of pre-treatment wood



Methods: Assigned scores to pre-treatment wood for CW %



Methods: Assigning scores—not as subjective as it may seem



Methods: Estimated amount of CW in posttreatment wood

- Found post-treatment wood.
- Marked CW zone at beginning, middle, and end of treatment.



Methods: CW in posttreatment wood (cont.)

- Measured angle (°).
- Calculated % of circumference in CW (100 x angle/360°).





Results: Much CW Produced



Results: CW in Pre-Treatment Wood H1) Straight trees have less CW than crooked trees.



Results: CW extent vs. stem angle

H2) CW extent is positively correlated with sample's inclination.





Sample inclination (°)



What We Leanned Abour Compression Wood

Evidence for overcompensation in crooked trees?

No.

Results contradicted expectations.

Results:

- Straight trees do NOT have less CW than crooked trees.
- CW amount is NOT correlated with stem inclination (at least in a universal manner).
- Straight trees do NOT produce more CW at a given angle.

Similarities & differences between straight and crooked trees

- Trunkwood of straight and crooked trees very similar for
 - amount of CW (in natural trees),
 - relationship of amount of CW to stem inclination.
 - In trees of both form
 - at stem angles <10°, CW amount very variable and unrelated to angle.
 - at stem angles of 10-30°, CW amount is usually higher and less variable, and not correlated meaningfully with angle.

For some reason (probably "genetic"), crooked trees

- grow crooked, and
- react to inclination in the same way as do straight trees.



What about leaders?

Do straight trees have straighter leaders than crooked trees?

Measured "Leader form factor:"

100 x (string length - ruler length)/(ruler length)



Do straight trees have less CW in

leaders than do crooked trees?

Estimated CW ranking

- Cut leader into 10 segments.
- Ranked trees
 by CW%
 (from 1-48).



<u>Leaders</u> from straight vs. crooked trees <u>do not differ</u> in straightness or in CW amount

- At the leader stage, crookedness is not yet a fixed feature of the stem.
- One <u>can't</u> make early predictions of stem form based on leader crookedness.



High tree-to-tree variability in when/where CW is formed

- Important role of geneticist for careful selection of stock.
- Reminds us of difficulty of using 'average radiata pine' values for tree-level predictions of
 - CW incidence, and
 - incidence of CW-caused defects.

















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