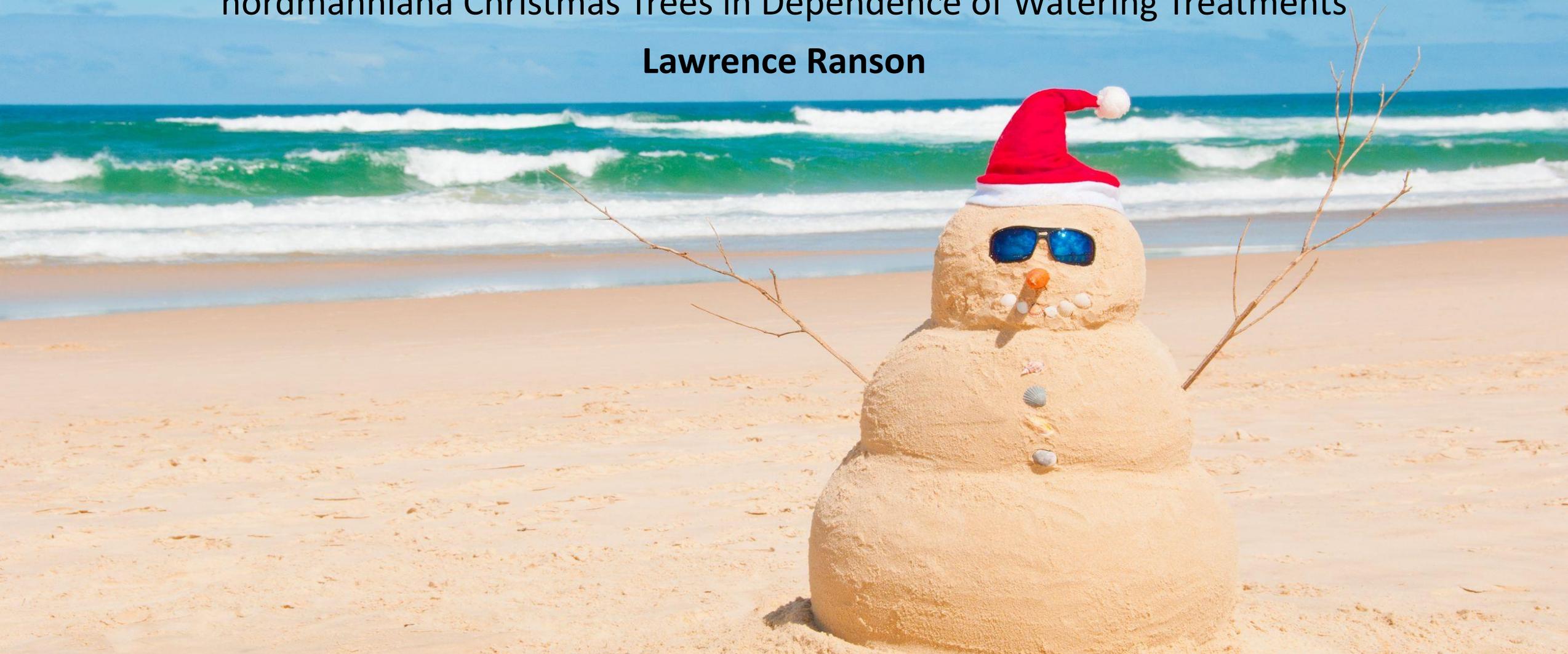


# Postharvest in the Southern Hemisphere

Postharvest Characteristics of Summer-cut *Abies procera* and *Abies nordmanniana* Christmas Trees in Dependence of Watering Treatments

**Lawrence Ranson**



# Australian market

- Tradition still strong
- Large European immigrant and Christian population (>75%)
- Supply low
- Artificial trees and radiata pine
- Trees often cut from Forestry thinnings



# MYTHBUSTERS RESULTS



Fresh-cut tree (Spring)

24  
hours



Same tree - day 2

- Many studies in the northern hemisphere
- Species well understood
- Practices well established
- Can this knowledge be transferred across the equator?

# Northern vs. Southern Hemisphere – Conditions

## Summer-harvest

- High temperatures
- Actively growing trees

## Postharvest expectations

- Faster drying rates
- Poorer postharvest characteristics across all treatments and species, compared with winter-harvested trees.



# The study

## ***Summer harvest and display – Is it feasible?***

- Species Comparisons
- Rates of postharvest quality deterioration –  $\Psi$  (stem water potential)
- Examination of inflection points in the drying process - tree stress physiological responses
- Identifying ‘damage thresholds’
- Watering treatments and effects on postharvest quality



Image: [www.spruced.net.au](http://www.spruced.net.au)

# Known factors influencing postharvest quality

- Species
- individual tree genetics
- Geographic ancestry
- Dormancy state at harvest
- Drying rate under the storage conditions  
Mitcham-Butler et al, 1988.
- “Drying, in terms of decreasing xylem (stem) pressure potential ( $\Psi$ ), is correlated with postharvest quality degradation of Noble and Nordmann firs.” Chastagner and Riley, 2003.



Day 0 – *Abies procera*



Day 15 – *Abies procera*

# Drying and tree stress physiological responses

- Inflection points during the drying process (likely tree physiological responses) and a final “damage threshold” by drying have been identified in some other *Abies* species.

Montano and Proebsting, 1986. Bates, et al, 2004

- The damage threshold for Douglas-fir and Fraser fir is between -3.5 and -4.0 Mpa.

Chastagner & Riley, 1984-1991. Hinesley, 1984

- Experiments on *Abies fraseri*, and *Abies nordmanniana* showed different early harvest dates to have a significant negative effect on needle retention and overall postharvest characteristics.

Mitcham-Butler, et al. (1988), Landgren, et al. (2008).

# Experimental design

## Watering treatments

- 20 sample trees from each species
- 'Dry' control group
- 4 groups with water application at 0, 24, 48, 96 hours after harvest
- 25 day experiment

## Sample species

- Noble fir (*Abies procera*)
- Nordmann fir (*Abies nordmanniana*)
- Fresh-cut trees, randomly selected & harvested on July 13<sup>th</sup>



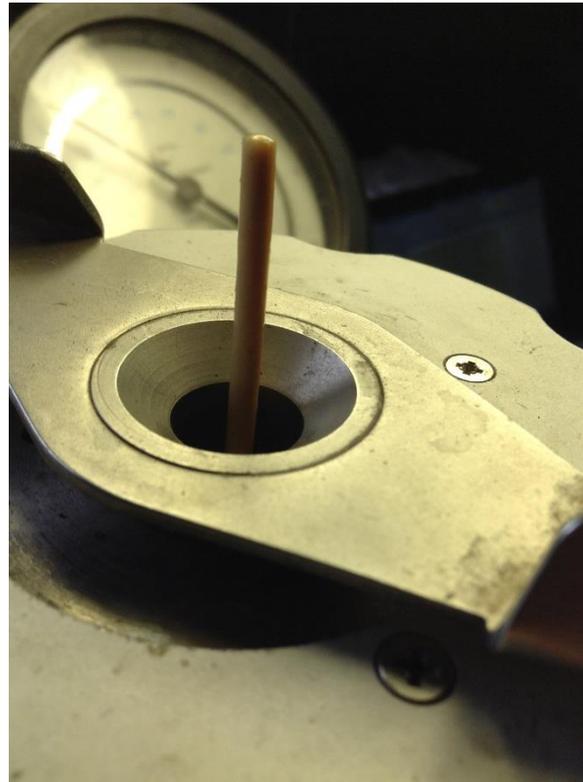
Noble Fir (*Abies procera*)



Nordmann Fir (*Abies nordmanniana*)

# Methodology

- Stem water potential ( $\Psi$ ) – Scholander Bombe method
- $\Psi$  values measured on days 0, 1, 2, 3, 4, 5, 10, 15, 20 and 25
- Needles on sample area collected and colour change observed
- Quantitative data, regular data collection intervals



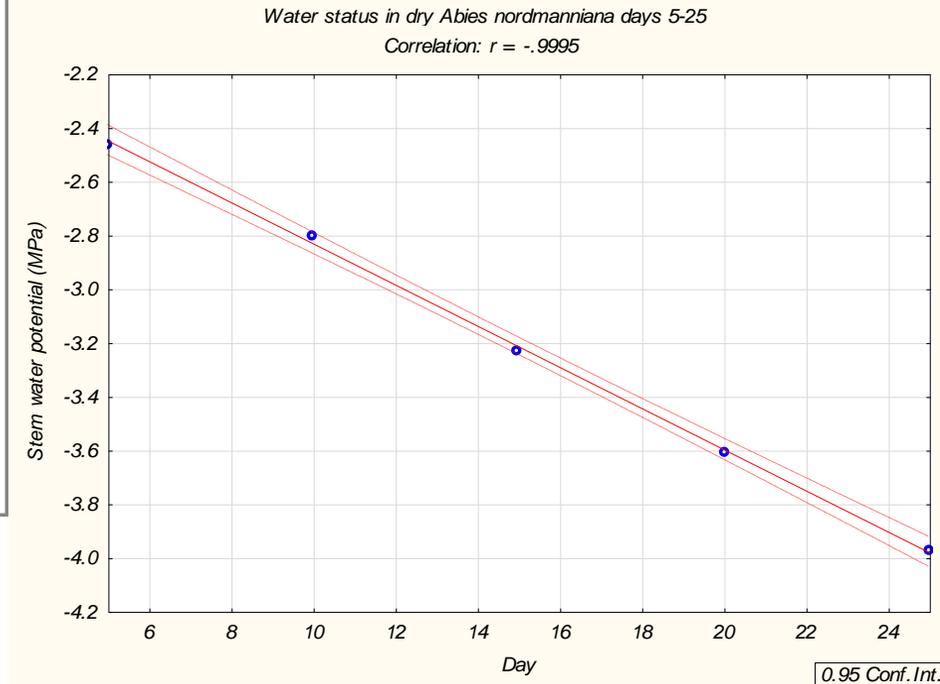
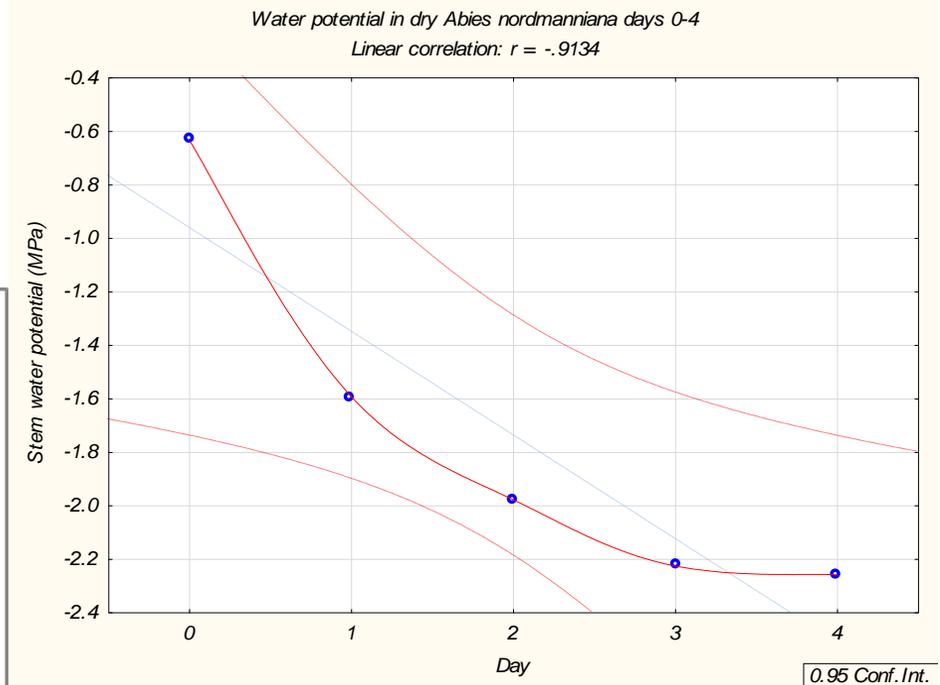
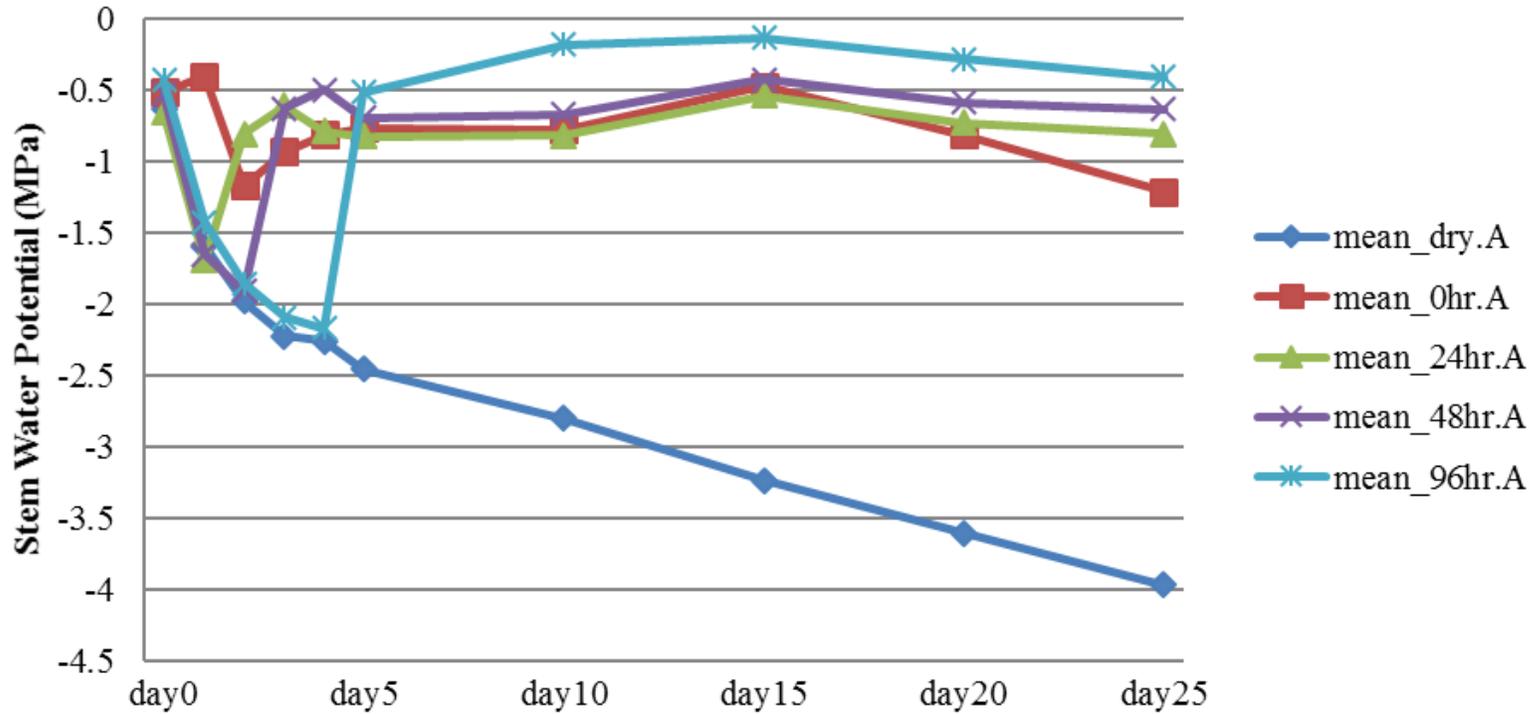
# Preliminary study

- Spring (May) harvested trees – very soft foliage, active growth
- Too metabolically active for display, new growth too delicate for transport.
- Very poor postharvest characteristics



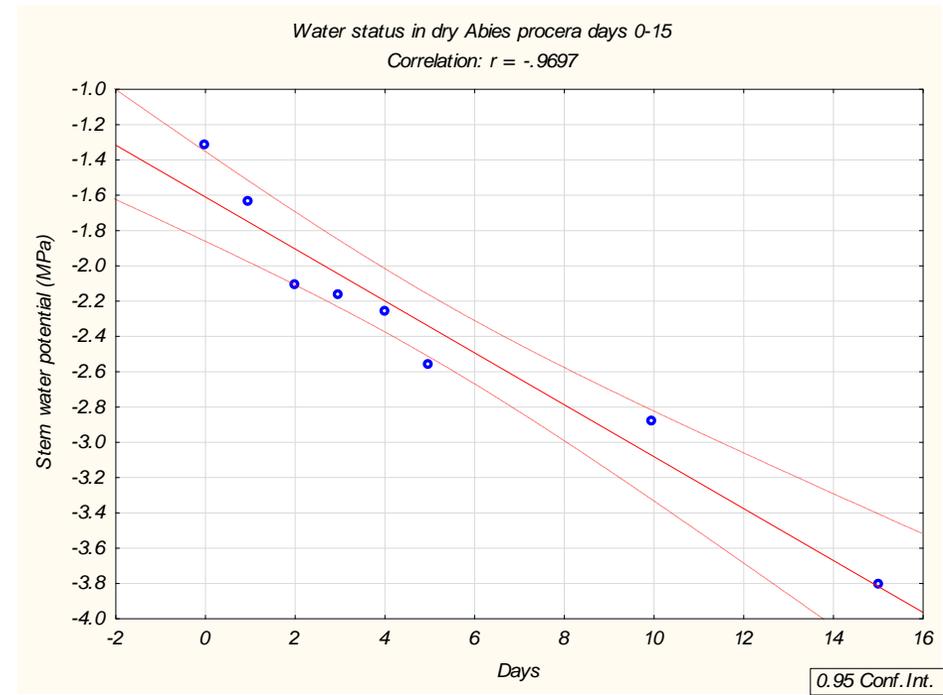
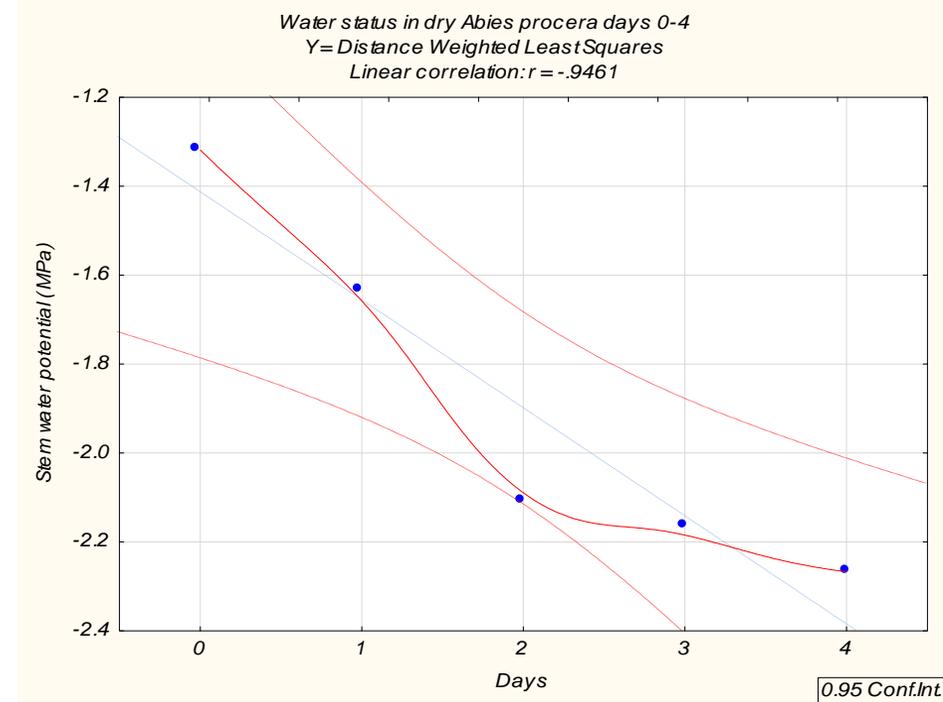
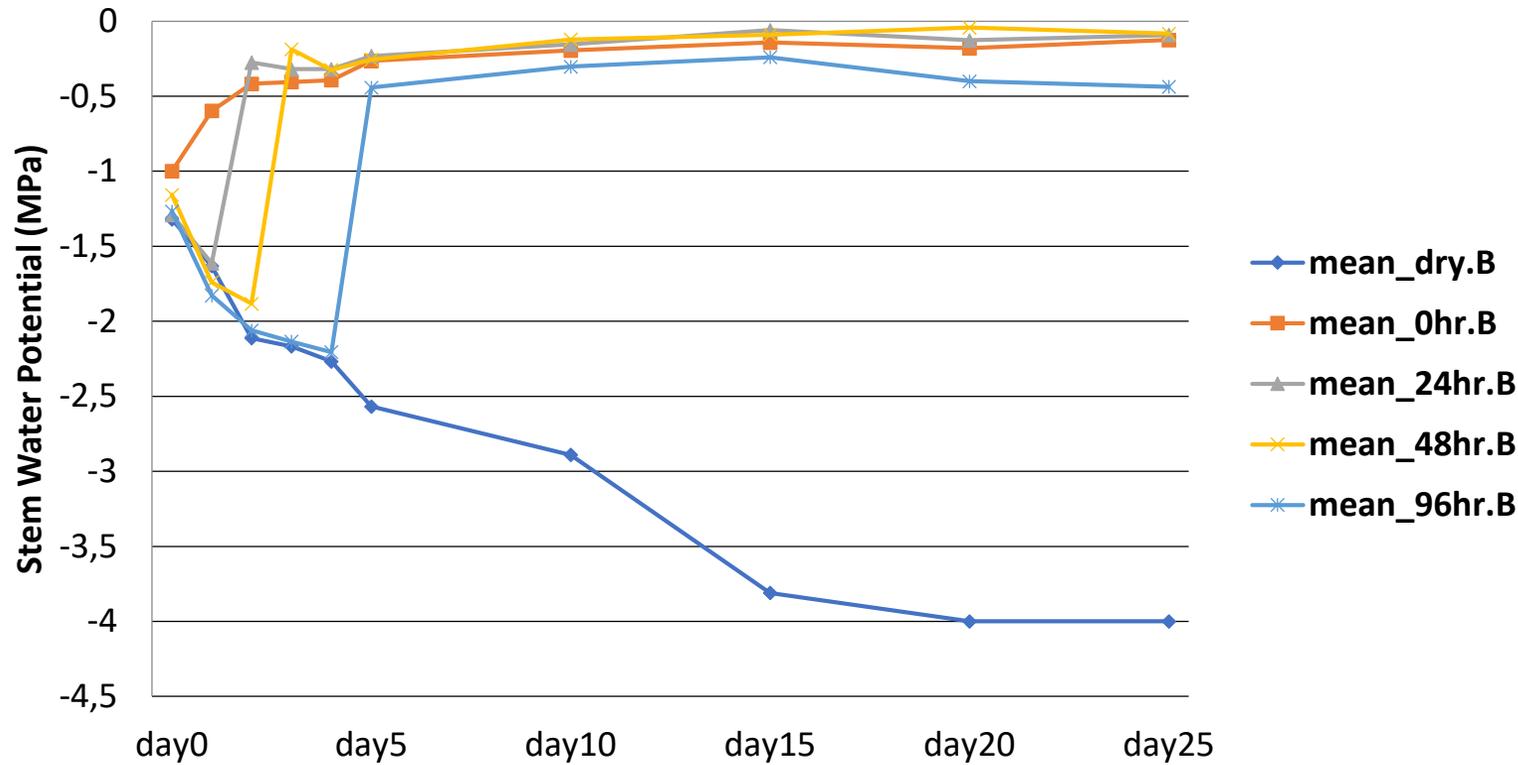
# Nordmann fir stem $\Psi$

## Water status of *Abies nordmanniana* under different watering treatments

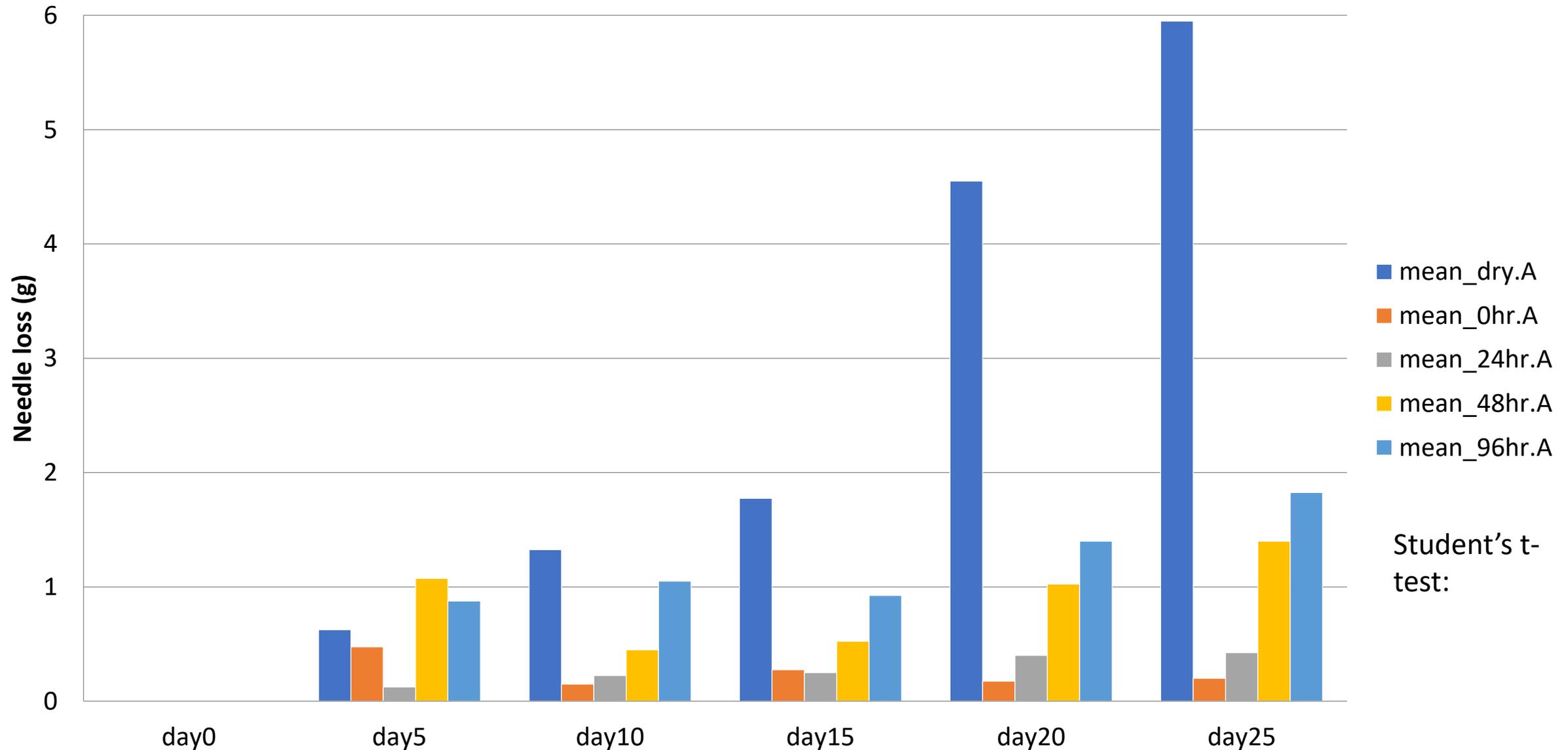


# Noble Fir Stem $\Psi$

## Water status of *Abies procera* under different watering treatments



# Needle loss of *Abies nordmanniana* trees under different watering treatments



Needle loss (g)



dry.B  
0hr.B  
24hr.B  
48hr.B  
96hr.B

# Nordmann Fir

- Strong water status – postharvest characteristics correlation  $r = -.9565$
- Responded well to all watering treatments after cutting
- possible inflection point that at stem water potentials fall of -2.0 and -2.5MPa.
- Should not be displayed dry in Summer due to heavy needle loss



# Noble Fir

- No obvious correlation between needle loss and stem water potential. Confirmed with one-way Anova test to  $p < 0.05$
- In dry treatment; water status declined at a relatively constant rate over time, ( $r = -.9697$ ).
- Sharp decline in postharvest quality (colour of current season needles) if unwatered.
- Watering after 48 and 96 hours seemed to promote some needle abscission.



# A comparison of species' needle loss with a series of Student's t-tests for 2 independent means ( $P < 0.05$ )

- Watered treatments – no significant difference between species
- Significant difference found under the dry treatment ( $p = 0.045$ )

## Observations –

- Needle loss mostly from current season needles
- Most pronounced in the 48hr and 96hr treatments of Noble fir

Watering treatment	T-value	P-value
0hr	0.956	0.362
24hr	0.719	0.488
48hr	0.287	0.780
96hr	0.186	0.856
Dry*	*	0.045*

# Conclusions

- Drying responses and postharvest quality vary in different species – can this be selected for (breeding)?
- Species and varieties should be selected for early bud burst and needle retention.
- Maturity state of current season needles at harvest is an important consideration
- Change of practice by grower, wholesaler and buyer needed
- Damage thresholds were not reached in either species...
- Noble fir – later spring flushing, more delicate – may be unsuitable
- Nordmann fir - hardier and more drought tolerant

# The future

## **Future studies:**

- More species and provenance trials
- Drought-induced dormancy
- Early harvest and cold storage

## **Potential practices:**

- Encourage early budding/growth and favour warmer sites – so as to achieve more mature and hardened trees come Summer harvest
- Get trees into water within a short time-window from harvest
- Refrigerated storage? Night transport? Water baths for fresh-cut trees?





# Christmas Trees in Australia

- Current fresh-cut Christmas tree supply is 99% *Pinus radiata*
- Radiata is drought and heat tolerant and takes only 2-3 years from planting to sale.
- Poor growth form and postharvest characteristics, regular pruning required
- Artificial trees dominate the market
- Fresh-cut market is under-developed, potted trees in demand but very little supply (and mostly radiata).



## Abies and Picea species:

- Only a few isolated mountainous regions in the south-eastern corner of Australia are viable for production.
- Must be grown at altitudes  $> 800\text{m}$  (2600 feet) and rainfall  $> 1000\text{mm}$  (40") per year.
- Advanced tubestock needed in non-irrigated sites due to erratic rainfall.



Image by Anton Balazh

# References

Images:

- <https://mythresults.com/> - Mythbusters images and text