

Macadamia (*Macadamia ternifolia* F.V. Muell.)

French: Macadamia; Spanish: Macadamia; Italian: Macadamia; German: Macadamia

Crop data

Perennial evergreen. Harvested part: fruits; nuts dehulled after harvest.

Transplanted in winter.

Flowers 4-5 years after transplanting.

Harvested about 7 1/2 months after flowering.

Plant density: Hawaii, 88-120 trees/ha; Australia, 182-212 trees/ha. In Hawaii, macadamia is largely grown in rockland of aa lava. Outside Hawaii, light soils are preferred as trees become chlorotic in heavier soils. Preferably pH is 5.5 - 6.5, but grows well up to pH 8.

Subtropical in its native range, but can be grown in tropical to cool subtropical climates. Irrigated in California (USA) and sometimes in Australia, but generally not in other tropical areas. Hawaii is the principal producer but production is increasing in South Africa, Guatemala, and Australia.

Nutrient demand/uptake/removal

Nutrient removal					
Source	g/45 kg yield of fruit				
	N	P ₂ O ₅	K ₂ O	MgO	CaO
Cooil et al, 1958	183	38	182	17	14

Plant analysis data

Plant analysis data - Macronutrients								
Plant part	Stage of growth	Source	% of dry matter					
			N	P	K	Mg	Ca	S
Leaf	current flush	Fox et al, 1976	0.9 (D) 1.5 (OS)	0.12 (OS)	0.84 (OS)	0.10 (OS)	0.40 (OS)	0.06 (D) 0.15 (OS)
Leaf	first flush	Fox et al, 1976	0.6 (D) 1.5 (OS)					0.08 (D) 0.20 (OS)
Leaf	oldest leaves	Fox et al, 1976	0.7 (D) 1.5 (OS)					0.10 (D) 0.25 (OS)
Leaf	current flush	Hue et al, 1988		0.12 (OS)				
Leaf	fully mature	Cooil et al, 1956	1.5 (OS)	0.06 (OS)	0.60 (OS)			
Leaf	fully mature	Cooil et al, 1966		0.10 (CVY)				
Leaf	fully mature	Hirae & Nagao, 1989		0.06 (D) 0.08 (OS)				
Leaf	fully mature	Stephenson & Cull, 1986	1.4 (OS)		0.60 (OS)			0.18 (OS)
Leaf	fully mature	Warner & Fox, 1972						0.02 (D) 0.24

								(OS)
D = Deficiency; OS = Optimum supply; CVY = Critical value (yield)								

Plant analysis data - Micronutrients							
Plant part	Stage of growth	Source	ppm dry matter				
			Fe	Mn	Cu	Zn	B
Leaf	4 months old	Labanauskas & Handy, 1970	10 (D)	3 (D)			
Leaf	current flush	Fox et al, 1976		141 (OS)		20 (OS)	
Leaf	fully mature	Stephenson & Cull, 1986					40 (OS)
Leaf	fully mature	Warner & Fox, 1972		100 (OS)	4.5 (OS)	15 (OS)	75 (OS)

D = Deficiency; OS = Optimum supply

Macadamia growth is near maximum when leaf N:S ratio is 9:1 to 14:1. High P (about 0.10 % leaf P) may induce chlorosis and yield reduction. Low leaf Fe:Mn ratio (below 1,2:1), induced by the high P, causes the chlorosis.

Fertilizer recommendations

Most macadamia orchards are grown in sod culture and so fertilizer is not incorporated in the soil except before planting. When applied before planting, superphosphate, lime, Cu and Zn are incorporated according to the results of soil testing (Australia). After transplanting, fertilizer needs are determined by leaf (6-7 month-old leaves sampled at beginning of spring flush) and soil analysis.

If necessary, the soil pH needs to be raised to pH 5.5 to 6.5 by liming, calcitic or dolomitic depending on Mg need.

The mineral fertilizer for macadamia is a basal NPK with or without supplementary N. Applications are split.

Preferred nutrient forms

In Hawaii, N is preferably applied as ammonium sulphate, P as single or triple superphosphate and K as sulphate; in Australia, N is applied as urea or ammonium nitrate, P as superphosphate and K as muriate or sulphate.

Present fertilizer practices

Hawaii (“ aa lava ” soil)

For trees up to 7.5 cm trunk diameter: basal dressing of 8.4 g N/cm diameter, 16.0 g P₂O₅/cm diameter and 23.0 g K₂O/cm diameter, applied January and July, and additionally 8.0 g N/cm diameter, applied April and October.

As trees increase in diameter, adjustments may have to be made according to leaf analysis.

Australia

Application is based on a standard quantity per tree to be multiplied by the tree age in years (up to 10). At year 10, the maximum application is reached and becomes the set application for older trees, except that, after thinning, the rate is increased proportionally with each metre

increase in spacing between trees (assumed to be 5 m at 10 years). Further adjustments may be necessary according to leaf analysis.

The standard quantity is 69 g N, 10 g P₂O₅ and 48 g K₂O per tree. In years 1 to 5, N and K are applied one-fifth each in February, April, July, October, and December. For trees 6 years and older, N is applied one-half in February, one-quarter each in April and October. P is supplied in a single application in March/April, and K one-third each in February, April and October.

When needed, foliar sprays of copper (6 g CuCl₂ · 3CuO/liter) and Zinc (1 g ZnSO₄/liter) are given once or twice per year.

Further reading

COOIL, B.J.; NAKATA, S.; AWADA, M.: Nutrient requirements of Macadamia varieties. Hawaii Farm Sci. 5(2):2-3, Hawaii, USA (1956)

FOX, R.L.; OKAZAKI, E.; CHANG, M.A.: Mineral nutrition of macadamia. I. External and internal nitrogen and sulphur requirements of seedling. Trop. Agric. (Trinidad). 53:231-241 (1976)

HIRAE, H.H.; NAGAO, M.A.: Involvement of nutrient deficiencies in macadamia dieback. California Macadamia Soc. Yearbook. 35:89-90 (1989)

HUE, N.V.; FOX, R.L.; McCALL, W.W.: Chlorosis in Macadamia as affected by phosphate fertilization and soil properties. J. Plant Nutr. 11:161-173 (1988)

STEPHENSON, R.A.; CULL, B.W.: Standard leaf levels for bearing macadamia trees in Southeast Queensland. Sci. Hort. 30:73-82 (1986)

WARNER, R.M.; FOX, R.L.: Concentration and distribution of S, Mg, and five micronutrients in macadamia in relation to yields. Proc. Hawaii Macadamia Producers Assn. 12:26-37 (1972)

Author: D. Sparks, College of Agriculture, The University of Georgia, Athens, USA