

New tissue nutrient reference levels for Victorian day-neutral strawberries cv. “Albion”

New leaf tissue reference levels for Albion strawberries have been established from a three-year study of commercial strawberry farms in Victoria. Currently available foliar nutrient reference levels for strawberry growers in Australia exist but are based on old overseas data and are a composite of both blade only and blade plus petiole data.

Local data was generated from 8–12 representative commercial strawberry crops, sampled 4–5 times over three growing seasons (2013–14, 2014–15 and 2015–16) – all field-grown, first year Albion plantings.

Californian data is based on a larger data set: two seasons of data from 53 different first-year Albion blocks, each sampled five times during the season.

The main difference between local and Californian reference values is that local values are based on sample averages, while Californian values are based on adjusted (DRIS method) nutrient levels from the higher yielding crops only. Despite this differing methodology, local average values correspond well with these recent Californian reference values.



Figure 1. Generalised leaf sampling pattern for project strawberry fields.

More detailed information on these reference levels and how they compare with other global references can be found in HIA Report BS12010.

The tables in this fact sheet allow growers to review their test results based on either leaf sampling method, show both local and USA reference values.

The micronutrient levels reflect local leaf tissue levels in Victoria, and the tolerance range may be wider. You are referred to the Reuter and Robinson data for micronutrient tolerance ranges.

How to collect samples

Samples can be collected at any time but those taken earlier in the season, ideally after first harvest but before peak harvest, are likely to be most useful by allowing growers to make any necessary adjustments early.

Use disposable gloves or clean, washed hands to collect 30–40 leaves into paper sample bags and refrigerate overnight if samples cannot be dispatched same day.

Leaf selection is based on taking the youngest mature leaf or fully expanded leaf (YML), although in a well developed canopy there are usually several suitable leaves on each plant.

Leaves should NOT be taken from unhealthy looking plants or those of less than average vigour in that part of the field. Physically damaged leaves should also be avoided.

Early in the season, the youngest mature leaves are usually the larger leaves but later, and after full canopy closure the youngest mature leaves are the healthy leaves at the top of the canopy of at least average size or larger.

Aim for larger, healthy, fully expanded leaves. Avoid sampling within several days of spraying nutrients or other chemicals. Leaves with clearly visible spray residues should not be sampled.

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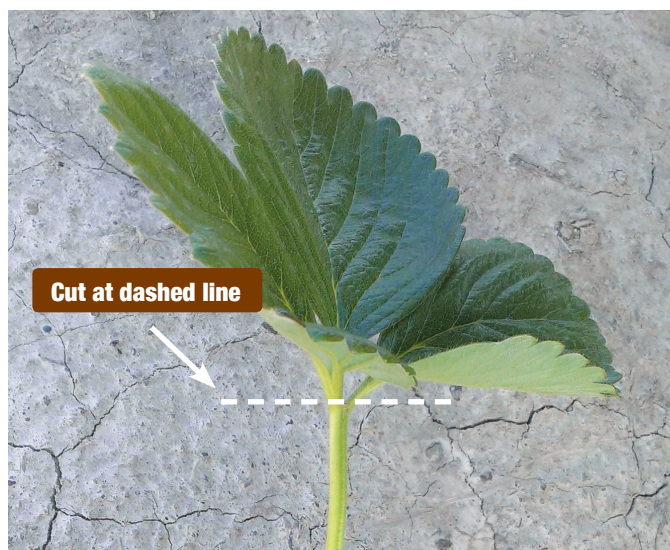


Photo 1: Preferred method for leaf sampling – blade only

Recent studies in the USA recommend taking blades-only leaf samples. This is the preferred method for collection in future for local samples as well. Petioles increase in size over the season and this can alter the proportions of nutrients in blades and petioles. For blade-only samples, cut immediately below the junction of the trifoliate leaf blade (photo 1).

For blade+petiole samples, the target point to cut leaves is close to the crown where the stipule meets the petiole.

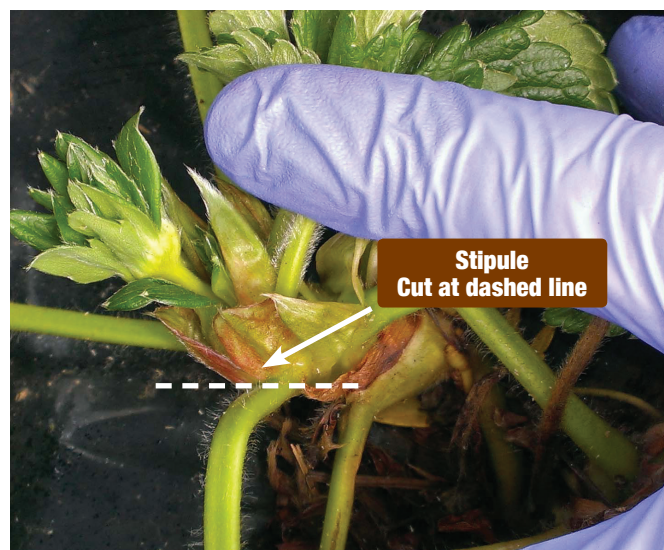


Photo 2: Older method for leaf sampling – blade+petiole

Lay the flat side of a clean, sharp knife blade against the crown. This will generally cut the petiole near this point (photo 2).

Leaves should be sampled in a roughly trapezoidal pattern, to cover a representative area of the field, avoiding plants in the outermost row or last couple of metres around the edge, sampling about 8–10 plants at roughly even intervals along each of the sides of the trapezium, as detailed in Figure 1.

Key messages for Victorian Albion growers

- Blade rather than blade+petiole testing is currently the preferred method for strawberry tissue testing
- Sampling earlier is generally more useful than sampling later in the season
- Tissue nitrogen levels are comparable with Californian reference values
- Tissue potassium levels are comparable to higher than average Californian reference values
- Tissue phosphorus levels are similar to some older reference values but slightly below Californian values; this may simply be related to the very high phosphorus buffering index of many Victorian soils (particularly the red soils or ferrosols); however, there is some evidence growers may benefit from increasing soil phosphorus levels to achieve tissue levels above 0.30% (blade only)
- Micronutrient requirements are difficult to accurately predict from these types of surveys; while many Victorian average values are similar to those in California, the Californian values may be a better reference for minimum values; recommended minimum values for copper in most established standards is 3–5 mg/kg.

Leaf blade nutrient reference values for southern Victorian strawberries cv. “Albion” (youngest mature leaf blade).

NUTRIENT	CROP STAGE				
	Pre-harvest	Early harvest	Peak harvest	Summer low harvest	Autumn harvest
Nitrogen (%)	3.4-3.9	2.7-3.5	2.2-3.0	2.2-2.9	2.1-2.9
Phosphorus (%)	0.30-0.54	0.23-0.35			
Potassium (%)	1.8-2.1	1.5-2.0			
Sulphur (%)	0.21-0.30	0.16-0.21			
Calcium (%)	0.7-0.9	0.9-1.3	1.2-1.7	1.3-1.8	1.4-1.9
Magnesium (%)	0.32-0.39	0.33-0.44			
Manganese (mg/kg)	Use existing references*				
Iron (mg/kg)	70-307	84-182			
Copper (mg/kg)	3.0-6.5	2.6-6.0			
Zinc (mg/kg)	12-30	10-29			
Molybdenum (mg/kg)	0.7-1.2	0.5-1.2			
Boron (mg/kg)	28-36	30-60			

Leaf blade + petiole reference values for southern Victorian strawberries cv. “Albion” (youngest mature leaf blade plus petiole).

NUTRIENT	CROP STAGE				
	Pre-harvest	Early harvest	Peak harvest	Summer low harvest	Autumn harvest
Nitrogen (%)	3.1-3.6	2.4-3.1	1.9-2.7	1.9-2.5	1.7-2.4
Phosphorus (%)	0.28-0.50	0.21-0.32			
Potassium (%)	2.0-2.4	1.6-2.2			
Sulphur (%)	0.19-0.27	0.13-0.18			
Calcium (%)	0.7-0.9	0.9-1.3	1.2-1.7	1.3-1.8	1.4-1.9
Magnesium (%)	0.34-0.42	0.33-0.44			
Manganese (mg/kg)	Use existing references*				
Iron (mg/kg)	67-293	75-161			
Copper (mg/kg)	2.8-6.2	2.5-5.8			
Zinc (mg/kg)	12-30	10-28			
Molybdenum (mg/kg)	0.6-1.1	0.5-1.0			
Boron (mg/kg)	27-35	28-54			

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How the new Victorian reference values for strawberry leaf samples compare to other references sources

SOURCE	HIA PROJECT BS12010 – AHR (2016)		HARTZ ET AL. (2012) DRIS OPTIMUM RANGE		HOCHMUTH & ALBREGTS (2003)		REUTER & ROBINSON, CSIRO (1996)	
LOCATION	Southern Victoria		California		Florida			
PLANT TYPE	Day neutral		Day neutral					
VARIETY	Albion		Albion					
PART SAMPLED	Blade		Blade		Blade+Petiole		Blade+/-Petiole	
SAMPLE TIMING	Pre-harvest	Harvest	Pre-harvest	Harvest	Main Harvest	Initial Harvest	Optimum	Deficient
Nitrogen (%)	3.4-3.9	2.2-3.2	3.1-3.8	2.4-3.0	3.0-3.5	2.8-3.0	2.0-2.5	
Phosphorus (%)	0.30-0.54*	0.23-0.35*	0.50-0.90	0.30-0.40	0.20-0.40	0.20-0.40	0.30-0.50	<0.1
Potassium (%)	1.8-2.1	1.5-2.0	1.8-2.2	1.3-1.8	1.5-2.5	1.1-2.5	2.0-3.0	<1.0
Sulphur (%)	0.21-0.30	0.16-0.21	0.19-0.23	0.15-0.21	0.25-0.80	0.25-0.80	0.10-0.20	<0.1
Calcium (%)	0.7-0.9	1.1-1.7	0.6-1.3	1.0-2.2	0.4-1.5	0.4-1.5	1.5-2.0	<0.3
Magnesium (%)	0.32-0.39	0.33-0.44	0.33-0.45	0.28-0.42	0.25-0.50	0.20-0.40	0.40-0.60	<0.2
Manganese (mg/kg)	Use existing references*		75-600	65-320	30-100	25	50-350	<30
Iron (mg/kg)	70-307	84-182	70-140	85-200	50-100	50	50-150	<50
Copper (mg/kg)	3.0-6.5	2.6-6.0	3.3-5.8	2.6-4.9	5-10	5	5-10	<3
Zinc (mg/kg)	12-30	10-29	13-28	11-20	20-40	20	30-50	<20
Molybdenum (mg/kg)	0.7-1.2*	0.5-1.2*				0.5	>0.5	<0.5
Boron (mg/kg)	28-36	30-60	31-46	40-70	20-40	20	25-50	<25

*Notes

- Victorian range values are based on +/- 1.0xSTDEV
- Molybdenum figures are 0.5xSTDEV. There is little recent data on molybdenum
- Victorian Manganese average is highly skewed by a some very high values; at the same time, a small number of samples were borderline-deficient by existing standards, although local figures are generally similar to USA; growers should use existing (Non-Victorian) reference ranges for manganese
- Local phosphorus values are slightly low by current USA standards; growers should aim to achieve a minimum value of 0.30%.

References Hartz, T. 2012. Strawberry Plant Sufficiency Levels Revised. 5 Mar 2012. <http://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=6958> Hochmuth, G. and E. Albregts. 2003. Fertilization of strawberries in Florida. IFAS Publ. CIR1141, <http://edis.ifas.ufl.edu/cv003> Reuter, D. & Robinson, J. 1996. Plant Analysis – An Interpretation Manual: 376-377.

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