Estimating and ameliorating the hardwood plantation yield gap through site specific management

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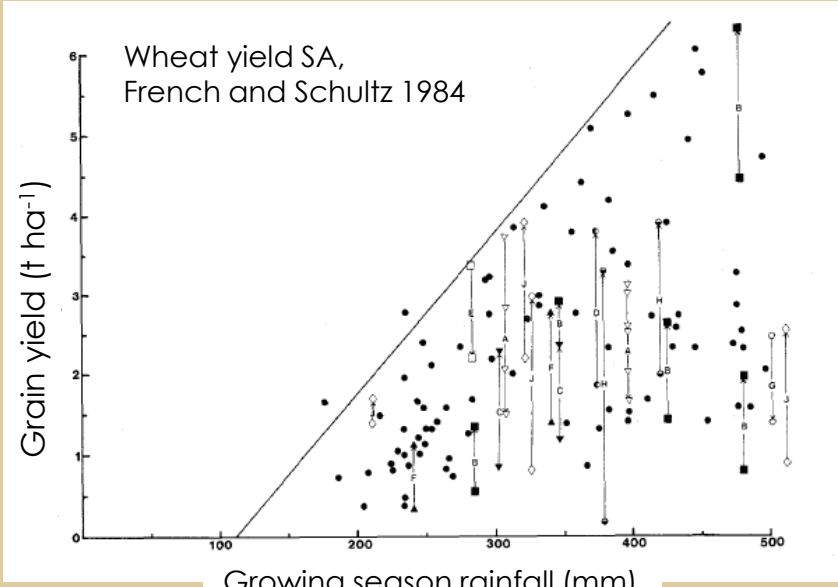
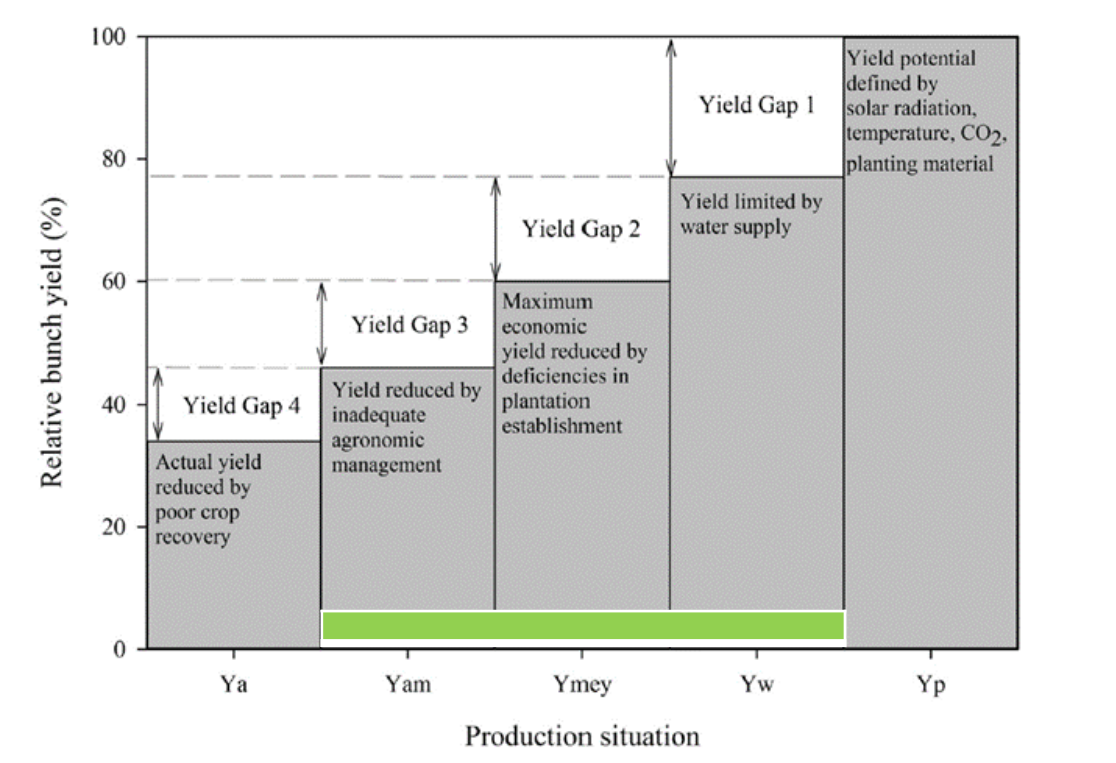
Background

- **Plantation productivity identified as a key issue**
  - Review of fertilizer responses (FWPA VNC 422 1617)
  - Industry & FWPA RD&E priority (Investment plans)
- **Industry structure**
  - Area of hardwoods contracted over last 10 yrs
  - Productive land scarce and expensive
  - Need increased productivity
  - **Potential yield/Yield Gap approach**
  - Used in cropping for 40 years
  - Used in plantation forestry (America)
  - Both empirical data and modelling



Identifying limitations to potential yield



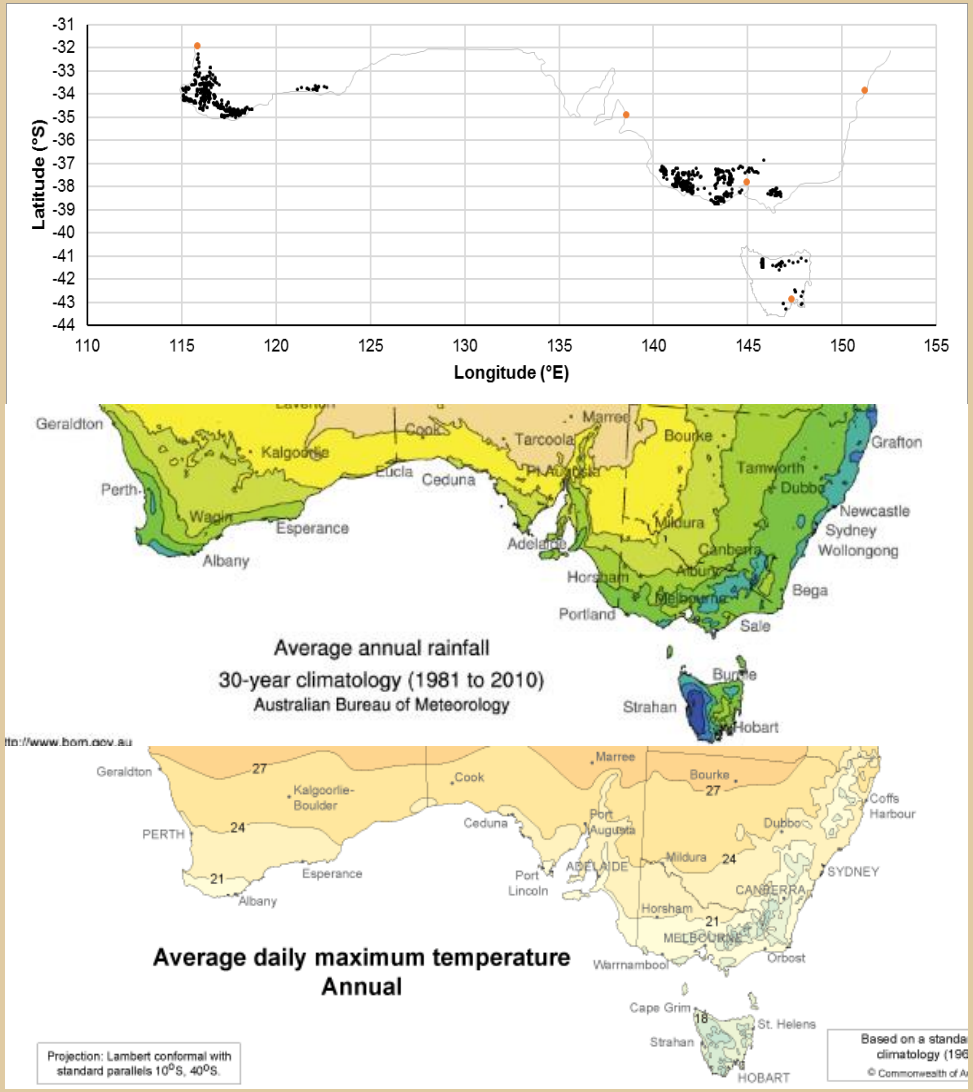
- **Environmental limitations**
  Climate, edaphic
  – difficult to manage
- **Management limitations**
  Establishment, silviculture, harvesting
  - can be managed
- **This work:**
  Analysis of prior trials & data
  Specific nutrition trials

Data sources, locations and climate

32-43°S

500-1300 mm R

14-22 °c Max T

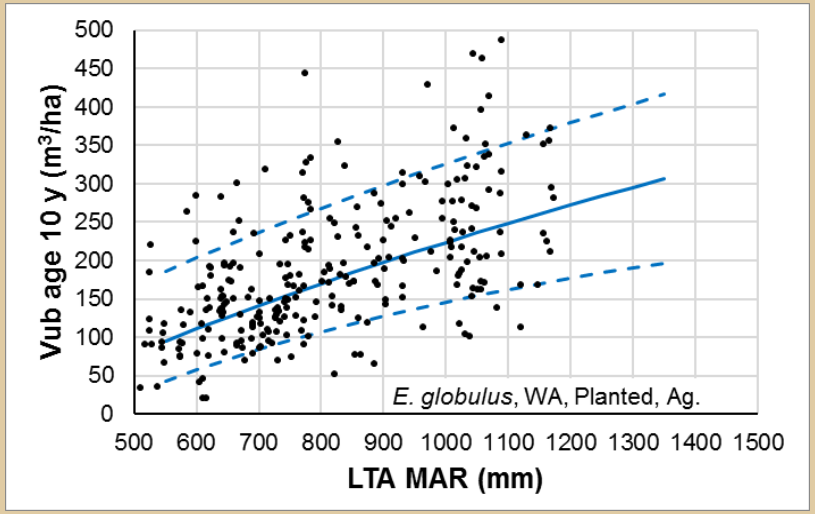


Plantations	1005
Prior trials	163
Current trials (fert)	37

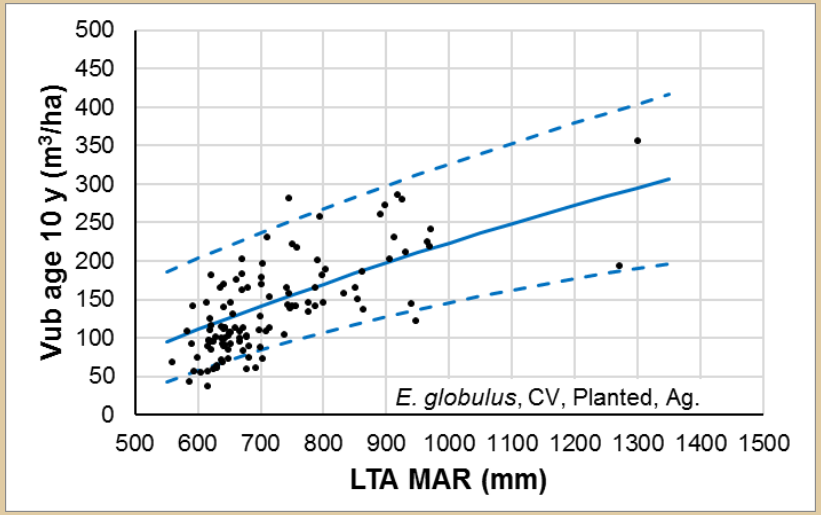
%	E. globulus	E. nitens
Species	95	5
Seed/Coppice	85/15	100/0
Ag/Non Ag land	92/8	60/40

Regional differences between volume at 10 yr v. Annual rainfall (*E. globulus*)

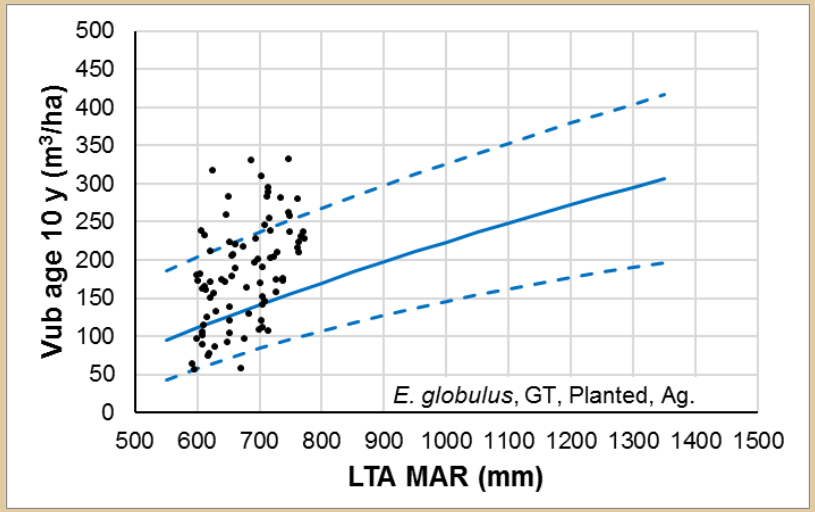
WA



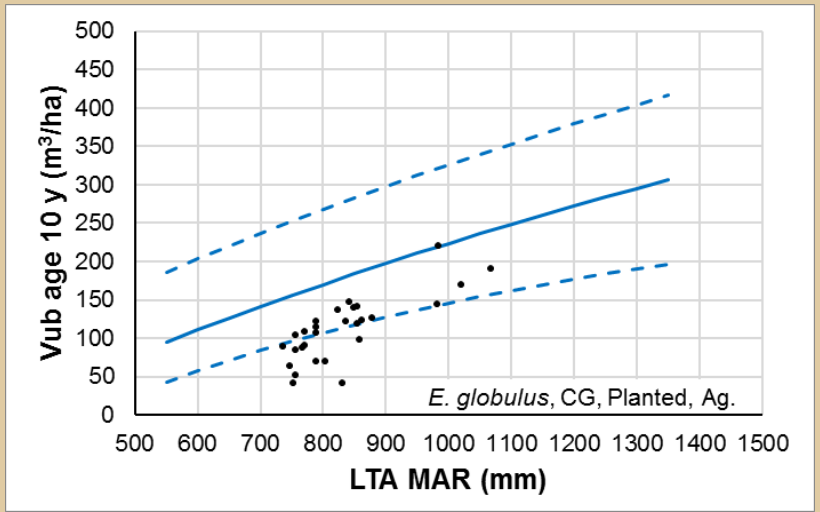
Central Vic



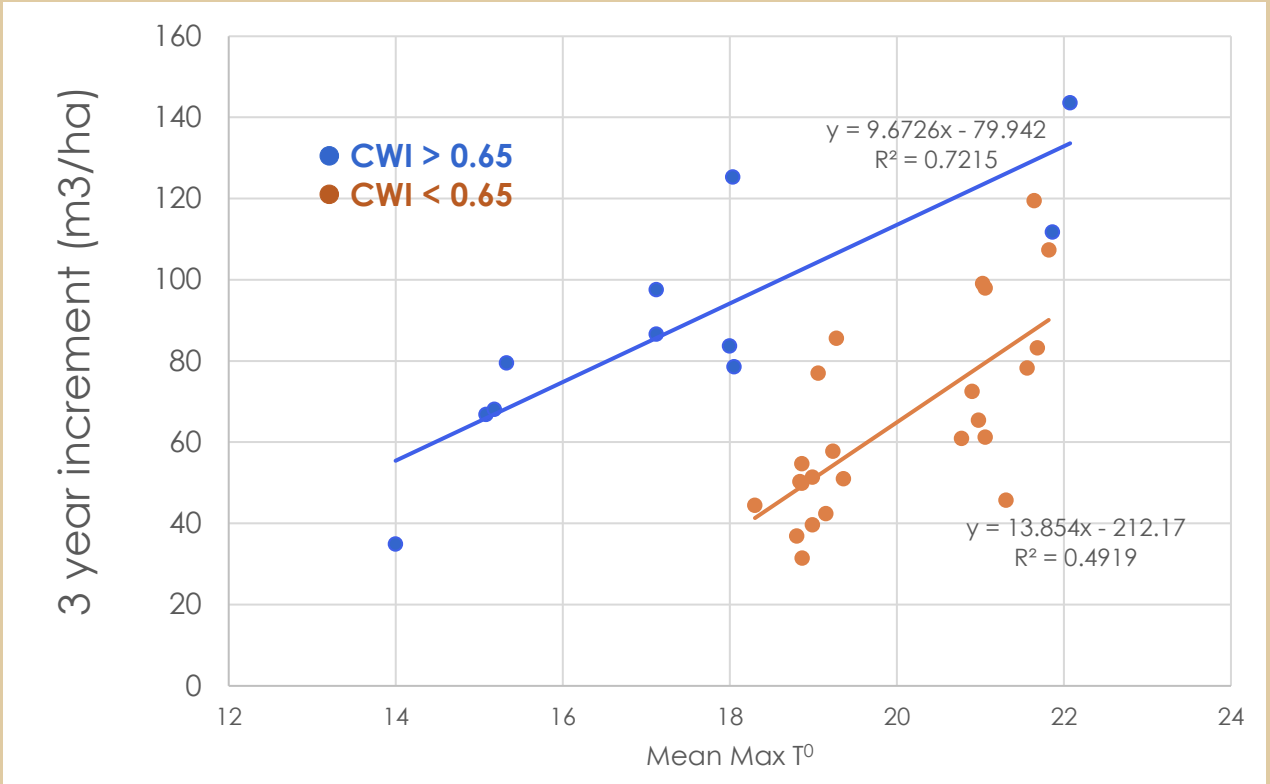
Green Triangle



Central Gippsland



Influence of temperature & water supply (CWI) on hardwood growth

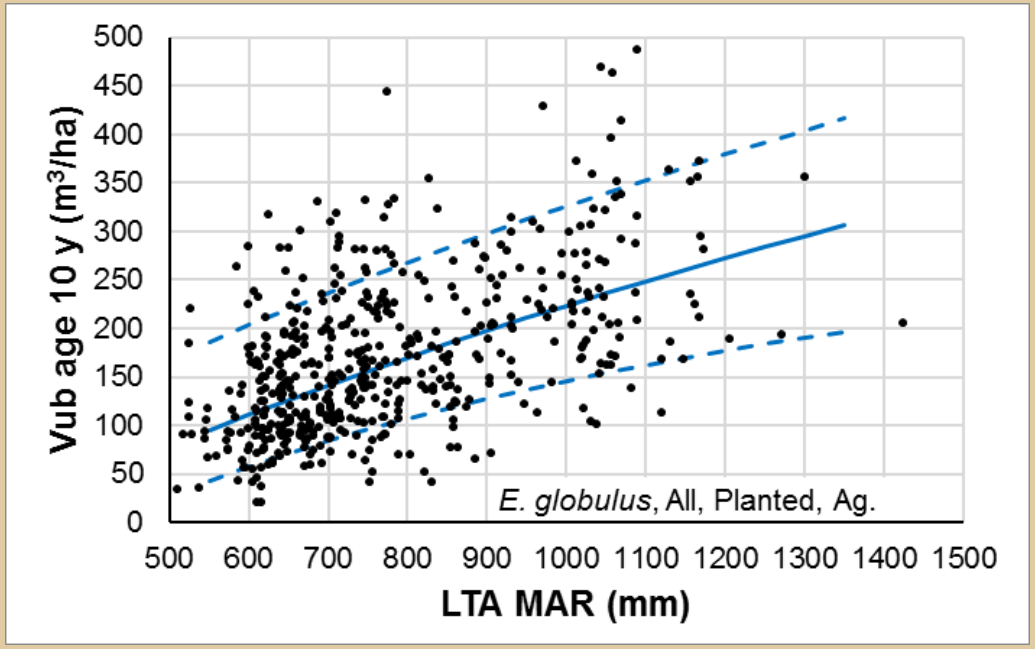


- **3 year increments**
- **Adequate fertilizer, to minimise nutrient effects**

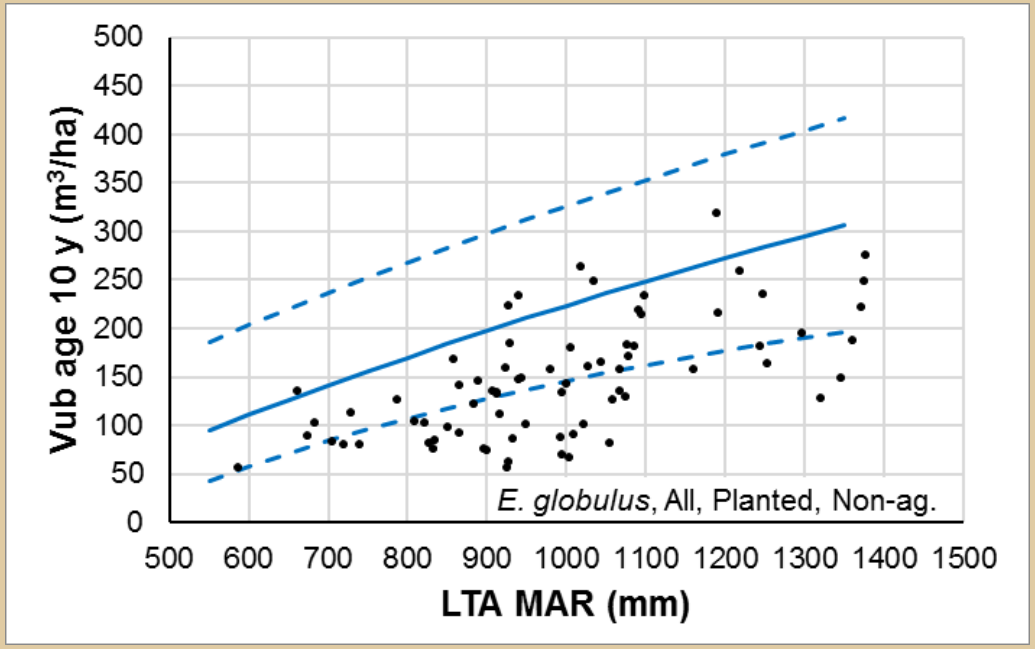
- CAI increased from 20 - 45 m^3/ha/yr as T^0 increased from $14^0 – 22^0$
- CAI reduced by ~ 15-20 m^3/ha/yr on drier sites

Impact of prior land use on Volume at 10 yr v. Annual rainfall (*E. globulus)*

- Planted on Ag sites (High fertility)

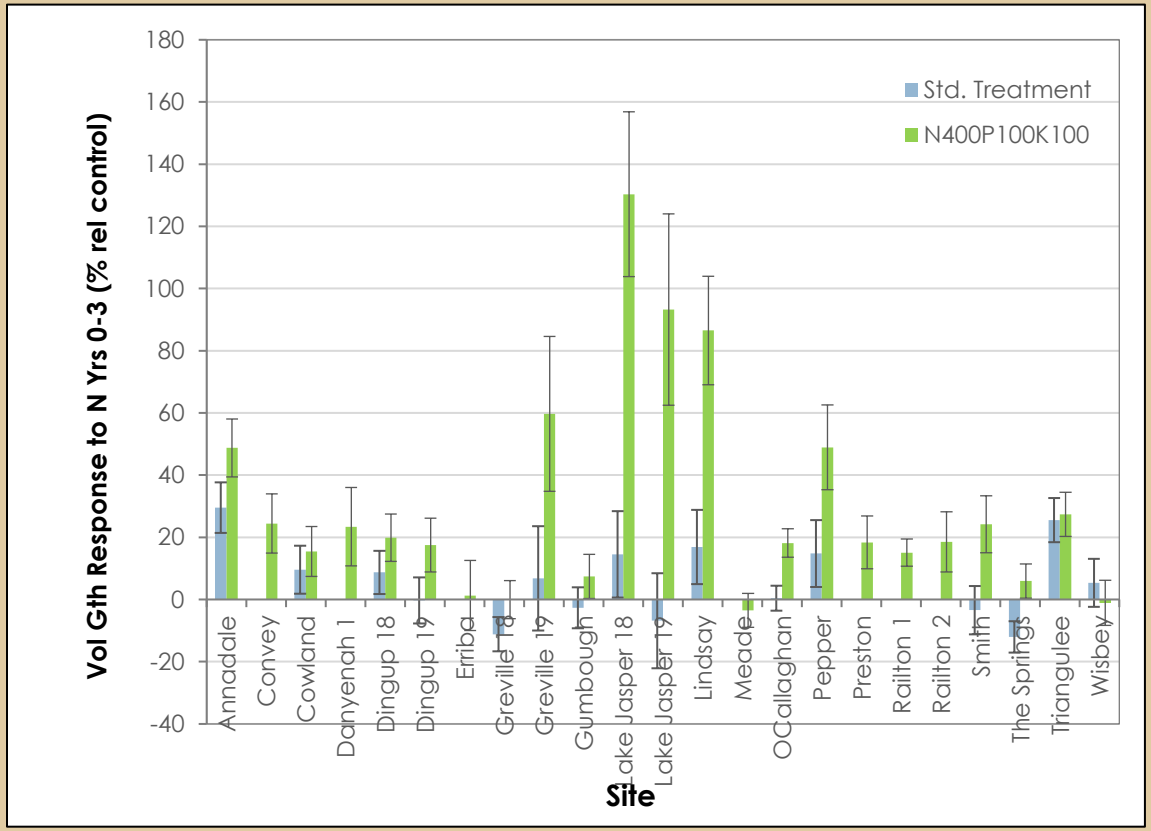


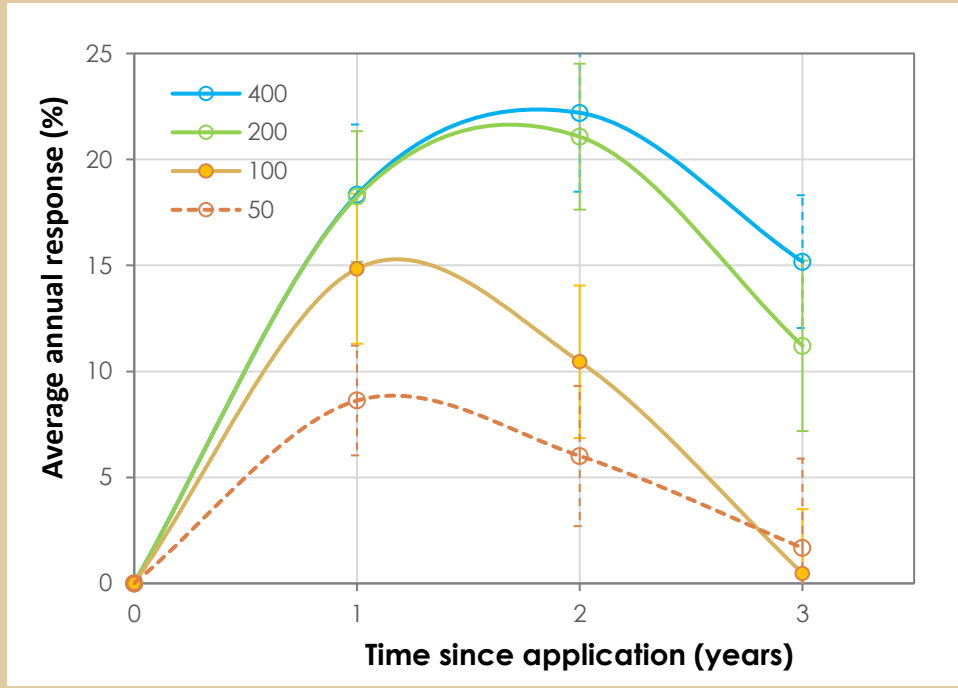
- Planted non Ag sites (Low fertility)



Current fertilizer trials

Responses to N, No response to P or K



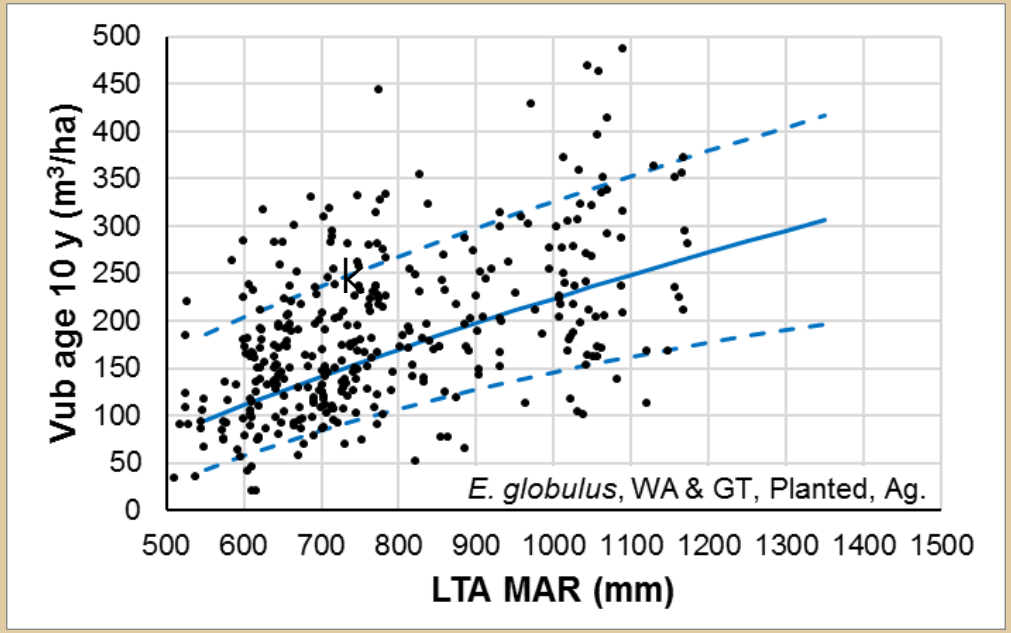


- **N400, P100, K100**
- **Significant at 9 of 23 (40%) of sites: responses 18 -130%,**

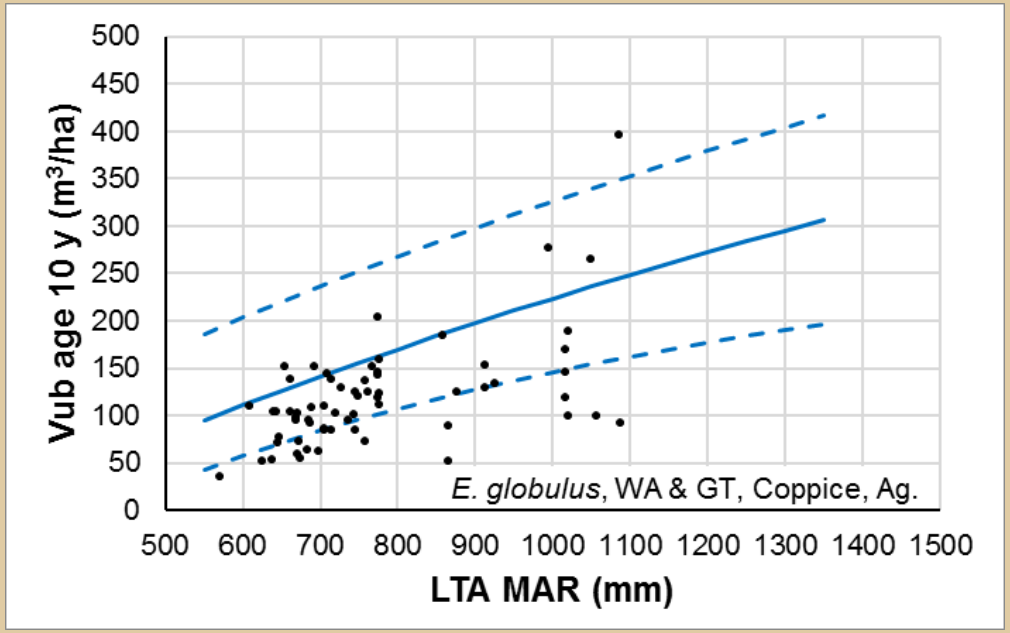
- **Responses disappear after 3 seasons at low N**
- **Extended responses at high N**
- **Frequent and or high N to optimize productivity**

Impact of seedlings vs coppice volume at 10 yr v. Annual rainfall (*E. globulus)*

- WA, planted, Ag

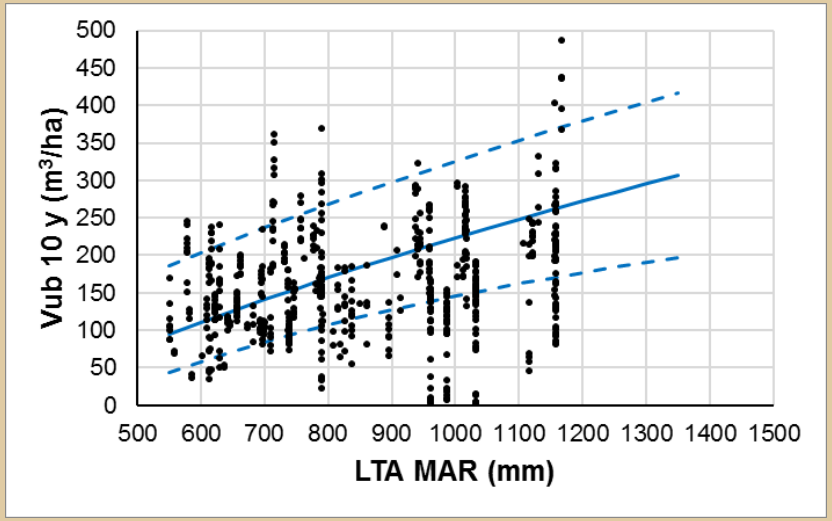


- WA coppice Ag

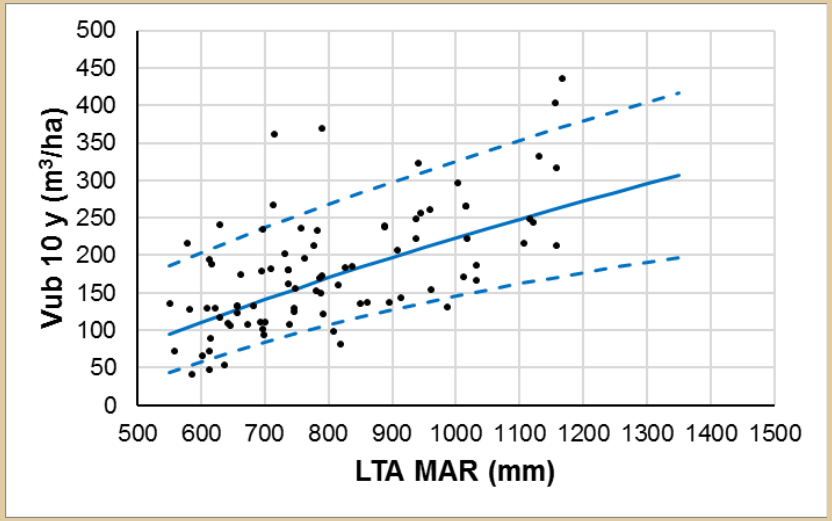


Prior trial data: volume at 10 yr vs annual rainfall : (84 trials)

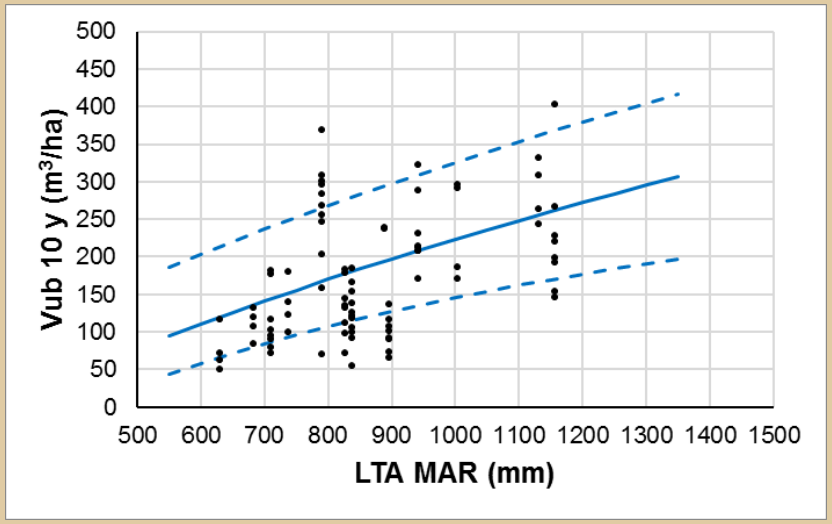
All treatments



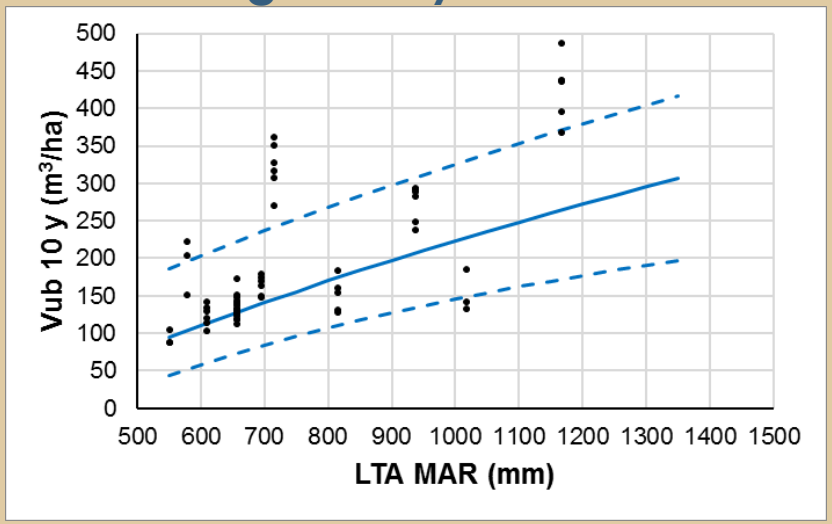
Maximal treatment



Seedlot differences



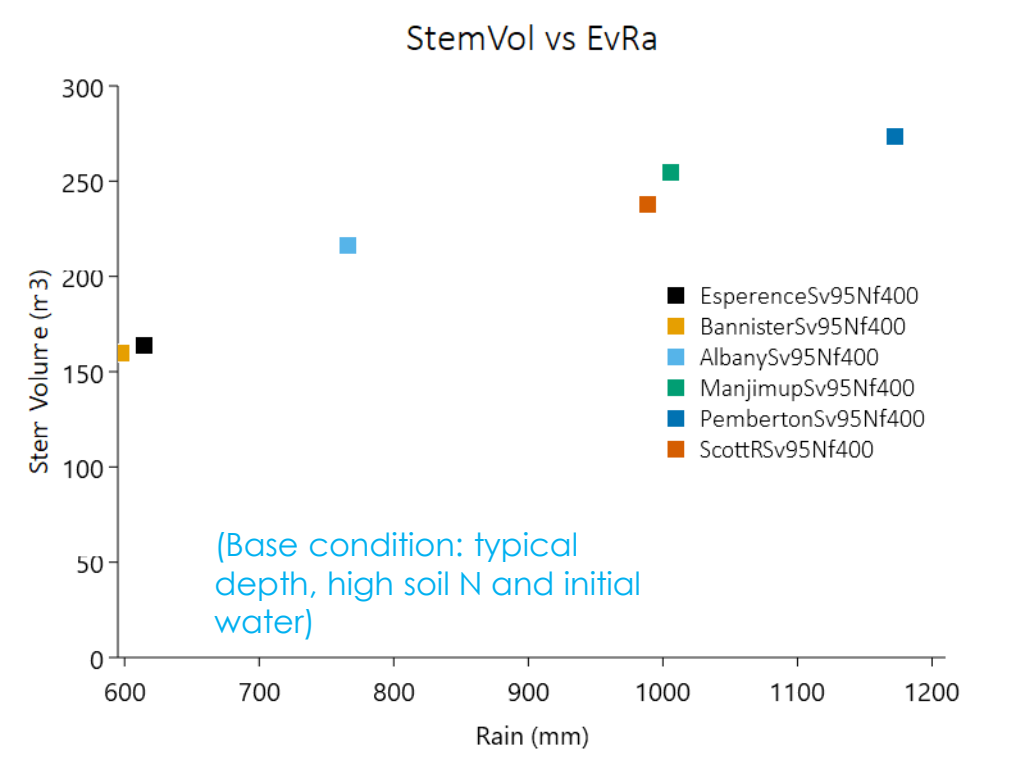
Planting density differences



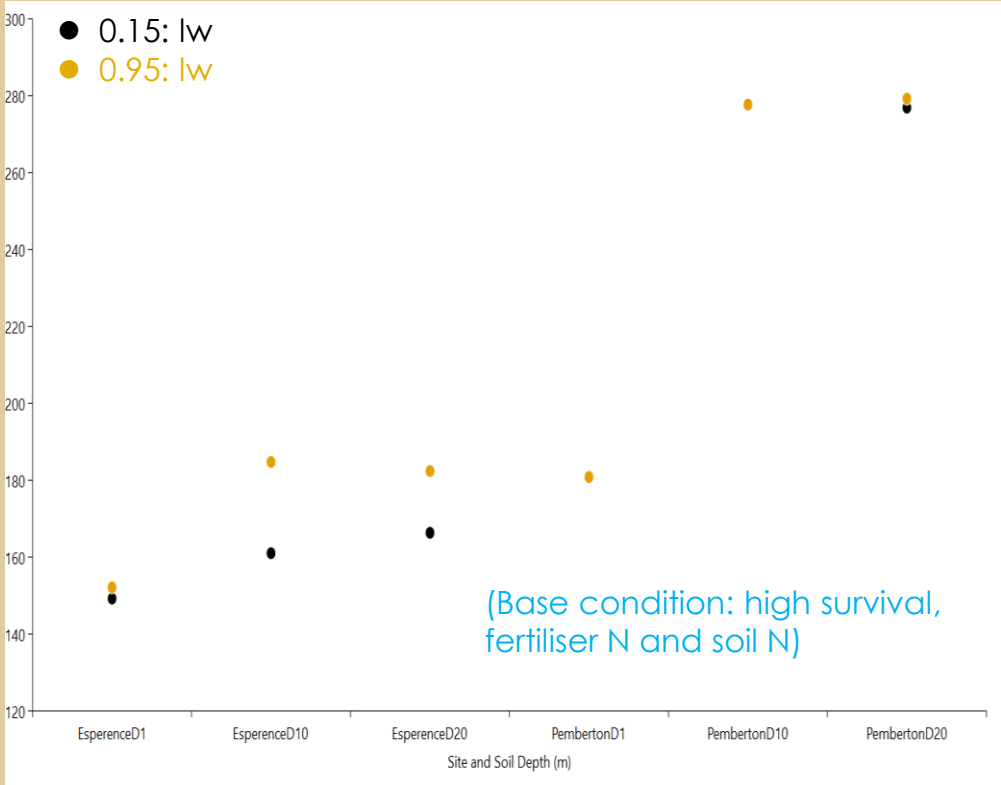
Simulated impact of (a) Rainfall and (b) Soil depth and initial water storage (APSIM)

(a)

Influence of rainfall

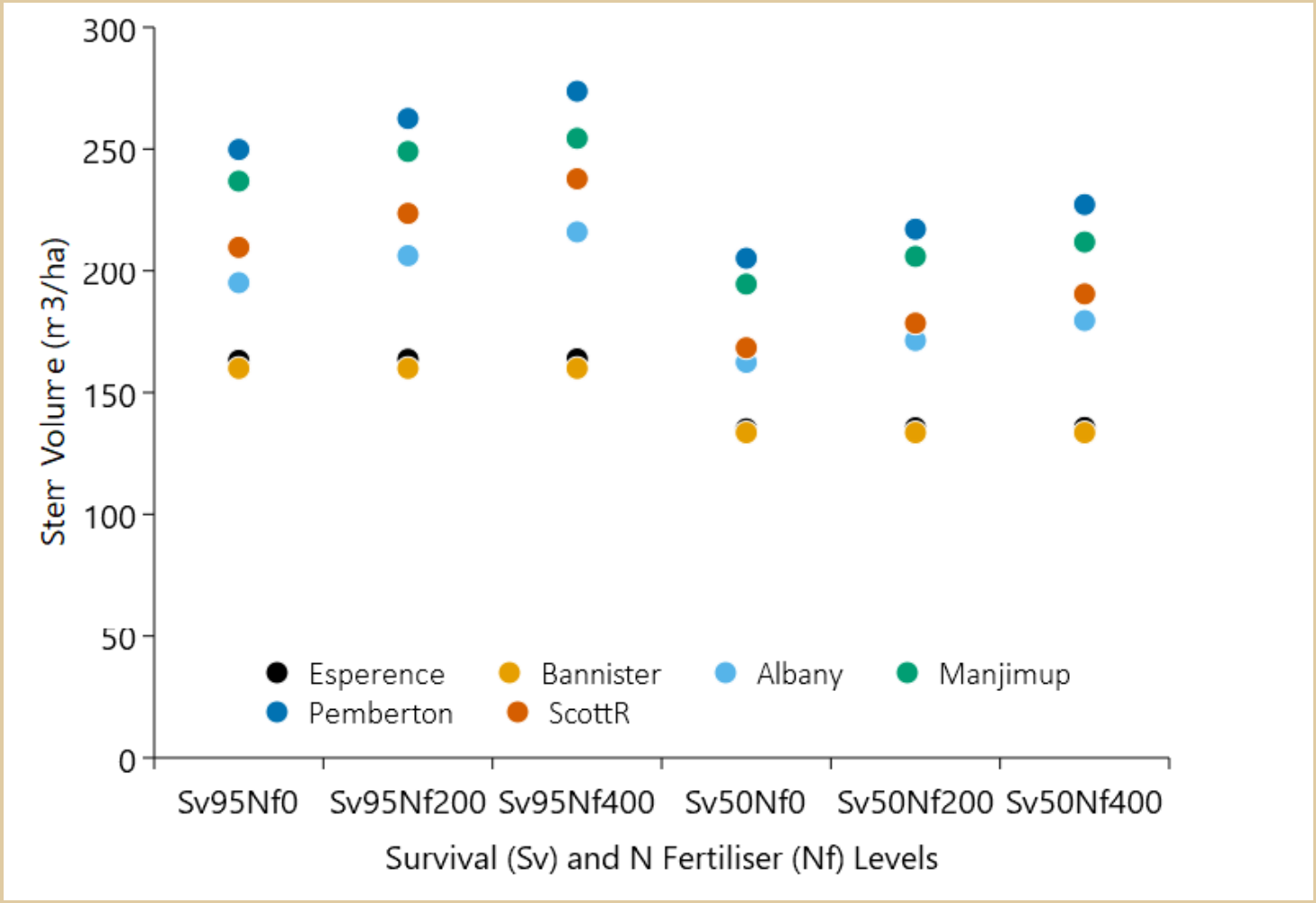


Influence of stored water



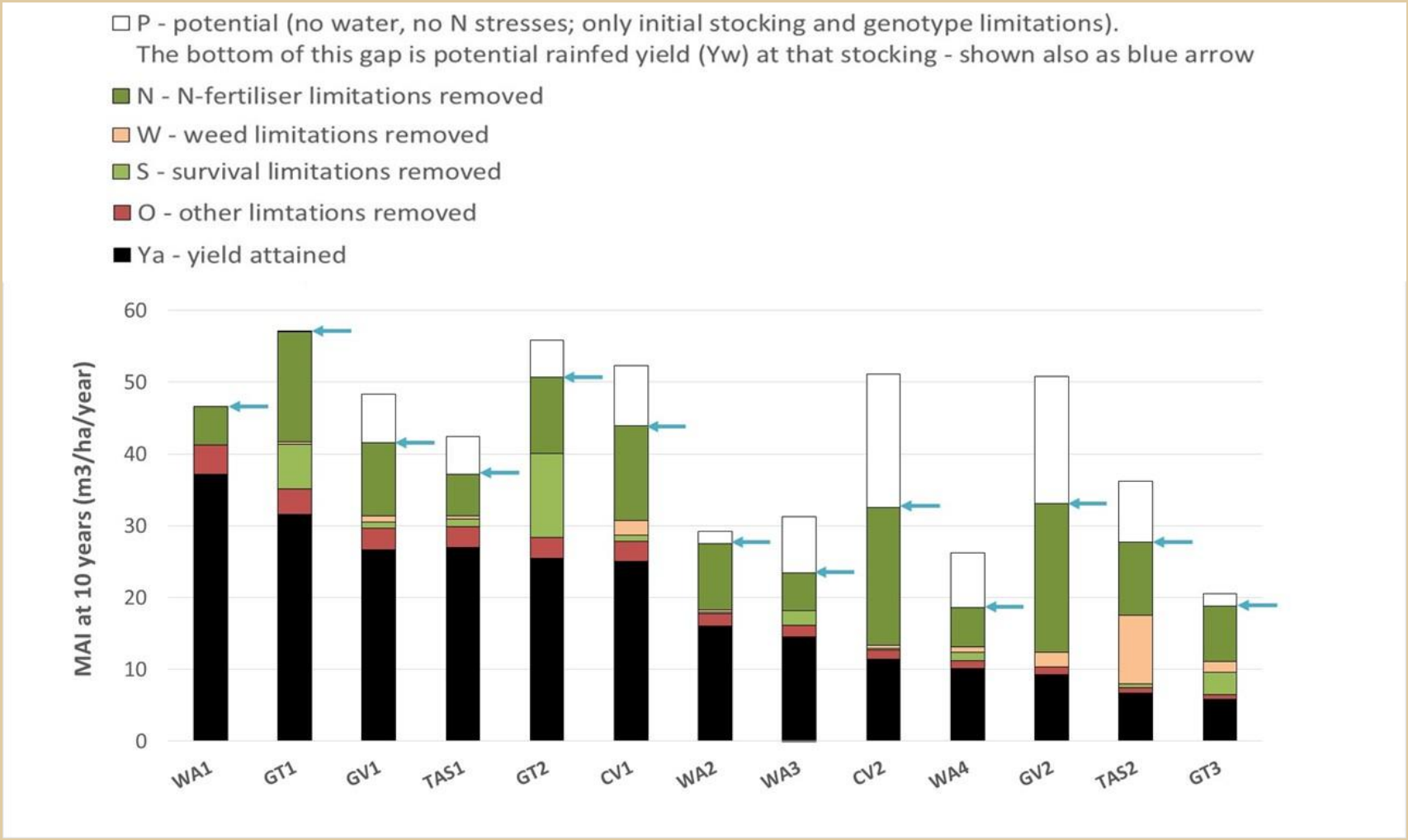
Simulated Stem volume in relation to survival and N fertiliser

- Survival and N fertiliser effects positive at the wetter sites (● ● ● ●)
- absent at the two driest sites (● ●)



(base conditions were high soil N and initial water)

Yield gap analysis for 13 contrasting sites

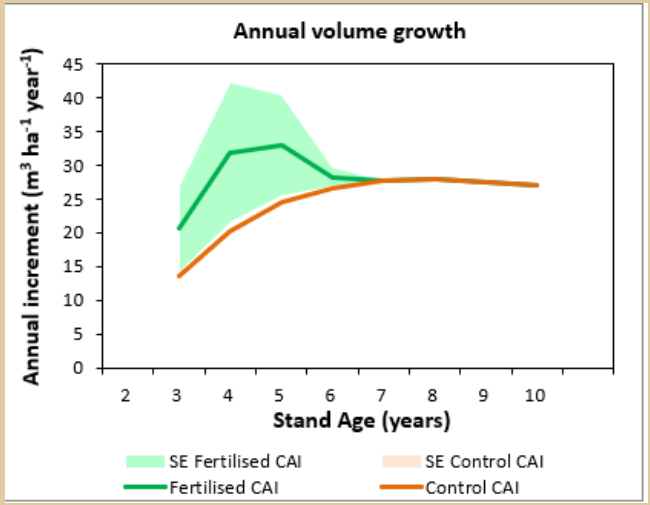


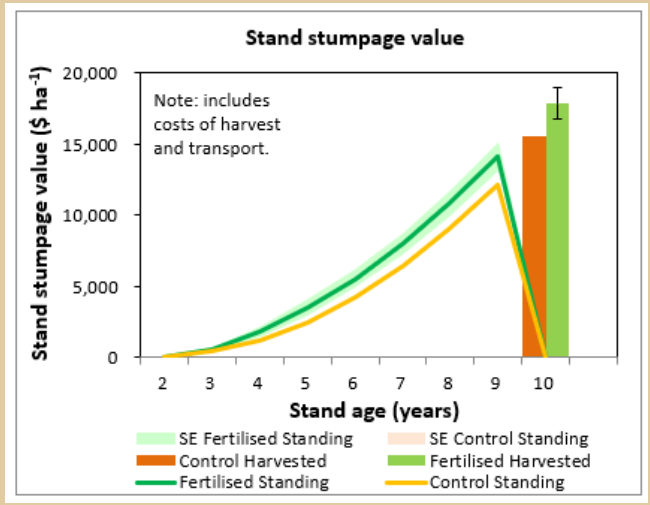
- Top of dark green bar for N represents water-limited (rainfed) yield (Yw).
- Top of the white bar represents potential yield if all water and N limitations were removed

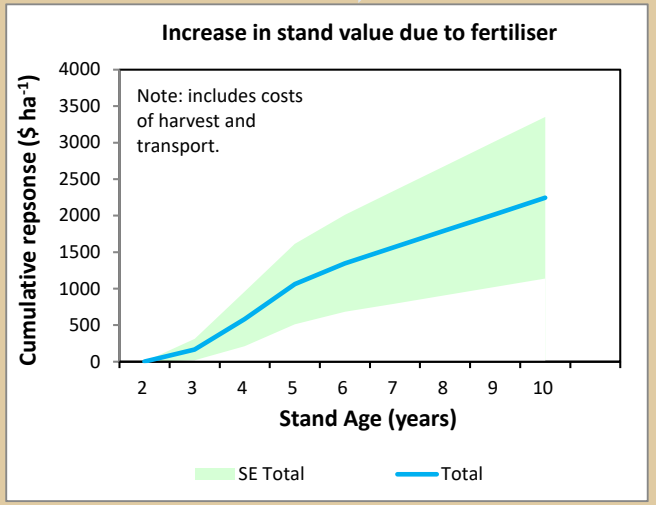
ProFert: Site specific fertilizer prediction tool

- Initially developed for softwoods
- Now parameterised for hardwoods
- Based on trials across southern Australia
- incorporates, soil, satellite and climatic factors

Volume response → Increase in wood value → Economic assessment

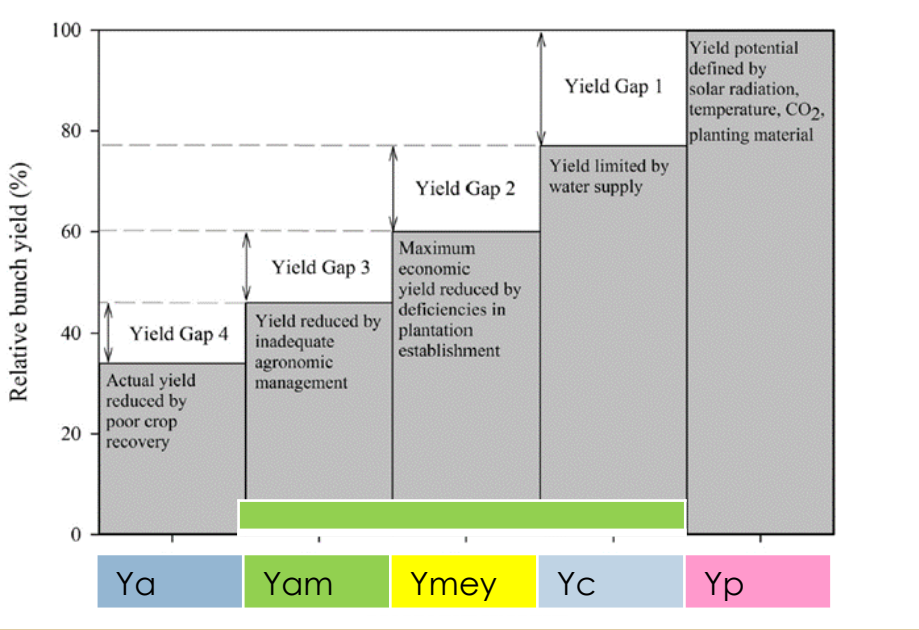






Summary of yield responses and gaps

Factor	Gap/ Response (m3/ha)	Description
Rain	150	As MAR increases from 600 -1200 mm
Evaporation	–20	As MAE increases 1000-1450 mm
Temperature	30*	As MAT increased 10.5 – 16^{0}C
Soil depth	?	Up to 75% mortality if soil < 2 m
Prior land use	–50	Lower if non-Ag.
Stand density	30	Increases as stocking increased 750-1100 sph
Coppicing	-70 to -90	Less for 2R relative to 1R seedling (Coppice or H_2O ?)
Nutrition	20-200	Largest gaps on non-Ag; mostly related to N on Ag sites



*** Note the temperature effect appeared higher in current trials**

Highest productivity on: Wet, Warm, Well Fertilised & Well stocked sites

Thank you

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