Breeding for wood quality:

A perspective for the future

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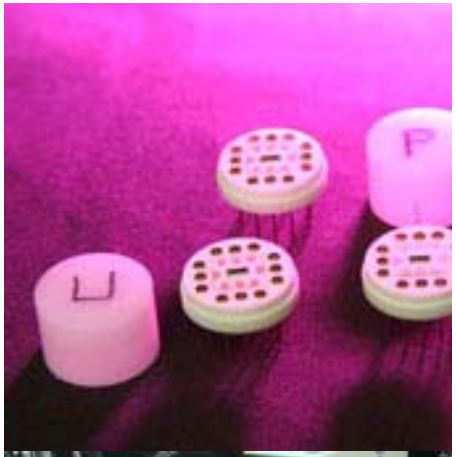
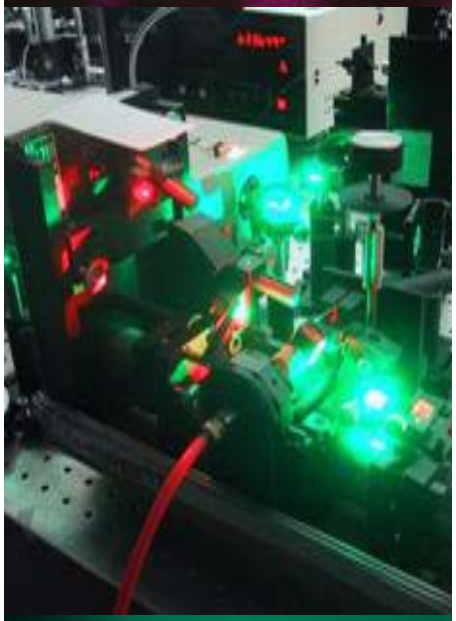
Andrea Louw



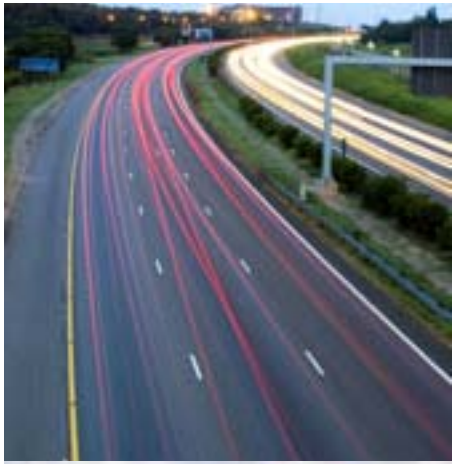


Why invest in tree breeding?

1. Technology is advancing rapidly

   - Processing:
     - Stem straightness
     - Wood colour

   - Breeding:
     - Genetic transformation



2. Markets are on the move

- Railways
- Mining
- Pulp and paper

- ie 3 changes in 100 years

- Renewable energy?

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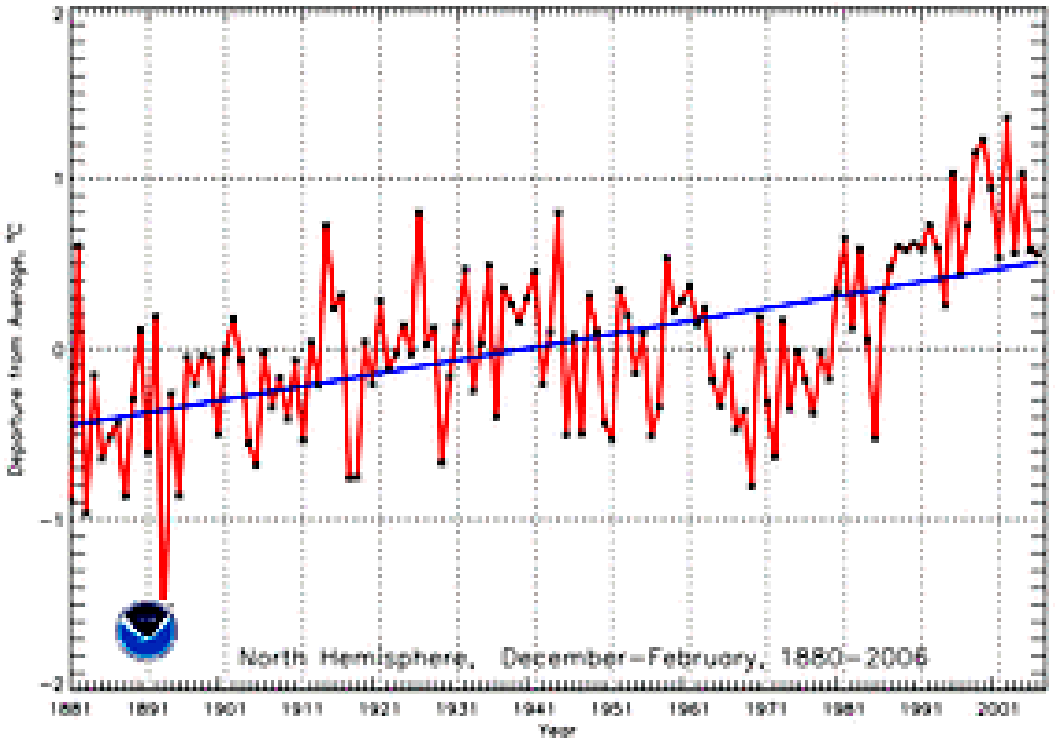
3. Environmental change

- Global climate change (5.8^0C)
- Pests and diseases



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Can breeding respond appropriately to these challenges?

- Eucalypt Pulp:
  - Immediate screen, trial, bulk-up of clones:

  7 yrs to plantation; 15 years to harvest.
  - Breeding, crosses, etc:

  11 -16 yrs to plantation; +- 22 years to harvest
- Short in forestry terms; long in market terms
- Best response possible in forestry
- More a question of beating competitors
  - Planting-> harvest is a given

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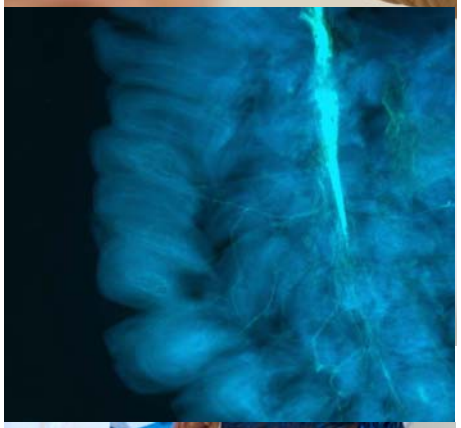

Strategies which may be used to respond to rapid change.

- Decrease testing, breeding and deployment time (Time-to-market)
  - Early screening
    - Juvenile-mature studies (wood denisity, growth)
    - Genetic markers
- Anticipate needs
  - Nature of forestry
  - Fuelled by quality trend

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Anticipating needs: perils

Modern tendency for:

1. Long shopping lists (multi-trait selection)
   - eg: diseases; rooting; lignin; cellulose; densities, growth, stem and crown form; or P.radiata breeding 6 routine + 4 other traits

     (JAYAWICKRAMA, K. J. S and CARSON, M. J., 1999).
2. 'Incorrect' or changing shopping lists (forecasting economic impact/ weightings)
   - eg: Straightness; colour

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1. Multi-trait selection considerations

(“long shopping lists”)

- Concurrent selection is most effective for breeding over time (Falconer 1989; Gjedrem 1971)
  - However, reduced progress per trait (Fins *et al*. 1992)
  - Economic weightings should be ‘correct’
- Clonal selection, with threshold criteria for multi-traits, is problematic.
  - Random probabilistic approach:
  - $P_C = P_1 * P_2 * P_3 * \ldots P_r$

  5 traits, top 10% -> 1 clone in 100 000 trees
  - Even 1 strict criterion can spell trouble
    - Eg: rooting

Multi-trait selection considerations

(continued)

Trial results (Louw 2006) :
475 trees
Top 10% of each of **4** traits->
ZERO selections.

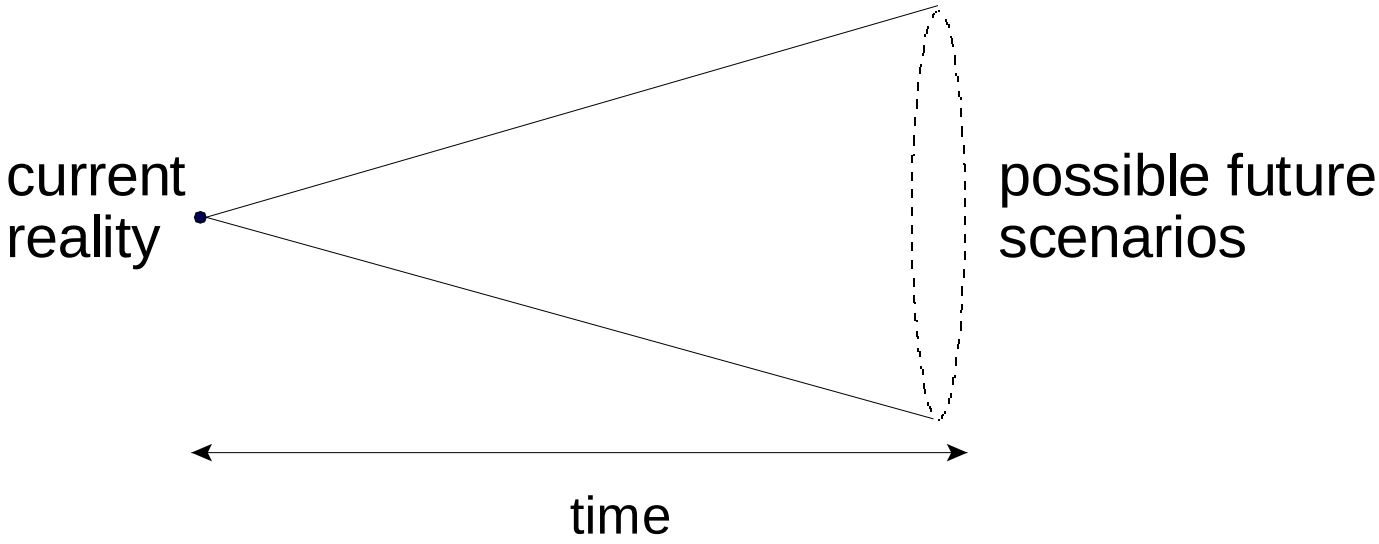
And

Only **ONE** tree selected for selection criteria relaxed to top 15%; 20% ;15% 30% for the four traits.
["probability" was 1.35 in 1000]

And in a trial of 773; **ZERO** clones for 4 traits at 20% each!
[For 5 traits we would need > 10 000 trees for 1 selection here.]

2. The risks associated with forecasting (‘incorrect’ shopping list)

- Can have significant financial implications (Beard 1988)
- Risks of error increase with time



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The risks associated with forecasting

(“incorrect” shopping list cont.)

Risks may be trait-dependant

eg Growth vs pulp & paper characteristics

A new BLUP equation?

$$\mathrm{w} = Ra'C'V^{-1}(y - X\hat{\beta})$$

Implications for Tree Breeding

(in order to ensure future impact….)

- Care with constructing trait portfolio
- Selection threshold criteria have to be carefully considered
- Adapt breeding and production strategies for multi-trait selection
  - Staged selection: eg Chile; RSA
  - Population sizes…rework
- Design rapid response strategies wrt risks
  - Conservation

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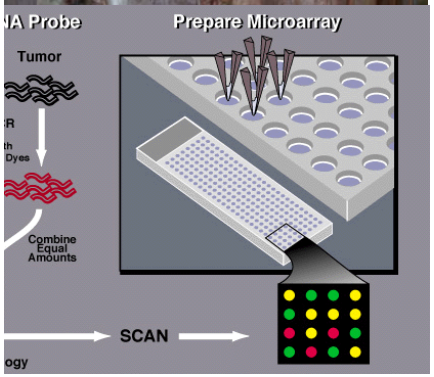
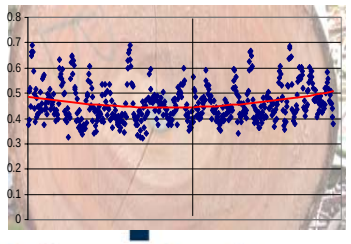


Implications for Wood/ Fibre Property partners

- Identification of key wood properties
  - Robust over changing:
    - Processing technologies
    - Markets/ uses
  - Over extended period of time

  ie Modelling of the future economic impact
  - Together with risks of changes in technology and needs
- Develop screening techniques with TTM and scale in mind:
  - Rapid, cost-effective, early (juvenile trees)
  - Potential role of genetic markers?
- Understanding role of environment
  - Matching genotypes to environment
  - CRC-Forestry
  - CSIR & Mondi (ForestIQ)



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In Conclusion

Tree breeding of the future is likely to seek more:

Sophistication in predicting fibre/ wood needs

+

Technologies for rapid response to these needs

Thank you for your kind attention.

Conclusions

For Tree Breeding to remain relevant in the rapidly changing scenario:

- Inclusion of traits for selection is likely to face stringent considerations wrt robustness over time
- There is a need to grow expertise in understanding & forecasting of economic impacts
- And associated error/ risk of a trait's economic impact
  - eg modified BLUP equation?
- Increased use of technologies which are responsive to time and scale needs.
  - Marker and other techniques to compete/complement

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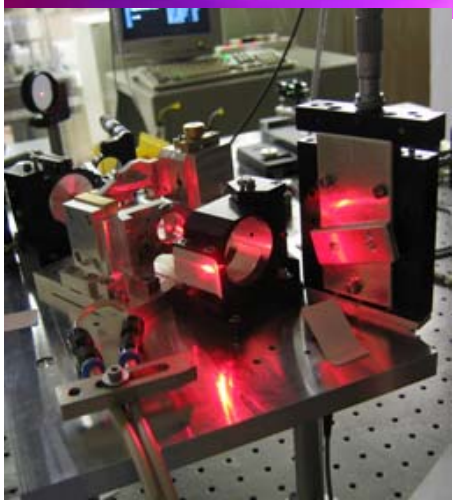

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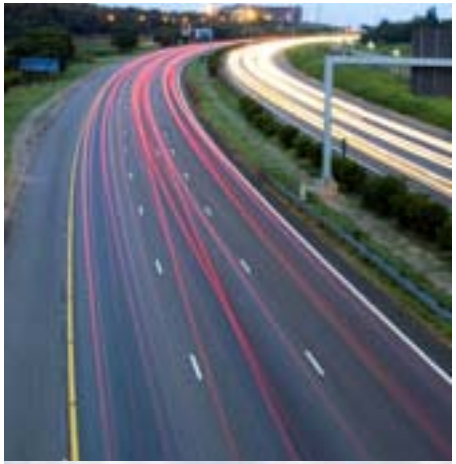

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Conclusions continued…

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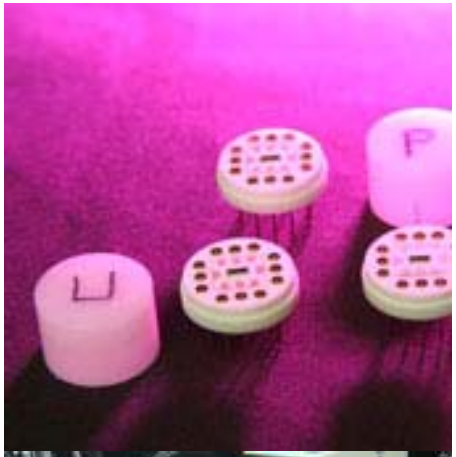

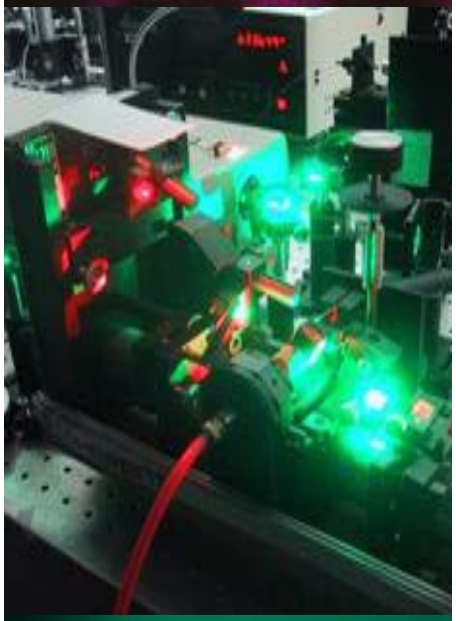

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