Making the most of post-harvest time in almonds

Post-harvest is one of the most important times of the year for crop nutrition in almonds, setting the trees up for overall health and better productivity. Almond growers and their advisers are encouraged to make the most of this opportunity by using soil and plant tissue test results to ensure adequate and balanced nutrition.

What is at stake?

Tree health and vitality is essential to the ongoing viability of the orchard. Healthy trees are better able to combat any stress they may encounter, such as extreme temperatures, water or radiation stress, or insect and disease pressures.

An adequate and balanced post-harvest fertiliser program gives trees a good start when it comes to the next crop. It promotes stronger root growth, rebuilds carbohydrates, provides energy to transfer and store nutrients and encourages strong flower set and leaf development.

Strengthening the trees will have a flow on effect when it comes to nut quality, size and yield. The longer the tree's nutrient status remains at the low end or below the optimal range, especially during stages critical to yield, the greater the negative effects on yield, nut size, quality and the following season's bloom.[1]

Nutrient requirements

The nutrients most likely to be needed in post-harvest fertiliser programs for almonds are nitrogen (N), phosphorus (P), potassium (K), zinc (Zn) and boron (B). However, plant nutrition involves 16 elements, any of which could be the key to improved performance. Other soil chemical conditions, such as pH or salinity, could be interacting with nutrition and may need attention. Soil testing is a good place to start.

Unfortunately, many post-harvest fertiliser programs are based on general industry knowledge or set rates for the district. Sometimes they are simply a repeat of last year's program.

The best way to calculate post-harvest fertiliser application rates is by assessing the crop's nutrient removal, as well as the nutrients present in the soil and their level of availability to the trees. This will help ensure fertilisers are not being under or over applied. *Table 1* gives an indication of nutrient removal from three different almond orchard examples as a guide.

Table 1: 2007/08 and 2008/09 Nonpareil whole fruit nutrient removal (kg/ha)

Non Pareil	Kernel yield (kg/ha)	Water (ML/ha)	N	P
Site 1	2,625	9.37	145.8	20.1
Site 2	4,510	16.09	266.3	33.7
Site 3	3,977	10.87	247.6	29.3

Non Pareil	K	S	Ca	Mg	Na
Site 1	179.9	5.4	17.6	12.7	7.0
Site 2	340	10.5	23.8	20.6	1.6
Site 3	231.5	9.4	20.6	16.4	1.6

Non Pareil	Cl	Zn	Mn	Cu	B
Site 1	15.8	0.3	0.2	0.1	0.4
Site 2	10.2	0.4	0.3	0.1	0.7
Site 3	14.2	0.3	0.5	0.1	0.4

Source: All About Almonds, fact sheet 08 – Crop Nutrient Removal, published by the Almond Board of Australia

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Using soil tests

Figures 1 and 2 show soil test results from samples taken at a commercial almond orchard near Renmark in South Australia in March this year. Separate soil tests were taken in a three-year-old and twenty-year-old Monterey almond tree crops and analysed by the Nutrient Advantage® laboratory.

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SOIL ANALYSIS REPORT

Grower Name:	**Paddock Name:**	ALMOND	**Sample Name:** ALMOND 20 Y
Sample Number:	**Test code:**	E13	**Sampling Date:** 20/03/2020

Analyte	Unit	Value	Optimum	Low	Adequate	High
SOIL						
Soil Colour		Brown				
Soil Texture		Clay				
Organic Carbon (W&B)	%	1.1	>1.2			
ACIDITY						
pH (1:5 Water)		6.0				
pH (1:5 CaCl2)		5.7	5 - 6.5	Mildly Acidic		
Aluminium (KCl)	cmol(+)/kg	<0.1				
Aluminium (KCl)	mg/kg	<9.0				
Aluminium % of Cations	%	<1.0	<5%			
SALINITY						
Electrical Conductivity (1:5 water)	dS/m	0.60	<0.21			
Electrical Conductivity (Sat. Ext.)	dS/m	3.7				
Chloride	mg/kg	210	<300			
Sodium (Amm-acet.)	cmol(+)/kg	0.52	<25			
STRUCTURE						
Calcium % of Cations	%	64.0	55-80%			
Magnesium % of Cations	%	16.0	6-25%			
Sodium % of Cations (ESP)	%	3.10	<6%			
Potassium % of Cations	%	16.00				
Calcium/Magnesium Ratio		3.9	2 - 6			
ELEMENTS						
Nitrate Nitrogen	mg/kg	160	12-25			
Ammonium Nitrogen	mg/kg	5				
Phosphorus (Colwell)	mg/kg	110	40-70			
Sulphur (KCl40)	mg/kg	120	4-15			
Calcium (Amm-acet.)	cmol(+)/kg	11.0				
Magnesium (Amm-acet.)	cmol(+)/kg	2.8				
Potassium (Amm-acet.)	cmol(+)/kg	2.80	.26-.4meq			
Available Potassium	mg/kg	1,100	60-160			
Zinc (DTPA)	mg/kg	7.70	0.8-5			

Analyte	Unit	Value	Optimum	Low	Adequate	High
Copper (DTPA)	mg/kg	13.00	0.3-5			
Iron (DTPA)	mg/kg	46.0				
Manganese (DTPA)	mg/kg	27.0	2-25			
Boron (Hot CaCl2)	mg/kg	2.7	0.54-15			
Silicon (CaCl2)	mg/kg	99.0				
ADDITIONAL						
Phosphorus Buffer Index		68		Low		
Cation Exch. Cap. (CEC)	cmol(+)/kg	17.1				

Figure 1: Soil test result from 20-year-old almond trees, Renmark, South Australia, March 2020. Analysed by Nutrient Advantage laboratory.

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SOIL ANALYSIS REPORT

Grower Name:	**Paddock Name:**	ALMOND	**Sample Name:** ALMOND 3 Y
Sample Number:	**Test code:**	E13	**Sampling Date:** 20/03/2020

Analyte	Unit	Value	Optimum	Low	Adequate	High
SOIL						
Soil Colour		Red				
Soil Texture		Sand				
Organic Carbon (W&B)	%	0.3	>0.5			
ACIDITY						
pH (1:5 Water)		6.7				
pH (1:5 CaCl2)		6.1	5 - 6.5	Neutral		
Aluminium (KCl)	cmol(+)/kg	<0.1				
Aluminium % of Cations	%	<1.0	<5%			
SALINITY						
Electrical Conductivity (1:5 water)	dS/m	0.08	<0.1			
Electrical Conductivity (Sat. Ext.)	dS/m	1.0				
Chloride	mg/kg	29	<300			
Sodium (Amm-acet.)	cmol(+)/kg	0.09				
STRUCTURE						
Calcium % of Cations	%	62.0	55-80%			
Magnesium % of Cations	%	23.0	6-25%			
Sodium % of Cations (ESP)	%	2.40	<6%			
Potassium % of Cations	%	13.00				
Calcium/Magnesium Ratio		2.7	2 - 6			
ELEMENTS						
Nitrate Nitrogen	mg/kg	11	12-25			
Ammonium Nitrogen	mg/kg	4				
Phosphorus (Colwell)	mg/kg	45	20-40			
Sulphur (KCl40)	mg/kg	7	4-15			
Calcium (Amm-acet.)	cmol(+)/kg	2.2				
Magnesium (Amm-acet.)	cmol(+)/kg	0.8				
Potassium (Amm-acet.)	cmol(+)/kg	0.46	.13-.25meq			
Available Potassium	mg/kg	180	50-100			
Zinc (DTPA)	mg/kg	0.58	0.8-5			
Copper (DTPA)	mg/kg	0.37	0.3-5			

Analyte	Unit	Value	Optimum	Low	Adequate	High
Iron (DTPA)	mg/kg	17.0				
Manganese (DTPA)	mg/kg	7.9	2-25			
Boron (Hot CaCl2)	mg/kg	0.4	0.54-15			
Silicon (CaCl2)	mg/kg	23.0				
ADDITIONAL						
Phosphorus Buffer Index		14		Very Low		
Cation Exch. Cap. (CEC)	cmol(+)/kg	3.6				

Figure 2: Soil test result from 3-year-old almond trees, Renmark, South Australia, March 2020. Analysed by Nutrient Advantage laboratory.

In the 20-year-old orchard, the sodium (Na) levels in the soil are at the higher end. This is most likely due to fertiliser choice. Banding gypsum and flushing the soil with good quality water would help mitigate this problem, as well as selecting different fertilisers. Nitrate nitrogen (NO3-), sulphur (S), potassium (K) and copper (Cu) are high.

Potassium and nitrate are likely to be high due to fertiliser choice. The high Cu levels may be high due to fungicide use. Organic carbon levels are low. If possible, organic matter should be incorporated into the soil. The fertiliser choice should be a straight N, not KNO_3^-, because there is already plenty of K in the soil. Calcium (Ca), boron (B) and zinc (Zn) should also be applied.

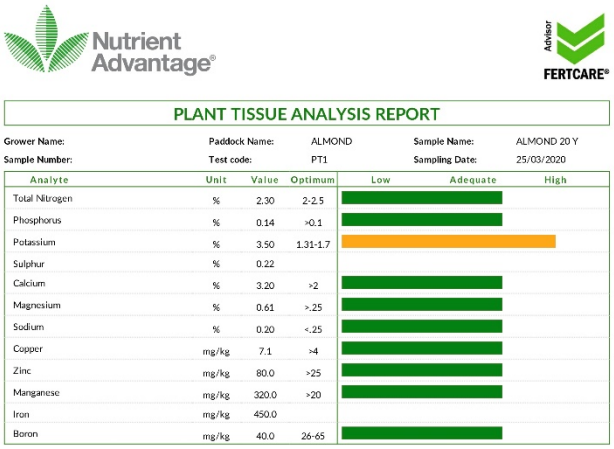
For the 3-year-old trees, the soil test results show Zn and B levels are low. Zn and B should be applied now and in early spring. The K is above the optimum range. Organic carbon levels are low. If possible, incorporation of organic matter would be beneficial. When reviewing this together with the tissue test results, K is clearly high and NO_3^- is low. The numbers show there is a need to rethink fertiliser choice and move to a straight N product for the coming season.

Using tissue tests

It is a good idea to back up soil testing results with a plant tissue analysis, particularly for the micro-nutrients. Plant tissue testing shows the nutrient uptake by the trees and can act as an early warning system, to highlight any nutrients that may be lower or higher than the optimal or normal range or which may affect nut yield potential and/or quality.

Just because a nutrient is available in the soil does not mean it is being taken up by the tree. Nutrient uptake may be limited by other factors such as temperature, humidity, soil moisture or disease. With results from both soil and plant tissue tests on hand, growers and advisers have the best possible information to determine the right post-harvest nutrition program for the crop.

Figures 3 and 4 show the results from a tissue test taken at the same orchards in Renmark in March 2020. In both paddocks, K is high in the tissue test results, backing up the soil test results. In the three-year-old trees, zinc levels are low, confirming the need to apply zinc now.



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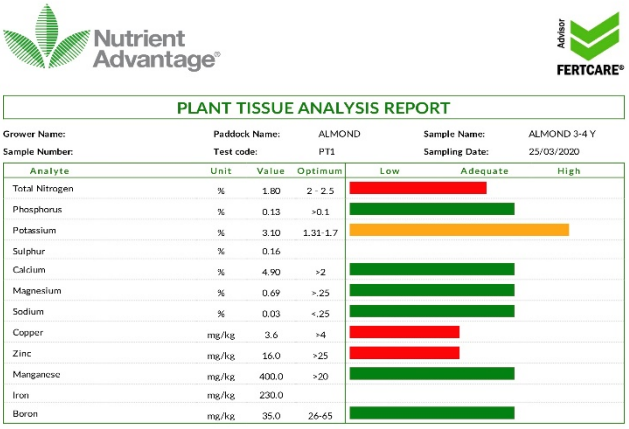
PLANT TISSUE ANALYSIS REPORT

Grower Name:	Paddock Name:	ALMOND	Sample Name: ALMOND 20 Y
Sample Number:	Test code:	PT1	Sampling Date: 25/03/2020

Analyte	Unit	Value	Optimum	Low	Adequate	High
Total Nitrogen	%	2.30	2-2.5			
Phosphorus	%	0.14	>0.1			
Potassium	%	3.50	1.31-1.7			
Sulphur	%	0.22				
Calcium	%	3.20	>2			
Magnesium	%	0.61	>.25			
Sodium	%	0.20	<.25			
Copper	mg/kg	7.1	>4			
Zinc	mg/kg	80.0	>25			
Manganese	mg/kg	320.0	>20			
Iron	mg/kg	450.0				
Boron	mg/kg	40.0	26-65			

Figure 3: Plant tissue test result from 20-year-old almond trees, Renmark, South Australia, March 2020. Analysed by Nutrient Advantage laboratory



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PLANT TISSUE ANALYSIS REPORT

Grower Name:	Paddock Name:	ALMOND	Sample Name: ALMOND 3-4 Y
Sample Number:	Test code:	PT1	Sampling Date: 25/03/2020

Analyte	Unit	Value	Optimum	Low	Adequate	High
Total Nitrogen	%	1.80	2 - 2.5			
Phosphorus	%	0.13	>0.1			
Potassium	%	3.10	1.31-1.7			
Sulphur	%	0.16				
Calcium	%	4.90	>2			
Magnesium	%	0.69	>.25			
Sodium	%	0.03	<.25			
Copper	mg/kg	3.6	>4			
Zinc	mg/kg	16.0	>25			
Manganese	mg/kg	400.0	>20			
Iron	mg/kg	230.0				
Boron	mg/kg	35.0	26-65			

Figure 4: Plant tissue test result from 3-year-old almond trees, Renmark, South Australia, March 2020. Analysed by Nutrient Advantage laboratory.

It is important to use a credible and accredited laboratory for all soil and plant tissue testing. The Nutrient Advantage laboratory is major provider of soil, plant and water analysis and is externally accredited by the National Association of Testing Authorities (NATA) and Fertcare®. It also participates in the Australasian Soil and Plant Analysis Council's (ASPAC) proficiency program.

Fertiliser programs

Growers will almost always apply nitrogen in their post-harvest fertiliser application. Nitrogen can be applied alone, using EASY N® liquid fertiliser for example, or with other nutrients, such as Ca, K or phosphorus (P).

Phosphorus is required for the effective uptake of all other nutrients. It is necessary for strong root development and growth and is an important energy source for the tree as it emerges from dormancy in spring. Phosphorus also assists in improving drought resistance and cold tolerance and contributes to disease resistance. Given that phosphorus plays such an important role, it is important to get P rates right post-harvest. Monitoring your soil levels each year will help determine how much P is being used by the orchard and how much needs to be replaced.

Fertiliser products for post-harvest phosphorus applications include superphosphate, MAP or DAP. For established orchards, an inter-row broadcast application could be used. In younger orchards, the fertiliser is better applied in bands under the trees where it is accessible to the tree roots.

Potassium is important for helping plants move and store energy, regulate water loss, grow, flower and fruit. Almonds are particularly K hungry crops. UC Davis and UCCE research found that inadequate K decreased yields by increasing spur death and decreasing the percent of spurs that had flowers, and thus set nuts.

While many growers apply potassium along with their nitrogen fertiliser, rates for potassium should ideally be determined by calculating crop removal and using soil and tissue testing. For example, in the soil and tissue test results from the orchards in Renmark, soil K levels were already high, therefore K fertiliser application rates could be reduced. Fertiliser products for post-harvest applications include Muriate of Potash or Sulphate of Potash.

Only small amounts of Zn or B are needed with the fertiliser, but they are just as important as any other nutrients. Zinc can help trees with a strong, uniform bud burst, nut set and retention and producing nuts of a good size. Boron promotes flowering and aids in the development of pollen tubules. It also helps with cell growth, the regulation of plant hormones and the translocation of Ca.

Fertiliser blends can be developed to supply the appropriate nutrient mix to suit your tree crop's requirements. There are thousands of fertiliser blends available from Incitec Pivot Fertilisers' custom blending service.

For more information on making the most of post-harvest fertiliser programs, please contact me on 0466 664 026 or conrad.leeks@incitecpivot.com.au

References

'Fertilization of Perennial Tree Crops: Timing is everything!' C. Lovatt University of California-Riverside (2009)

'Role of potassium in fruit crops – a review' A. Ramesh Kumar, N. Kumar and M. Kavino (2006) Agric. Rev. 27 (4) : 284-291

'Influence of elevating tree potassium on fruit drop and yield of pecan' Bruce Wood, Lenny Wells and Frank Funderburke (2010) American Society of Horticultural Science, Volume 45, Issue 6

'Potassium management for sustained almond yields' Katherine Jarvis-Shean, UCCE Orchard Adviser, published by Sacramento Valley Orchard Source

http://www.sacvalleyorchards.com/almonds/horticulture/potassium-management-for-sustained-almond-yields/