Precision fertigation for improved apple orchard productivity

In this project, we are looking at how efficiently apple trees use both water and nitrogen and how we can manipulate the timing and rate of these to consistently produce high quality fruit. We are now two years into the project and are pleased to report on the second season's data collection and analysis from our research orchards at Lucaston.

The Experiment

The fertigation experiment is set up in a Royal Gala/Galaxy commercial orchard block at Lucaston in the Huon Valley. The experiment combines irrigation and nitrogen fertigation, with 5 different fertigation regimes overlaying 3 irrigation rates.

Figure 1: Fertigation unit

Irrigation treatments	
HIGH	4.0 L/hour
MEDIUM	2.3 L/hour
LOW	1.6 L/hour

Fertigation nitrogen was applied as calcium nitrate [Ca(NO3)2]. Pre-harvest fertigation treatments commenced in November 2012, coinciding with the first irrigation application for the season. Post-harvest treatments were applied in March/April 2013. The trees were fertigated once/week for 4 weeks for each treatment (including the control).

Treatment	***Pre* Harvest**	***Post-* Harvest**	***Total* Applied**
	Nitrogen (kg/ha)	Nitrogen kg/ha	Nitrogen (kg/ha)
0 N *(Control)*	0	0	0
Low N - *50:50 split*	15	15	30
High N – *50:50 split*	30	30	60
Low N - *Post-Harvest*	0	30	30
High N - *Post-harvest*	0	60	60

Results

The harvest results reflect the response of trees to ***pre-harvest*** nitrogen and irrigation treatments only. The impact of post-harvest treatments will be observed in productivity and fruit quality in 2014/15.

Yield Efficiency

This is the yield of fruit relative to the size (trunk diameter) of the tree. To date, there has been no significant effect of nitrogen and irrigation treatments. This result is not surprising given that the data only reflects one pre-harvest treatment application and the treatment trees are likely to still have residual effects from previous season's fertiliser application.

Fruit size and weight

The **HIGH irrigation** treatment produced fruit that was significantly longer, of greater diameter and heavier. Although significant differences were found for nitrogen treatments, there were no clear trends for the influence of nitrogen on fruit size and weight.

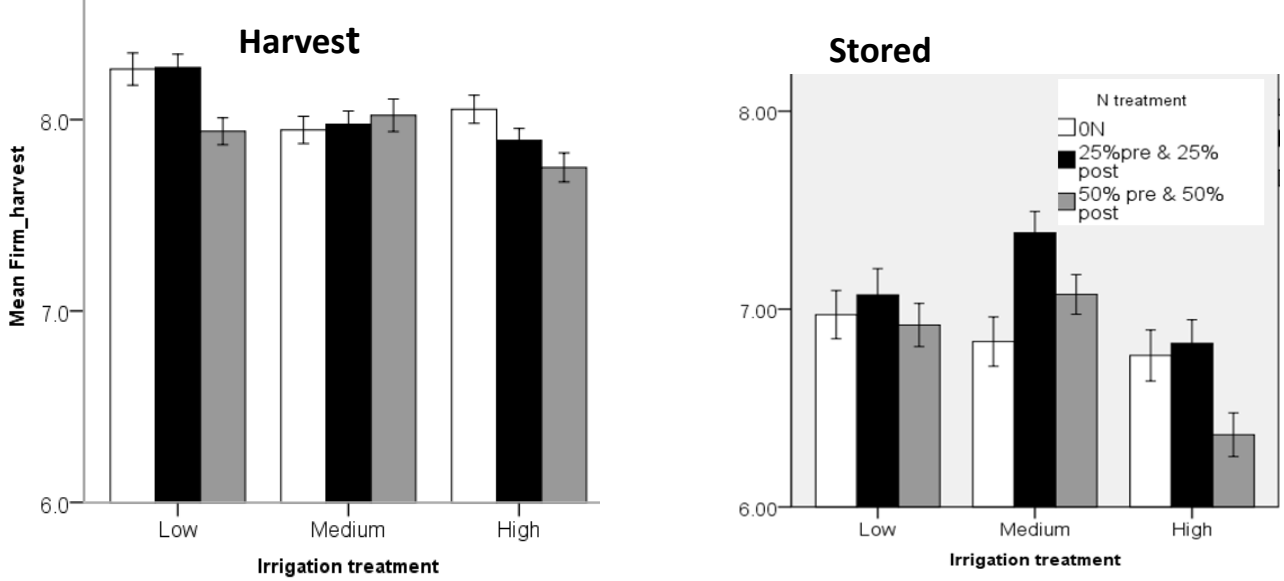

Figure 2: Fruit firmness at harvest and after four weeks storage measured by the Guss Texture Analyser

Results *(continued)*

Fruit firmness and sweetness

HIGH irrigation produced the least firm fruit at both at harvest and 4 weeks post-harvest. **HIGH nitrogen** treatments resulted in the least firm fruit at harvest (Figure 2).

In other fruit quality parameters, sugar content was significantly influenced by both nitrogen and irrigation treatment. The high fruit sugar content recorded for trees receiving no nitrogen may have been due to differences in fruit maturity at harvest. Nitrogen application delays ripening. This means that fruit from the zero nitrogen treated trees was riper and therefore sweeter at harvest than those receiving nitrogen.

Key Messages

- Fruit size and firmness can be manipulated through small alterations in pre-harvest irrigation and nitrogen quantities.
- High irrigation produced bigger , heavier fruit that was less firm at harvest.
- High nitrogen treatment resulted in softer fruit

We thank the Griggs family at Lucaston Park Orchards for their continued support of the research undertaken in their orchard.

Monitoring soil water

To determine the efficiency of nitrogen and irrigation treatments, we installed drainage fluxmeters (DFM) under a range of nitrogen and irrigation treatments (Figure 3). Fluxmeters are essentially 'rain gauges' located in the soil to measure both drainage (water) and leaching (solutes). The concentration of nutrients (solutes) in the drainage water will help us monitor the balance of nutrients applied and lost through leaching under different treatments.

Figure 3: Installation of drainage lysimeters at Lucaston..

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