PIPS 2
Extension update
June 2017

Facilitated by
Ross Wilson
AgFirst
PIPS 2 extension

The Productivity, Irrigation Pests and Soils (PIPS) program coordinates different organisations to undertake orchard research for the apple and pear industry.

We are now taking PIPS research and communicating about it with growers on a regular basis.
Six projects

1. Tree structure
2. Biennial bearing
3. Apple tree and fruit nutrition
4. Profitable new pears
5. Integrated pest and disease management
6. Program coordination by the RM Consulting Group
1. Tree structure

Team leader: Dr Sally Bound

Organisation: Tasmanian Institute of Agriculture

Topic:

Artificial Spur Extension (ASE) versus chemical thinning
Treatment application

Pruning completed September of each year

ASE treatments
- Gala set at 5 buds/cm² LCSA in 2015/16 and 6 buds in 2016/17
- Fuji set at 6 buds/cm² LCSA in both years

Chemical thinning (Gala & Fuji trial trees)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Alvina Gala</th>
<th>Fiero Fuji</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 ppm NAA at 7 dAFB</td>
<td>14 Oct 2015, 19 Oct 2016</td>
<td>-</td>
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</tbody>
</table>
Flower clusters

- Flower buds reduced prior to bud burst (Fuji off-year in 2015/16)
- Note that 1st year of setup can get variable results, settles down in 2nd year
Fruit set response

- High proportion of buds set fruit in 2015 (unusual season)
- Note that 1st year of setup can get variable results, settles down in 2nd year
- ASE higher percentage fruit set than conventional
- Chemical thinning impact variable between seasons
Short flowering period in 2015 (~6 days)

ASE > proportion buds setting multiple fruit, even in high set season

Cultivar and seasonal differences
Yield (tonnes/ha)

- ASE = more consistent yields across seasons

**2015/16**

- **Yield (tonnes/ha)**
  - **ASE**
  - **ASE+CT**
  - **Conv**
  - **Conv+CT**

**2016/17**

- **Yield (tonnes/ha)**
  - **ASE**
  - **ASE+CT**
  - **Conv**
  - **Conv+CT**
Fruit quality - weight

- Larger fruit from ASE trees
2. Biennial Bearing in Apple

**Team leaders:** Dr Jens Wünske and Dr Dario Steffanelli

**Organisations:** University of Hohenheim (Germany) and Vic DEPI (Australia)

**Topic:**

Extending the understanding of the genetic, physiological and cultural aspects of biennial bearing.
Mix of pure and applied science

Project led by University of Hohenheim, Germany
- Molecular and genetic studies
- Metabolic and Biochemical studies
- PhD program

AVR co-lead for field applications, Australia
- Crop load and fruit quality studies
- Adaptation of predictive thinning models (i.e. MaluSim)
- Image analysis
- PhD program
Flower Bud Development, 2016, Germany

Number of initiated buds increases

Not initiated = 0
Initiated = 1
Adaptation of carbon balance thinning models

<table>
<thead>
<tr>
<th>Weather</th>
<th>Carbon supply</th>
<th>Carbon demand</th>
<th>Carbon balance</th>
<th>Thinners efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark, cloudy weather</td>
<td>✔️ Reduces solar radiation intercepted, reducing photosynthesis</td>
<td></td>
<td>Lowers</td>
<td>Thinnners are more effective</td>
</tr>
<tr>
<td>High night-time temperatures</td>
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<tr>
<td>(&gt;18.3°C)</td>
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<tr>
<td>High daytime temperatures</td>
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<td></td>
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<tr>
<td>(&gt;29.4°C)</td>
<td></td>
<td></td>
<td>Lowers</td>
<td>Thinnners are more effective</td>
</tr>
<tr>
<td>Clear sunny days</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Cool daytime temperatures</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>(&lt;18.3°C)</td>
<td></td>
<td></td>
<td>Increases</td>
<td>Thinnners are less effective</td>
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</table>
Digital image analysis – periodical picture collection
Results – Fruit ripening on tree

Nicoter

Rosy Glow
Results – Fruit size (weight in grams)

- **Nicoter**
  - $R^2 = 0.7138$
  - Graph showing the relationship between crop load (fruit/cm²) and mean weight (g)

- **Rosy Glow**
  - $R^2 = 0.6902$
  - Graph showing the relationship between crop load (fruit/cm² TCSA) and mean weight (g)
Results – Fruit total soluble solids

Nicoter

R² = 0.7267

Rosy Glow

R² = 0.6484
Results – Return Bloom (# flower clusters)

Nicoter

Rosy Glow
3. Tree and fruit nutrition for improved apple productivity

Team leader: Dr Nigel Swarts (Project lead)

Organisation: Tasmanian Institute of Agriculture and New Zealand’s Plant and Food Research.

Topic:
Apple tree and fruit nutrition for improved productivity.
The SINATA model
Strategic Irrigation and Nitrogen Assessment Tool

**SOIL DATA**

- Water content [L/L]
- Pressure head [cm]

**CROP DATA**

- Variety
- Training system
- Root stock
- Phenology
- Planting density
- Yield target

**CLIMATE DATA**

- Historical (BOM)
- Daily values
- Solar radiation
- Temp & RH%
- Wind speed
- Rainfall

**MANAGEMENT**

- Irrigation
- N Fertilizer
- Crop Load
- Timing
- Rates
- Strategies

**SPASMO CORE**

**OUTCOMES**

- Irrigation need
- Fertilizer need
- Yield & Response
- Benchmarking
- Planning
- What-if answers
What is the purpose & intended use of SINATA?

• STRATEGIC and PLANNING purposes

• Benchmarking (performance and efficiency perspective)

• To answer the WHAT-IF questions  
  e.g. what would happen if I made this decision?

• To run a comparative scenario analysis  
  e.g. how does this (season or decision) compare?

• A learning tool and repository for scientific understanding  
  e.g. what is the system response to this decision?
Model inputs: orchard tree parameters

Use of slider bars to adjust other plant parameters → Will load parameters for phenology, yield targets etc
Model inputs: irrigation & N strategies

- Effective area of shade (EAS, %): 50
- Effective width of mulch or herbicide strip [%]: 25
- Understorey management: Complete cover of grass
- Irrigation system: Minisprinkler
- Irrigation strategy: Conservative
World’s best data!!
Sap flow data used for a Climate-based estimates of tree water use (FAO-56)

- Tree water use is estimated using $\text{ET}_c = K_c \text{ET}_o$
- The crop factor, $K_c$, derived for 1-yr old Envy apple trees
Modelling used to develop sustainable irrigation practices

- Grower applied too much water last year (~400 L/tree)
- Targeted irrigation could save 1 ML per ha per year
Sampling regions
Fruit %N

N (%)

- 0N Control
- 30 PrPo
- 30 Po
- 60 Po
Colour parameters

- ON Control
- 30 PrPo
- 60 PrPo
- 30 Po
- 60 Po

IRC
% RC area
B'grd col
4. Profitable pears

Team leader: Dr Ian Goodwin

Organisation: Department of Economic Development, Jobs, Transport and Resources (Victoria).

Objective:
Investigate sustainable management techniques to increase precocity, fruitfulness and fruit quality of new pear cultivars.

More Details
Materials and Methods

4 ha experimental orchard “Pear Field Laboratory”

Statistically designed experiments

- Training systems:
  - 2D single- and multi-leader Open Tatura and vertical
  - 3D central leader, spindle and vase

- Tree densities: 740 – 4444 trees/ha

- Rootstocks: D6, BP1, D6/BM2000, D6/Nijisseiki, D6+ virus, Quince A/BH, Quince C/BH

- Cultivars: ANP-0131 (marketed as Deliza®), ANP-0118 (marketed as Lanya®), ANP-0534

- Wetted root volume: drip and microjet, standard and frequent, +/- root pruning

- Plant growth regulators: GA3, GA4+7, benzyladenine, ethryl, hydrogen cyanamide

Nitrogen management: modelling N-flux (SPASMO), remote sensing N status

Economics: discounted cash flow
Planting systems treatments

2D vertical single-leader
0.5 m tree spacing

2D vertical two-leader
1.0 m tree spacing

2D vertical four-leader
2.0 m tree spacing

3D central leader
2.0 m tree spacing
Light interception (LI) and yield results YTD

- Vertical and Open Tatura systems had similar light interception (30-35%)
- High tree density intercepted more light
- D6 and QA had similar Light Interception and both higher than BP1
- Quince A had far superior 3rd leaf yield, brix and red colour
Irrigation Results

- Drip irrigation increased yield by 100% with 35% less water
PGR Results ~ promoting branching

- Cytokinin 6-benzyladenine (Maxcel®) combined with notching produced more shoots.
- Efficacy was substantially reduced with later treatment (31 Oct).

PGR Results ~ promote fruit set

- Gibberellic acid (GA₃) applied at 90% bloom more than doubled fruit set and yield
- However cluster number was significantly reduced the following season

5. Integrated pest management

**Team leader:** Dr David Williams

**Organisation:** Department of Economic Development, Jobs, Transport and Resources (Victoria).

**Topic:**

Release of biocontrol agent, “Mastrus ridens” against codling moth.
Mastrus ridens update

- Field releases of the parasitoid wasp (50,000/site) in Victoria (2 sites 2015), Qld (2 sites 2016), NSW (5 sites 2017), Tas (1 site May 2017), SA (2018).
- Lab testing impact of pesticides on parasitoid (3 so far at 1000 insects/batch)
- Now assessing establishment of the parasitoid

Go to Youtube and search Matrus ridens
Get more info on all PIPS research

APAL website has contacts, links, articles and videos about PIPS:
apal.org.au/industry-info/pips/

Also

Acknowledgements

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• **Coordinated by** RM Consulting Group.

• **Research by** Department of Economic Development, Jobs, Transport and Resources (Victoria); Tasmanian Institute of Agriculture; and University of Hohenheim (Germany).

• **Extension by** AgFirst.

• **Communication support and industry input** by APAL.

• None of the work would have been possible without the support, goodwill, and professionalism of the orchardists who often risked their crops to generate new knowledge for the benefit of us all.