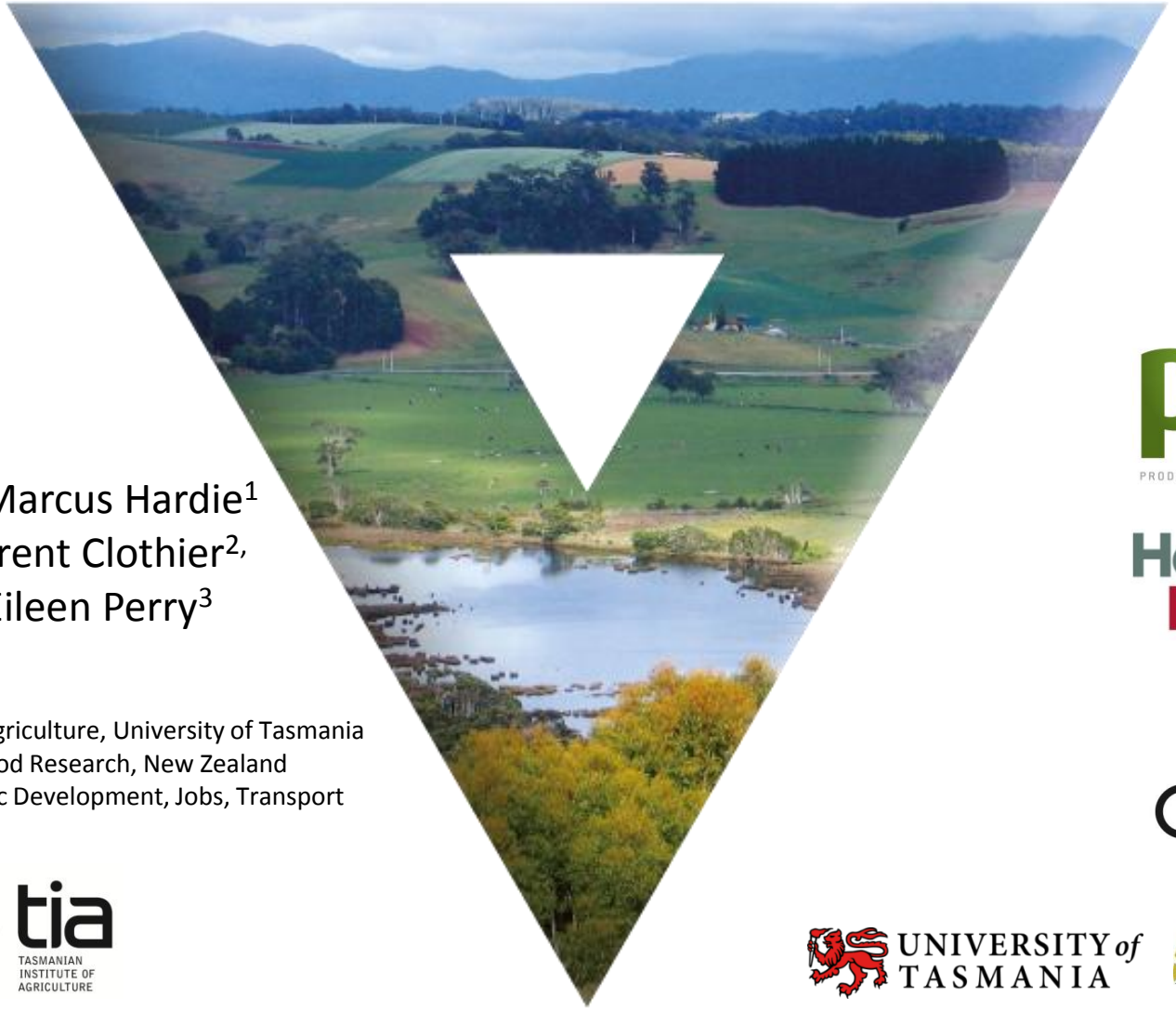
Precision fertigation for improved apple orchard productivity



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PRODUCTIVITY IRRIGATION PESTS AND SOILS

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Project Overview

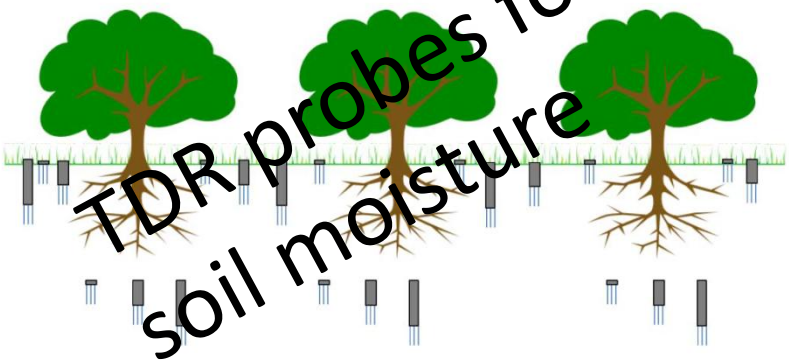
Current situation: Guidelines for fertigation are generic and don't fully consider total N flux and impacts of rates and timing of application

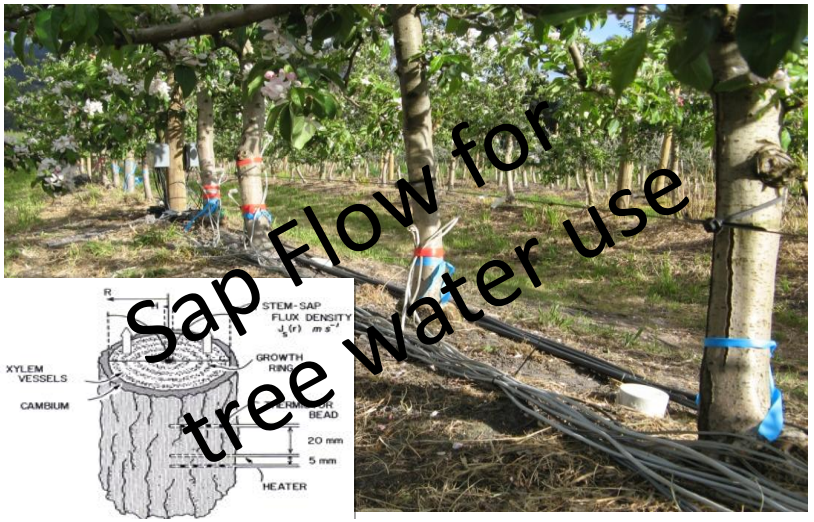
Aim: Optimal N nutrition in apple orchards through fertigation

Major outcome: Protocols for precision fertigation in apple orchards that account for tree uptake, utilisation and fruit quality, crop, leaf and pruning removal and nutrient flux

Trial Establishment

'Galaxy' at Lucaston Park Orchards, Tasmania



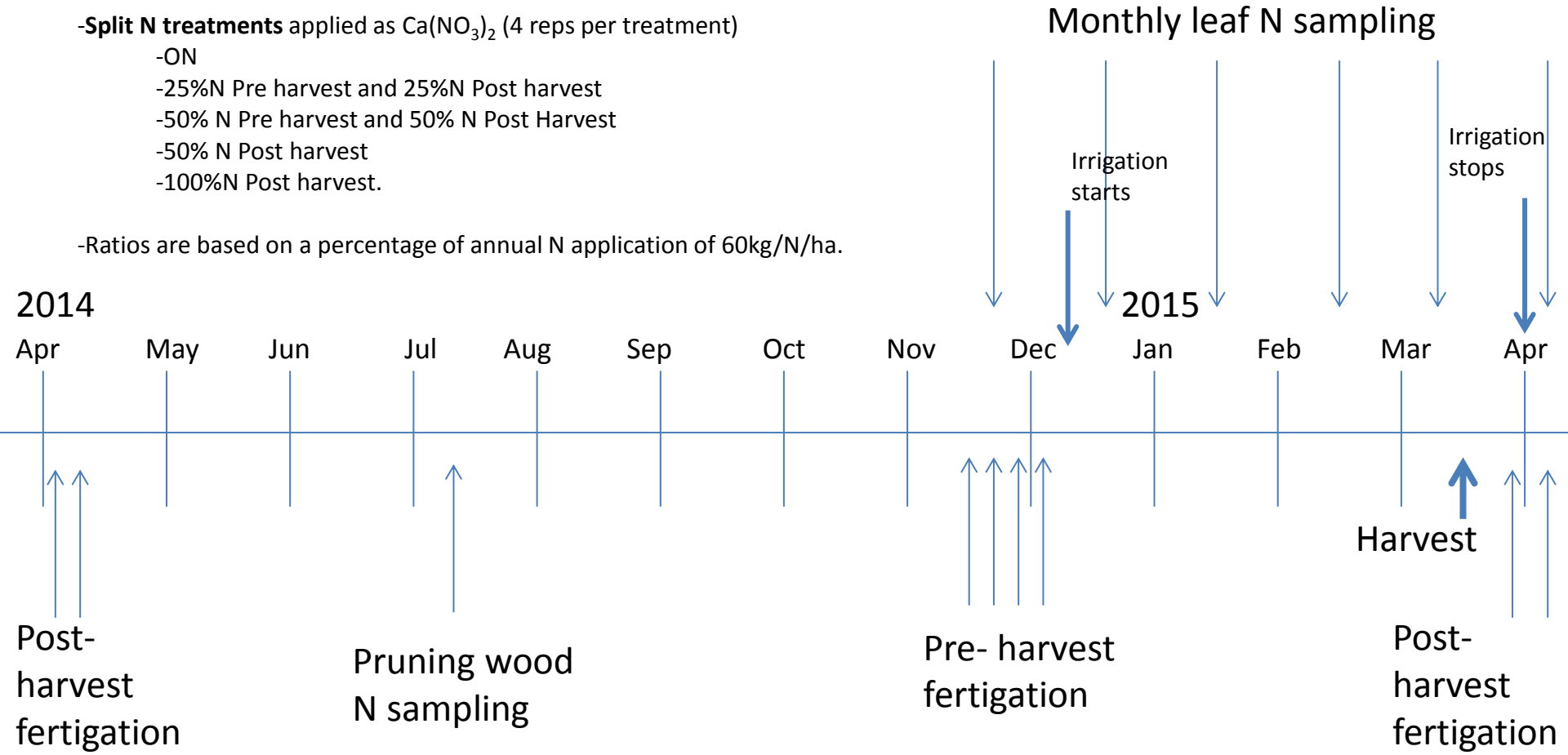


Experimental Design

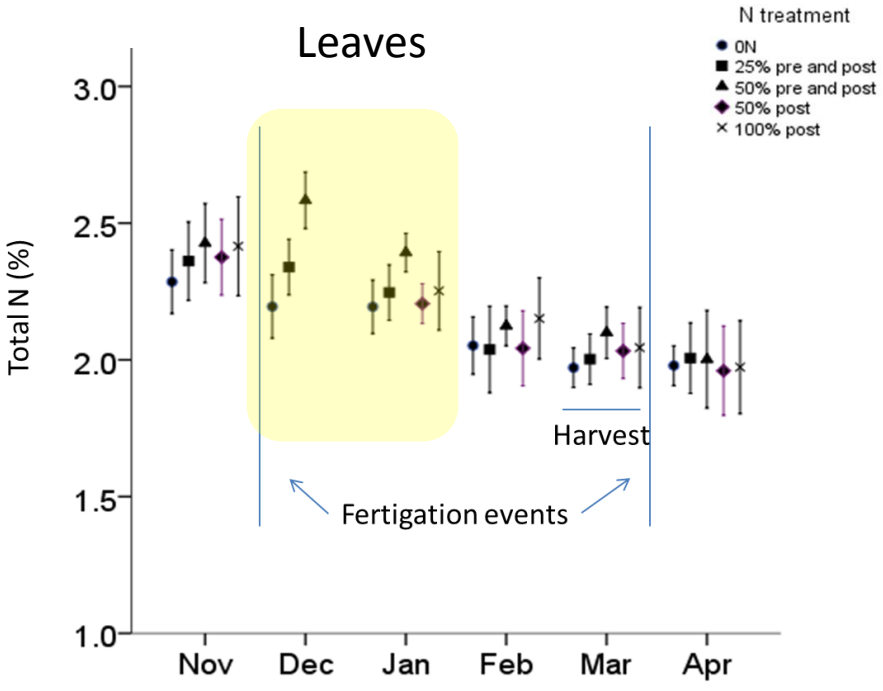
-**Irrigation treatments applied when grower irrigates**: high (3.9L/hr), medium (2.3L/hr) and low (1.6L/hr)

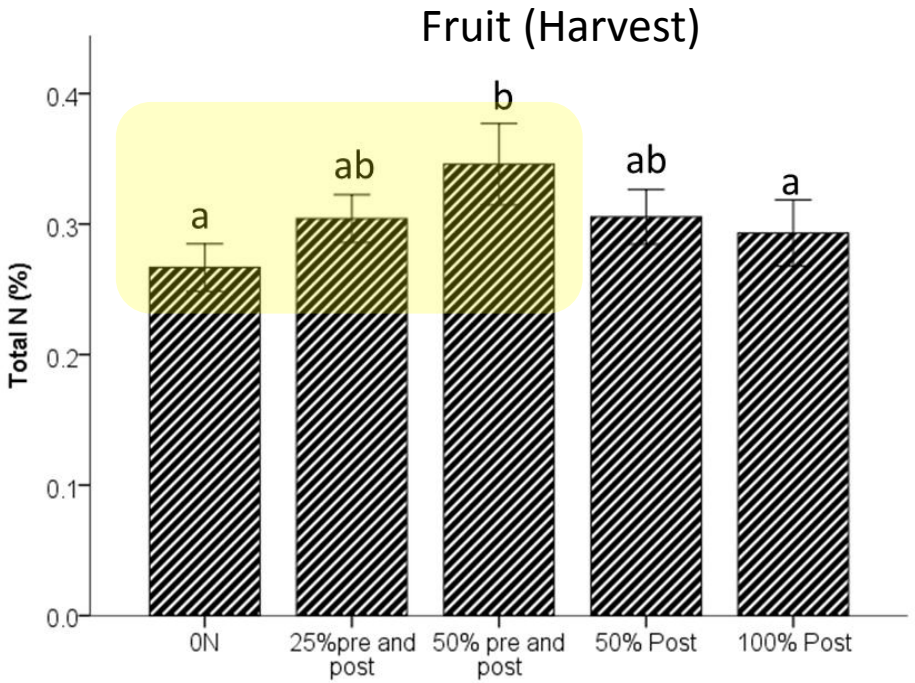
-**Split N treatments** applied as $Ca(NO_3)_2$ (4 reps per treatment)
- -ON
- -25%N Pre harvest and 25%N Post harvest
- -50% N Pre harvest and 50% N Post Harvest
- -50% N Post harvest
- -100%N Post harvest.

-Ratios are based on a percentage of annual N application of 60kg/N/ha.



Leaf and Fruit N content

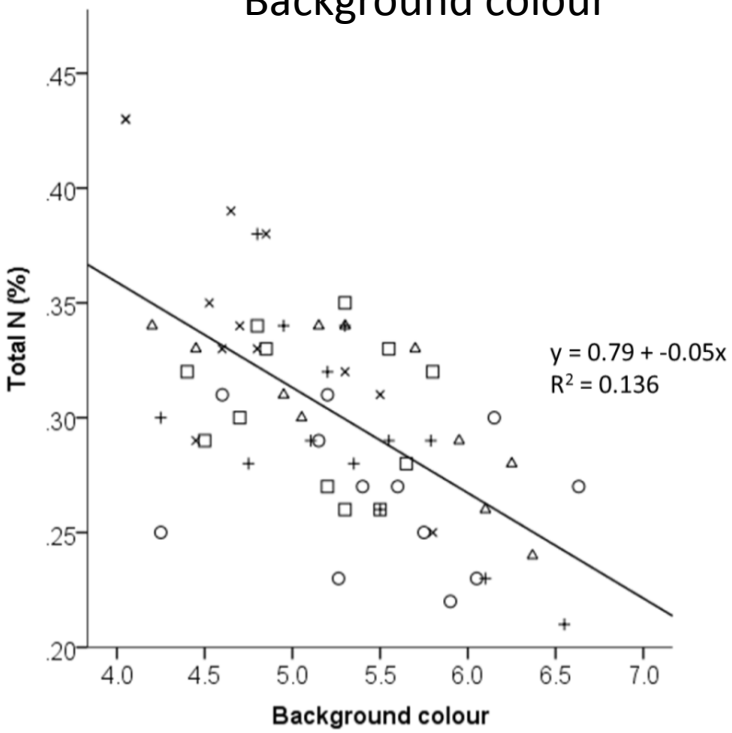




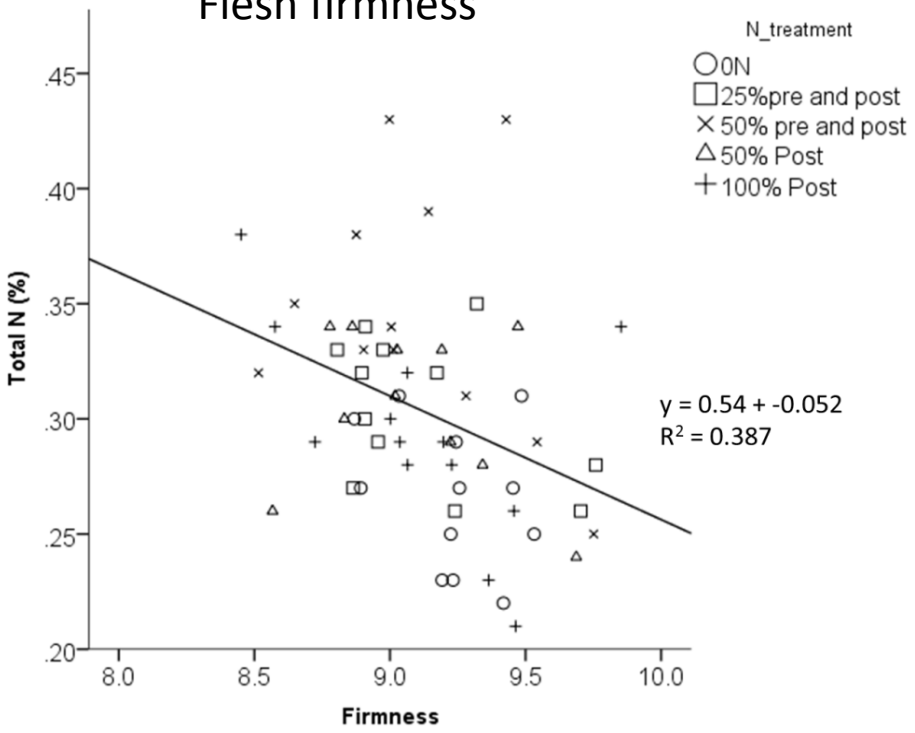
- Pre-harvest fertigation significantly increased leaf and fruit N

Fruit Quality

Background colour

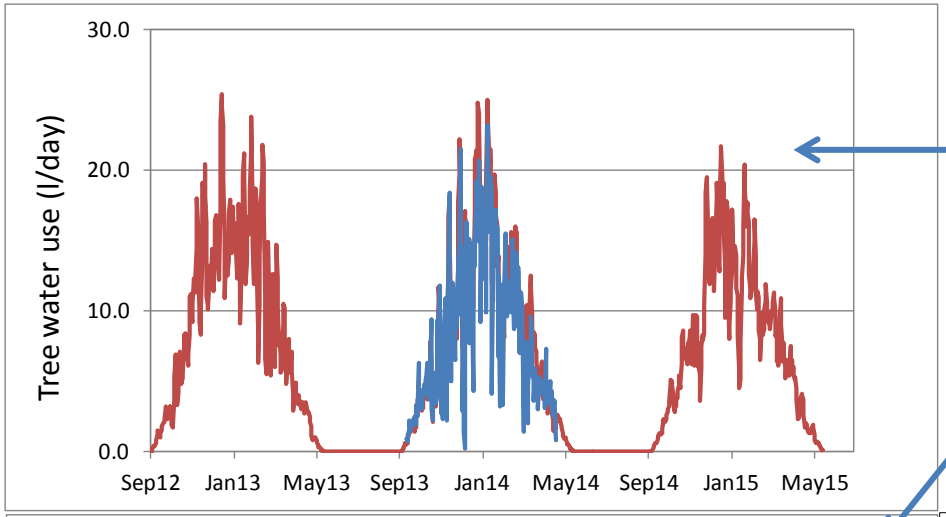


Flesh firmness



- Pre-harvest N fertigation significantly influenced fruit colour (3 indices)
- No significant influence of fertigation on firmness

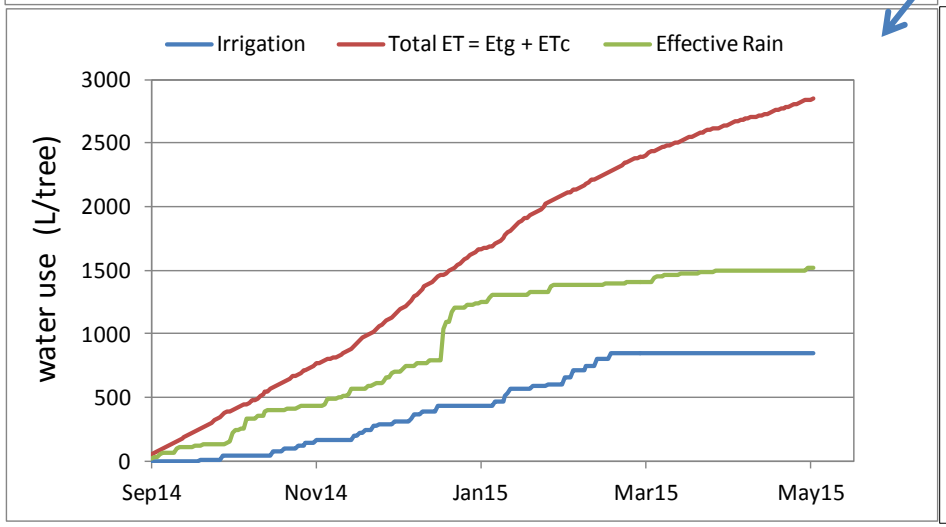
Orchard water use efficiency

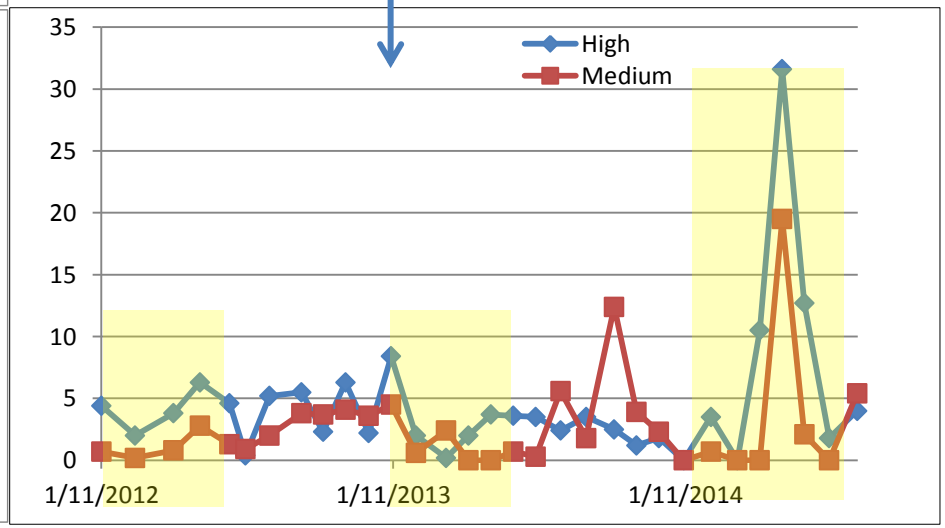


Yearly tree water use

Cumulative water use over a season

Seasonal drainage





‘Eco-efficiency’ of apple orcharding

‘activities that create economic value while reducing ecological impact and resource use’

Average inputs and outputs of apple growing at Lucaston

Growing season	Irrigation (L per tree)	Fertigation N (kg/tree)	Yield (kg / tree)	Drainage loss (L /tree)	nitrate loss (kg-N/tree)
2013-14	1335	0.014	39	424.35	0.015
2014-15	567	0.014	33	447.75	0.016

Growing season	Water Inputs ε_1 (L/kg fruit)	Water Outputs ε_2 (L/kg fruit)	Nitrogen Inputs ε_3 (kg fruit /kg N)	Nitrogen Outputs ε_4 (kg fruit /kg N)
2013-14	34.2	10.9	2820	2543
2014-15	17.2	13.6	2386	2056

These simple metrics, on a year by year basis, will enable us to assess the impact of different irrigation and fertigation strategies on the eco-efficiency of orchard production

Additional factors to consider: season N recycling, crop removal, mineralised N etc

N^{15} Trial: Nitrogen recycling

Questions

- What is the importance of N remobilisation versus N uptake by roots for new shoot growth and when does this occur?
- Can the quantity of N stored be influenced by timing and application rate of N fertigation?
- When is uptake most efficient?

Treatments:

- Zero N^{15} control
- Pre-harvest N^{15} (60g/tree) only
- Pre-harvest N^{15} (60g/tree) plus post-harvest N^{15} (60g/tree)
- Post-harvest N^{15} (60g/tree) only.

PIPS II: Building on fertigation research

- ***Sub-project 1: Building a multi-season N budget for optimised fertiliser management***
  - Use ^{15}N to trace the fate of N over multiple seasons
  - Quantify the relative contributions and timing of all N sources
  - Quantify total N loss above and below ground
  - Determine the uptake of N, P and K under foliar and fertigation treatments and influence on fruit quality

- ***Sub-project 2: A nationwide decision support tool to guide on-farm irrigation and nutrient management***
  - Develop a grower/adviser focused decision support tool for irrigation and nutrient management – using SPASMO
  - Will include: point-source application of water and nutrients via a line of drippers or sprinklers, 3D tree-canopy module with leaf processes linked to local microclimate and orchard specifics

Acknowledgements

- Andrew and Matt Griggs as grower collaborators
- Agronomists Peter Morrison, Andrew Hall and Nigel Bartels for industry collaboration
- Dr Sally Bound for advice
- Garth Oliver, Justin Direen and Steve Paterson for technical support
- This project is part of the Apple and Pear industry Productivity Irrigation Pests and Soils (PIPS) flagship program and funded by HIA using the apple and pear industry levy, Voluntary contributions from Plant and Food Research NZ and matched funds from the Australian Government.