

Future Orchards Trial Outline

Project title:	Leaf Defoliation in low chilling environments
Region:	South West Western Australia
Contact:	Susie Murphy White
Projective Objective:	Define current management practices to defoliate apples leaves. Does leaf defoliation enable trees to enter the dormant phase earlier and therefore gain more winter chill in a low chill environment?

Outline/method/ (what we will do did):	<p>Survey growers on current practices used to defoliate apple leaves; purpose, product, rate, and timing.</p> <p>Demonstrate 4 variables (Urea, Hydrogen cyanamide, ABA & control)</p> <p>5 trees treated with each product randomised block design</p> <p>One timing of application on one variety (late May)</p> <p>Variety (Cripps Pink)</p> <p>Monitor winter chill using ting tag in orchard</p> <p>Weekly photo points after leaf deoliation spraying until leaves defoliated (June)</p> <p>Assessment of 5% green tip (September)</p> <p>Assessment of 80% full bloom (September – October)</p>
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Milestones	Planned Date or Completion Date
Trial defined	1 st November 15
Survey of growers current practices	1 st Feburary 16
Trial setup	May 2016
Records Measurement 1	5 % Green Tip
Field day	During flowering September 2016 or during leaf fall (June July)
Records measurement 2	80% full bloom
Reporting	March 2017
Presentation growers	After harvest

MAP & Layout:

Shaun Fontanini Fruit and Nut Farm 789 Seven Day Road Manjimup 34°17'19.3"S 116°03'42.6"E
<https://www.google.com/maps/@-34.2893127,116.0619011,233m/data=!3m1!1e3>



References:

- Allderman, L. a., Steyn, W.J. & Cook, N.C., 2011. Growth regulator manipulation of apple bud dormancy progressions under conditions of inadequate winter chilling. *South African Journal of Plant and Soil*, 28(2), pp.103–109.
- Campoy, Ruiz, D. & Egea, J., 2011. Dormancy in temperate fruit trees in a global warming context: A review. *Scientia Horticulturae*, 130(2), pp.357–372.
- Finger N, Darbyshire R, (2015) The Effect of Manual Defoliation on Dormancy Induction and Release of ‘Deliza’[®] Pear Trees. University of Melbourne Master project.
- Mohamed, A.K. (2008) The effect of chilling, defoliation and hydrogen cyanamide on dormancy release, bud break and fruiting of Anna apple cultivar Department of Horticulture, Assiut University, Egypt

Future Orchards Trial: Final Report

Project title:	Leaf Defoliation in low chill environments
Region:	WA – South West
Contact:	Susie Murphy White
Projective Objective:	Does leaf defoliation enable trees to enter the dormant phase earlier and therefore gain more winter chill in a low chill environment?

Outline/method/ (what you did):	<p>Survey of growers to define current management practices used to defoliate leaves.</p> <p>Demonstration <u>4 treatments x 1 variety x 1 location</u></p> <table border="1"> <thead> <tr> <th>One Variety on same rootstock</th> <th>Product Cost</th> </tr> </thead> <tbody> <tr> <td>ProTone (ABA Absicic Acid)</td> <td>Supplied by Sumitomo/APAL (\$622)</td> </tr> <tr> <td>Dormex (Hydrogen cyanamide)</td> <td>Supplied by Pomewest (climate change project surplus \$110)</td> </tr> <tr> <td>Urea or Zinc sulphate</td> <td>Supplied by grower</td> </tr> <tr> <td>Control – no treatment</td> <td></td> </tr> </tbody> </table> <p>a. 5 trees per treatment, random block design, 20 trees required in total. b. Products to be applied one concentration and timing – as determined by the product label. c. All other management practices to proceed as per grower’s regular schedule.</p> <p>Spray application</p> <table border="1"> <thead> <tr> <th></th> <th>ProTone (ABA)</th> <th>Dormex</th> <th>Urea</th> </tr> </thead> <tbody> <tr> <td>Active constituent</td> <td>Absicic acid</td> <td>Hydrogen cyanamide</td> <td>Nitrogen</td> </tr> <tr> <td>Product application rate</td> <td>100ppm</td> <td></td> <td>50kg/ha</td> </tr> <tr> <td>Mixing</td> <td>50g per 100L</td> <td>3L per 100L</td> <td></td> </tr> <tr> <td>Application timing</td> <td>As the leaves start to turn yellow</td> <td>35 days before bud burst</td> <td>2 weeks post harvest</td> </tr> <tr> <td>Determination of application date</td> <td>20 May 16</td> <td>25/8/16</td> <td>20 May 16</td> </tr> </tbody> </table>	One Variety on same rootstock	Product Cost	ProTone (ABA Absicic Acid)	Supplied by Sumitomo/APAL (\$622)	Dormex (Hydrogen cyanamide)	Supplied by Pomewest (climate change project surplus \$110)	Urea or Zinc sulphate	Supplied by grower	Control – no treatment			ProTone (ABA)	Dormex	Urea	Active constituent	Absicic acid	Hydrogen cyanamide	Nitrogen	Product application rate	100ppm		50kg/ha	Mixing	50g per 100L	3L per 100L		Application timing	As the leaves start to turn yellow	35 days before bud burst	2 weeks post harvest	Determination of application date	20 May 16	25/8/16	20 May 16
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Results Summary (measurements and observations, photos, photos of control area if applicable)

This demonstration seeks to investigate if it is possible to manipulate dormancy progression using plant growth regulators (PGR's) in a way that would reduce the chilling requirement or advance the entrance of the buds into dormancy with a resultant improved budburst in spring.

Temperate perennial fruit trees produce leaves and flowers in spring before developing fruit over summer, losing their leaves in autumn before entering a period of dormancy over winter where the tree is externally inactive (Campoy et al. 2011). The winter dormancy period is vital for fruit growth; ensuring freezing temperatures do not damage the sensitive tissues which are necessary for flower and fruit formation (Campoy et al. 2011). To ensure that this damage does not occur the tree will only resume external growth when environmental temperatures, typically associated with the start of spring, are suitable (Campoy et al. 2011). Small knob-like structures situated on the tree's stems and branches, known as 'buds' are the structures that develop into flowers and vegetative tissues as the tree exits the dormancy period.

Abscisic acid (ABA) is considered to play a role in dormancy as it inhibits growth in plants (Campoy et al. 2011). Previous research into the role of growth regulators and dormancy suggested that ABA, acting in an inhibitory role, increased in concentration as the tree approached dormancy. Over the dormancy period these levels decrease as other hormones such as cytokinins and gibberellins began to increase and eventually cause the release of dormancy and beginning of vastly increased auxin levels and growth in the plant (Allderman et al. 2011). Whilst the level of ABA and other hormones were once considered to be the likely causal agent of dormancy, more recent research has suggested that ABA receptivity is more closely related to dormancy than changes in ABA levels. Previous defoliation research, where ABA was sprayed onto leaves in hope of inducing earlier leaf-fall had no effect on bud break as trees 'normalised' following the treatment (Allderman et al. 2011) providing support to ABA receptivity more closely related to dormancy effects. As such, if hormones are playing a critical role in dormancy their relationship is complex, most likely related to hormone receptivity changes rather than hormone concentrations in the plant.

It was found that manual-defoliation had no statistically significant impact on either dormancy induction or release, providing no observed positive or negative effect in regard to dormancy induction or release (Finger2015).

Some growers suggest that leaf removal (defoliation) increases the period in which winter chill accumulates, increasing the likelihood that a variety will meet its chill requirement. It is common practice for foliar application of urea and zinc sulphate for the purpose of defoliation has been linked to delayed flowering, an undesirable characteristic in fruit growing (Finger 2015).

When a sample of WA orchardists was surveyed about their orchard practices around leaf defoliation the following information was collected.

70% of growers defoliate the apple trees leaves, 30% did not defoliate the leaves. When asked why they under took leaf defoliation 42% were applying nitrogen to boost the buds. 33% were ensuring they were entering the dormant phase earlier and therefore gaining more chill, 17% undertook the management practice to clean up the orchard and as disease prevention and 8% used the opportunity to start pruning earlier. The majority of growers use a foliar urea at a rate of 40kg/ha with some using Zinc Sulphate and Copper Sulphate. The growers that didn't defoliate the leaves thought that the practice wasn't economic enough.

ProTone (ABA) was applied on 20 May 16 at Shaun Fontanini's orchard on 5 Cripps Pink trees, 5 Kanzi and 5 Buck Eye Gala. A rate of 100ppm was mixed up in a small tank on the back of a quad

bike at 50g/100L and applied using a hand lance over the 5 trees from the Cripps Pink, Kanzi and Buck Eye Gala blocks. The remaining rows of each block were treated with the standard grower practice of Urea at 50kg/ha and no trees were left untreated as a control. (need to check)

Monitoring of leaf fall was undertaken on a weekly basis with photo's taken of each treatment.

Cripps Pink leaves finished leaf fall on 30 June, ABA trees still had some leaves (30%) to drop, it appears that the urea was quicker in assisting in leaf fall than ABA.

On 30 June Kanzi had about 10% of leaves to drop on urea trees, ABA still 50% and the Buck Eye Gala 20% leaves still present on the ABA treated trees with the urea trees completely defoliated.

It appears from our trial of using ABA to assist leaf defoliation that leaf defoliation did not occur at faster rate than urea. The ABA might have been applied too early particularly on the Kanzi and Buck Eye Gala as no signs of yellowing had begun. The Cripps Pink leaves had begun to yellow (10%) but maybe not enough. Or the rate applied may have been too low.

To see if an effect on when the trees come out of dormancy and if flowering can be compacted by defoliating the leaves. Green tip and full bloom monitoring will need to take place in September through to October 16. To show the effect of a dormancy breaker compared to leaf defoliation Dormex will be applied to 5 Cripps Pink trees 35 days before expected bud burst (24 August).

In the Cripps Pink 5% green tip (21 September) and first flower was reached in the trees sprayed with Dormex before those sprayed with ABA or urea. But when full bloom occurred (24 October) no difference between the treatments occurred (suspect that winter oil had been applied to all trees hence no effect seen on the dormex treated trees).

The Kanzi trees treated with ABA reached green tip before the Dormex and Urea. No difference observed at full bloom between treatments.

Above average chill occurred in 2016 with 76 chill portions received by 31 August 2016. Chill accumulation started later (27TH April) delaying leaf fall until June.

Table 1. Cripps Pink leaf defoliation progression after ABA and Urea applied.

Date	ABA	Urea
26 May 2016 <ul style="list-style-type: none"> • Yellowing of leaves 		
17 June 2016		
30 June 2016 <ul style="list-style-type: none"> • ABA 30% of leaves remaining • Urea only a few leaves left 		

Table 2. Kanzi leaf defoliation progression after ABA and Urea applied.

Date	ABA	Urea
26 May 2016 <ul style="list-style-type: none"> • No yellowing of leaves 		
3 June 2016		
17 June 2016 <ul style="list-style-type: none"> • Yellowing of leaves starts 		
30 June 2016 <ul style="list-style-type: none"> • ABA 50% leaves remaining • Urea 10% leaves remaining 		

Table 3. Buck Eye Gala leaf defoliation progression after ABA and Urea applied.

Date	ABA	Urea
26 May 2016		
3 June 2016 <ul style="list-style-type: none"> ABA leaves turn dark purple 		
17 June 2016		
30 June 2016 <ul style="list-style-type: none"> ABA 20% leaves remaining Urea completely defoliated 		

Green tip counts undertaken in September through to Full Bloom in October 2016

Table 4. Cripps Pink bud burst and flowering progression after ABA, Dormex and Urea applied.

Date	ABA	Urea	Dormex
15/9/16			2% @ green tip 
21/9/16			5% @ green tip
10/10/16			First Flower
24/10/16	80% @ full bloom	80% @ full bloom	80% @ full bloom

Table 5. Kanzi bud burst and flowering progression after ABA, Dormex and Urea applied.

Date	ABA	Urea	Dormex
15/9/16	20% @ green tip 	2% @ green tip	10% @ green tip 

Implications (What did we learn? How will this impact on the business? What will we change? What are the road blocks/obstacles to change?)

If demonstrated again;

- Use higher rate of ABA,
- Test against Ethryl
- Application of ABA to be after application of urea, after the leaves have started to yellow.