Future Orchards Trial: Final Report

Project title:	What leaf test levels of Nutrition can tell us about fruit quality attributes?
Region:	Orange & Batlow, New South Wales
Contact:	Kevin Dodds NSW DPI
Projective Objective:	Compare leaf nutrition test results on Pink Lady blocks of apples known to have good colour and poor colour. Trial to be replicated at Orange and Batlow.

Outline/method/ (what you did):	This nutrient testing and data collection trial was replicated across the two largest apple growing regions of NSW (Batlow and Orange). Therefore this final report covers this local trial for both regions. Below is an update and outline of the sampling and assessment process that was employed. **Block Selection (February 2016)** **Below is a list of the sample blocks selected for the Orange and Batlow districts.** **ORANGE** **Bernard Hall** Hay Shed – Pink Lady Drive - Pink Lady Hill – Pink Lady House – Pink Lady Standford - Pink Lady **Peter West** Main Road Block – Pink Lady M26 / Grafted MM106 Long Row Block – Pink Lady M26 **BATLOW** **MountView Orchards** Ehmsens A – Pink Lady Ehmsens B – Pink Lady MTV 2 - Pink Lady MTV 3 – Pink Lady MTV 10 – Pink Lady

	Sample Collection (Late February 2016) Samples were collected from the selected Pink Lady blocks at Orange in the third week of February and sent to Incitec-Pivot Laboratory for testing. Matt McMahon provided use of his Nutrient Advantage account through the Batlow Fruit Co-operative so all samples could be sent to the one lab for consistency. The cost of samples were billed to NSW DPI by the Batlow Fruit Co-operative Ltd. **Laboratory Testing (March 2016)** Samples were tested and reported on by Incitec-Pivot laboratories during the month of March **Summary of Test results (March 2016)** Results from the Incitec-Pivot lab reports for all samples were then collated for interpretation. Collaborating growers were be provided with report on their block nutrient results. **Inspection of test blocks (April – May 2016)** Photos were taken and observations of tree health and fruit quality were assessed at each of the tested blocks just prior to normal harvest. **Final Report (expected June 2016)** This final report was prepared for APAL in June 2016 summarising the results obtained at both Batlow and Orange. Presentations of the results were made orchard walks in each district.

Results Summary (measurements and observations, photos, photos of control area if applicable)

a. Orange Sample Sites

b. Batlow Sample Sites

Figure 1(a&b). The Pink Lady sample blocks for Orange and Batlow Districts were located closely together on adjoining properties.

Method Details

The following is a summary of the method used in sampling and preparation.

Sample Date : Batlow 17th February 2016, Orange : 18th February 2016

Sample Method

- ≈ 100 Fully expanded mid shoot leaves on current season extension growth
- 2 Leaves per tree off 50 trees

Tested by

- All samples send by courier O/Night to Incitec Nutrient Advantage Lab

Additional Treatments

- Leaves from one site (5 blocks) at Orange were washed to remove excess residue (Surround or similar sunscreen spray)

Figure 2. Five of the seven sample sites had excessive of the sun protectant spray Surround, which needed to be washed before the samples were packaged and dispatched to the laboratory.

Figure 3. There was noticeable variation in the depth of the green colour of leaves across blocks. Possibly indicating variable nutrient levels.

Figure 4. Photographs of the sample blocks showing trees size and netting. Sample sites included one structured net block, two drape netted blocks and four un-netted.

Results

Figures 5 to 8 below show the foliar analysis results for samples collected at Orange and Batlow. Reference levels are provided for each nutrient and colour coding is used to identify test results that fall outside of the optimum range.

Figure 5. Randomised test results for Pink Lady leaf tissue samples Orange and Batlow.

District	Grower	N	P	K	Ca	Mg	Cu	Zn	Mn	B
Orange	3	1.5	0.32	1.2	2.4	0.34	3.8	33	29	27
Orange	3	1.8	0.13	1.4	1.6	0.38	3.8	21	62	21
Batlow	1	2	0.14	1.4	1.5	0.34	7.4	13	32	26
Orange	2	1.8	0.19	1.6	1.7	0.37	4.2	71	47	28
Batlow	1	1.9	0.18	1.2	1.8	0.32	6.5	9.5	20	25
Orange	3	1.9	0.16	1.1	2.1	0.39	4.1	22	64	19
Batlow	1	2	0.16	1.3	1.6	0.39	8.3	11	44	26
Orange	3	1.9	0.13	1.8	1.1	0.28	4.3	26	40	25
Batlow	1	2	0.16	1.3	1.7	0.35	7.6	11	47	27
Orange	2	1.9	0.17	1.8	1.1	0.32	5.5	81	59	30
Orange	3	1.6	0.27	1.5	2.2	0.25	3.5	17	26	27
Batlow	1	2	0.14	1.4	1.6	0.3	7.4	21	34	26

Ref Low Opt	2	0.15	1.1	1.1	0.21	6	16	25	21
Ref High Opt	2.4	0.2	1.5	2	0.4	20	50	100	60

Above Optimum
Below Optimum
Deficient

Figure 6. Test results sorted for Nitrogen (High to Low), showing that (in general), Nitrogen levels at Orange were the lowest, with some below optimum or deficient.

District	Grower	N	P	K	Ca	Mg	Cu	Zn	Mn	B
Batlow	1	2	0.14	1.4	1.5	0.34	7.4	13	32	26
Batlow	1	2	0.16	1.3	1.6	0.39	8.3	11	44	26
Batlow	1	2	0.16	1.3	1.7	0.35	7.6	11	47	27
Batlow	1	2	0.14	1.4	1.6	0.3	7.4	21	34	26
Batlow	1	1.9	0.18	1.2	1.8	0.32	6.5	9.5	20	25
Orange	3	1.9	0.16	1.1	2.1	0.39	4.1	22	64	19
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Orange	3	1.5	0.32	1.2	2.4	0.34	3.8	33	29	27

Ref Low Opt	2	0.15	1.1	1.1	0.21	6	16	25	21
Ref High Opt	2.4	0.2	1.5	2	0.4	20	50	100	60

Above Optimum
Below Optimum
Deficient

Figure 7. Test results sorted for Copper (High to Low). All blocks at Orange were unusually low in Copper.

District	Grower	N	P	K	Ca	Mg	Cu	Zn	Mn	B
Batlow	1	2	0.16	1.3	1.6	0.39	8.3	11	44	26
Batlow	1	2	0.16	1.3	1.7	0.35	7.6	11	47	27
Batlow	1	2	0.14	1.4	1.6	0.3	7.4	21	34	26
Batlow	1	2	0.14	1.4	1.5	0.34	7.4	13	32	26
Batlow	1	1.9	0.18	1.2	1.8	0.32	6.5	9.5	20	25
Orange	2	1.9	0.17	1.8	1.1	0.32	5.5	81	59	30
Orange	3	1.9	0.13	1.8	1.1	0.28	4.3	26	40	25
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Orange	3	1.9	0.16	1.1	2.1	0.39	4.1	22	64	19
Orange	3	1.8	0.13	1.4	1.6	0.38	3.8	21	62	21
Orange	3	1.5	0.32	1.2	2.4	0.34	3.8	33	29	27
Orange	3	1.6	0.27	1.5	2.2	0.25	3.5	17	26	27

Ref Low Opt	2	0.15	1.1	1.1	0.21	6	16	25	21
Ref High Opt	2.4	0.2	1.5	2	0.4	20	50	100	60

Above Optimum
Below Optimum
Deficient

Figure 8. Test results sorted for Zinc (High to Low). Orange blocks typically had higher Zinc levels than those at Batlow.

District	Grower	N	P	K	Ca	Mg	Cu	Zn	Mn	B
Orange	2	1.9	0.17	1.8	1.1	0.32	5.5	81	59	30
Orange	2	1.8	0.19	1.6	1.7	0.37	4.2	71	47	28
Orange	3	1.5	0.32	1.2	2.4	0.34	3.8	33	29	27
Orange	3	1.9	0.13	1.8	1.1	0.28	4.3	26	40	25
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Batlow	1	2	0.14	1.4	1.6	0.3	7.4	21	34	26
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Orange	3	1.6	0.27	1.5	2.2	0.25	3.5	17	26	27
Batlow	1	2	0.14	1.4	1.5	0.34	7.4	13	32	26
Batlow	1	2	0.16	1.3	1.6	0.39	8.3	11	44	26
Batlow	1	2	0.16	1.3	1.7	0.35	7.6	11	47	27
Batlow	1	1.9	0.18	1.2	1.8	0.32	6.5	9.5	20	25

Ref Low Opt	2	0.15	1.1	1.1	0.21	6	16	25	21
Ref High Opt	2.4	0.2	1.5	2	0.4	20	50	100	60

Above Optimum
Below Optimum
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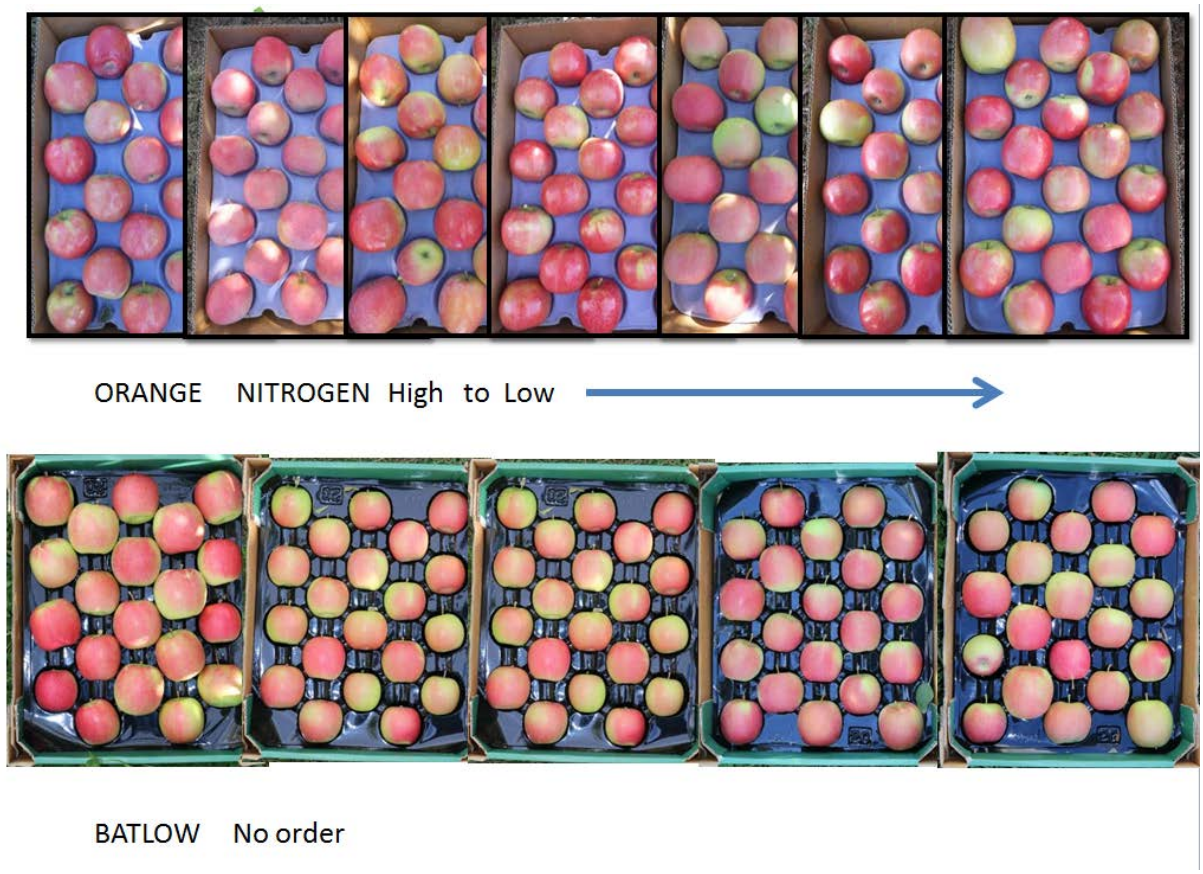
Summary of sample results

Nitrogen – N levels were generally lower at Orange than Batlow and several blocks were actually in the marginal to deficient range. A visual assessment of the fruit colour at harvest from the blocks at Orange showed no clear differences in red colour from the blocks with higher N to those which tested lower (Fig 9.)

Generally, the fruit colour from the Orange blocks may have been slightly better for overall red colour (Fig 9.) which may be an indication that higher N levels at Batlow were impacting on fruit colour. However, there are many variables effecting fruit colour so this observation cannot be made with a high degree of confidence.

Figure 9. Comparison of fruit colour at harvest across all the Pink Lady leaf sample blocks. Orange is sorted for Nitrogen level (High to Low N) from left to right. Batlow not sorted as test results were all the same.



Copper – Cu levels at Orange were consistently low to deficient compared with Batlow. This result is worthy of further investigation to determine if the low copper level is associated with low soil Cu or a lack of recent copper fungicide applications.

Zinc – when the results were sorted for Zn from high to low, the Orange blocks generally came out higher while four out of the five Batlow samples tested marginal or deficient (Fig 8). The Batlow district is known to have a history of Zinc deficiency, which is clearly not a major concern for the Orange sites in these tests.

Phosphorus – P levels varied considerably across the sample blocks, however there was no clear trend by district. Both Orange and Batlow data sets featured blocks with marginal to deficient levels of Phosphorus.

Potassium – K test results were almost all in the optimum range, with two blocks at Orange testing High.

Calcium – Ca levels also tested mostly in the adequate range across all sites except one which tested above optimum.

Magnesium – Mg levels across all samples were optimum.

Boron – B levels were optimum with the exception of one marginal result at Orange.

Implications

What did we learn?

Nitrogen levels at Orange were generally on the low side compared with Batlow. This may be due to soil type and physical characteristics, fertiliser programs or more likely a combination of both. Similarly, significant differences in Phosphorus levels across blocks and districts reinforced the importance of soil and tissue sampling by block to facilitate fine tuning of fertiliser inputs to achieve a better balance of key nutrients.

We were unable to demonstrate a clear response in fruit colour development at harvest to different levels on leaf Nitrogen in February. This may in part be due to the impact of other nutrient levels (such as below optimum Phosphorus) or another overriding factor such as climate. The 2016 harvest weather was not ideal for colour development, with warm days and nights persisting through the early to mid-harvest period at both Orange and Batlow.

The deficient Copper levels at Orange are worthy of further investigation to determine the cause of such low leaf Cu. Whilst Copper is not normally a limiting nutrient in NSW apples, in this case some supplementary copper either soil applied or as a foliar treatment may aid leaf photosynthesis and general tree health.

The results of foliar tests reported here, were also presented to growers at the June 2016 orchard walks in Orange and Batlow. The test results generated a significant amount of interest. Fortunately, our international guest for this round of walks was Tienie du Preez who has significant experience and knowledge of apple nutrition. Mr du Preez offered his comments on the trial results which are provided below.

Email Received : 12 July 2016 From : Tienie du Preez

Dear Kevin, please find my comments about the foliar analysis trials of Orange and Batlow:

· Batlow have higher N levels than Orange and I see also more colour on the Batlow fruit or am I wrong? I found in South Africa that colour is better when N is a bit higher as suggested. When N drops too low at harvest the background colour is rather yellow with only a pink blush. My suggestion however is to make sure of good bud development and fruit set for the next season by applying your soil nitrogen but when trees are yellow also follow with a Urea spray at 1.5kg/100 lit water.

· The P varies a lot but producers can be advised to check the P levels over time and where lower than 0.16% to apply a foliar MAP Technical spray 4 weeks before harvest at 500g/100 litres water to enhance colour development. On Gala the colour response is still good up to 0.18% P.

· As far as K is concerned rather aim for an optimum K content of 1.2% by end January. Some K levels are alarmingly high and can lead to internal and physiological disorders and poor shelf life. Applying K sprays for colour must be done with care as it will only enhance colour when deficient.

· For maximum CHO (carbohydrate) production I suggest to up the minimum leaf Mg level to 0.35%.

· Copper. Check why the difference between the two locations. The Orange farmers need to apply a maintenance copper spray. Copper is a very important element in the photosynthesis process and protects the chlorophyll. Normally a Copper Oxychloride spray of 100 grams product/100 litre can maintain the copper levels but if low rather do a 150g/100 litre. (Cu-O-Cl 80% Cu). If before harvest remember the withholding period. The green tip fungicide Copper spray will also maintain the copper levels.

· Zinc is low according to my experience but I do not know your russet situation. In South Africa we also had the russet problem with Zn but that was long ago when Zn-Oxy-Sulphate or not good ZnO was used. With Zintrac we have no problem and my trials actually showed less russet (although not statistical) with Zn sprays. My program is 30ml Zintrac at green tip followed by 3 sprays of 50 cc Zintrac per 100 liter water every 14 days from 21 days after petal drop to mid December. I normally add Boron with the three sprays.

· Target 35-45 ppm B at end Jan as optimum B. I believe your B levels are slightly low. Solubor or similar is a good product to use. In your scenario I would use Solubor (21%B) at 120 g/100 lit at 30-90% flowering followed by three B sprays together with the Zn sprays above at 75g/100 litre. If still too little we can raise the dosage to 100g/100 lit. Based on the leaf analysis B can also be applied in Autumn before harvest at 100-150g/100 lit.

Hope you find this helpful. Kind Regards. Tienie

How will this impact on the business and what will change?

This trial has reinforced the importance of regular nutrient testing to inform grower's decision making in relation to orchard nutrition and fertiliser needs. This information can be used by remind growers of the value of nutrient monitoring in NSW apple orchards.

Although the trial did not enable us to make strong conclusions regarding nutrient levels and fruit quality attributes such as fruit colour, there are some important insights about certain nutrients at both Orange and Batlow that will be worth following in future tests.

Generally low nitrogen at Orange flags the need for more attention to this nutrient, whilst highly variable Phosphorus levels should lead growers to look more closely at the fine tuning of this major nutrient.

The cause of low Copper level at Orange should be investigated further via some additional foliar tests and some soil testing to determine the cause of the low levels. Growers will be encouraged to consider application of foliar copper to correct potentially limiting low levels of copper.

What are the road blocks/obstacles to change?

This trial has clearly demonstrated the variable nutrient levels across pink lady blocks and growing regions. This reinforces the need for good nutrient monitoring to inform fertiliser programs.

The ability of growers to adopt regular nutrient testing is only limited by their level of willingness to engage with a consultant or fertiliser expert in their region.