Macadamia integrifolia

Maiden et Betche

Proteaceae

LOCAL NAMES
English (smooth macadamia nut,Queensland nut,macadamia nut,Australian bush nut)

BOTANIC DESCRIPTION
Macadamia integrifolia is a large, spreading, evergreen tree attaining a height of 18 m and a crown of 15 m.

Leaves in whorls of 3, oblong to oblanceolate, 10-30 x 2-4 cm, glabrous, coriaceous, irregularly spiny-dentate when young, entire in later stages; petiole 5-15 mm long; 3 buds arranged longitudinally in the axil of each leaf usually only the top bud shoots out, making a sharply acute angle with the trunk.

Racemes axillary on mature new growth or on leafless older shoot, pendulous, 10-30 cm long, with 100-500 flowers; flowers in groups of 2-4, about 12 mm long, creamy-white; pedicles 3-4 mm long; perianth tubular with 4 petaloid sepals.

Fruit a globose follicle, 2.5-4 cm in diameter; pericarp fibrous, about 3 mm thick. Seed (nut) usually 1, globular, with a smooth, hard, thick (2-5 mm) testa enclosing the edible kernel.

The genus is named after J. Macadam (1827-1865), secretary of the philosophical Institute of Victoria. The specific name integrifolia is from the Latin integri-'entire' and folium-'a leaf' in allusion to the grouping of leaves in whorls of four.

BIOLOGY
Floral initiation takes place when temperatures drop and trees become quiescent in autumn, the optimum temperature being 18 deg. C. The initials remain dormant for 50-96 days; the racemes extend after a rise in temperature and some rain. In Australia high yields are associated with a strong and early spring flush before anthesis, followed by minimal shoot growth throughout the 6-month nut development period. At the end of nut development, there is a late summer flush; meanwhile nuts may be retained on the tree for a further 3 months, but gradually they fall.

The flowers are protandrous, the anthers dehiscing 1-2 days before anthesis, whereas the stigma does not support pollen tube growth until 1-2 days after anthesis.

Pollination is by insects; most cultivars are at least partly self-incompatible. Planting pollinator trees and introducing bees are important for good fruit set. Fruitlets continue to be shed up to 2 months after bloom.

Flowers and foliage (Fagg, M. ANBG Photo No.: a.9845)

Goats are used to graze under macadamia nut trees where they control weeds without doing much damage to the trees or the hard nuts which fall to the ground when mature. (Craig Elevitch)

(Craig Elevitch)

ECOLOGY

M. integrifolia prefers well-drained soils, shelter from winds and a mild, frost-free, subtropical climate with well-distributed annual rainfall of at least 1 200 mm. It occurs naturally in the fringes of subtropical rainforests. It appears to tolerate only a narrow range of temperatures (optimum during the growing season is 25 deg. C). Temperature is the major climatic variable determining growth and productivity. Trees in Southeast Asia grow fairly well but flower and fruit sporadically throughout the year. In eastern Africa, orchards are planted at elevations of 1 000-1 600 m in areas with a prominently seasonal climate, leading to a synchronous resumption of growth and flowering over a cool, overcast season. Abnormal tree growth, low yield and poor nut quality have been noted in Africa at higher altitudes with little sunshine during the flowering and fruiting season.

The xerophytic characteristics of the tree, including the sclerophyllous leaves and proteoid roots (dense clusters of rootlets formed to explore poor soils low in phosphorus) suggest adaptation to relatively harsh environments. However, the conditions required for optimum production may be quite different from those for survival. Mature M. integrifolia is capable of withstanding mild frosts, but only for short periods. The brittle wood makes trees susceptible to wind damage.

BIOPHYSICAL LIMITS

Altitude: 0-1 600 m, Mean annual temperature: 15- 25 deg. C, Mean annual rainfall: 700-3 000 mm

Soil type: M. integrifolia can be grown in a wide range of soils including poor soils, but not on heavy, impermeable clays and saline or calcareous soils. It is most suited to deep, well-drained loams and sandy loams with good organic matter content, medium cation exchange capacity and pH of 5-6.

DOCUMENTED SPECIES DISTRIBUTION

Native: Australia

Exotic: Brazil, China, Colombia, Ethiopia, Fiji, Guatemala, Indonesia, Kenya, Malawi, Mexico, Peru, Samoa, South Africa, Tanzania, Thailand, United States of America, Venezuela, Zimbabwe

The map above shows countries where the species has been planted. It does neither suggest that the species can be planted in every ecological zone within that country, nor that the species can not be planted in other countries than those depicted. Since some tree species are invasive, you need to follow biosafety procedures that apply to your planting site.

PRODUCTS
Food: The fine, crunchy texture, rich cream colour and delicate flavour make the macadamia nut one of the finest dessert nuts. The eating quality of the nut is enhanced by lightly roasting it in coconut oil and salting. Raw kernels are also popular alone or in a wide range of confectionery and processed foods. The quality of the kernel is related to its oil content and composition. Nuts are mature when the kernels accumulate 72% or more oil, as determined by specific gravity. Kernels also contain 10% carbohydrates; 9.2% protein, which is low in methionine; 0.7% minerals, particularly potassium;, and niacin, thiamine and riboflavin.

Apiculture: Macadamia pollen is very attractive to bees, providing necessary forage for honey production.

Fuel: Macadamia shells may be used as fuel, generating sufficient energy to dry wet, in-shell nuts.

Tannin or dyestuff: The hulls, the green covering of the nuts, contain approximately 14% of substances suitable for tanning leather.

Lipids: Macadamia is the richest oil-yielding nut known. The kernel contains more than 75% oil, suitable for human consumption.

Essential oil: The characteristic, subtle macadamia flavour is probably due to volatile compounds, the major ones being similar to those in other roasted nuts.

SERVICES
Shade or shelter: M. integrifolia makes an excellent evergreen shade and shelter due to its thick crown of leaves.

Soil improver: The decomposed husk is commonly used in potting soil.

Ornamental: As well as being an evergreen nut-bearing tree, M. integrifolia has good symmetrical shape and when in full bloom is covered with creamy-white and pinkish flowers in long, narrow, drooping racemes. These make it a popular ornamental tree.

Intercropping: Inter-row cropping can be practised with trees such as citrus, if they are removed at 12 years. Macadamia will retard the growth of papaya planted near it.

TREE MANAGEMENT
Seedling growth, initially slow, gathers momentum as saplings produce a series of extension growth flushes in a year. The juvenile phase lasts for 7 years or more, but grafted trees come into bearing after 3 years. The current trend is for high-density hedgerow plantings, which maximize early yields. Inter-row spacing of 10 m is most common (7 m if mechanical pruning is carried out). The distance between rows should be 4-6 m, depending on cultivar and growing conditions.

Correct branching should be induced at an early age after which there should be no further pruning. During the first 2 years, training (a form of corrective pruning) is done to develop a strong, well-balanced framework for future growth. The young trees should receive careful attention with respect to irrigation, weed control and frost and wind protection. They should also be fertilized to make them grow well and induce early flowering.

Mulching is recommended for young trees (when the trees come into bearing, it interferes with nut collection). Fertilizer management should be guided by leaf and soil analysis, the phenological cycle and yield. Macadamia trees appear to be sensitive to nutrient deficiencies and imbalances, and positive responses to N, P, K, Zn, B, S, Mg, Fe and Cu have been observed.

Yields of 45 kg nuts-in-shell from better trees or an average of 3.2-3.5 t/ha per year are obtained in Hawaii.

GERMPLASM MANAGEMENT
Seed storage behaviour is uncertain. Drying until the kernel rattles in the shell does not harm viability; no loss of viability during 4 months of storage in paper bags at room temperature, after which time viability is reduced, and none survives after 12 months. No loss in viability after 12 months of storage in polythene bags at 12 deg. C; viability maintained for 24 months with partially dried seeds at 15 deg. C.

PESTS AND DISEASES
In their place of origin macadamias are attacked by more than 150 pest species, although parasites and predators usually provide considerable control. Insects that commonly reduce yields include macadamia flower caterpillar (Homoeosoma vagella), fruit spotting bug (Amblypelta nitida), banana spotting bug (A. lutescens), macadmia nutborer (Cryptophlebia ombrodelta), and macadamia felted coccid (Eriococcus ironsidei). Any of these have the capacity to destroy much of the crop during severe infestations. The macadamia twig-girdler (Neodrepta luteotacetella) and macadamia leafminer (Acrocercops chionosema) destroy foliage and may therefore reduce yield indirectly. Many of the minor macadamia insect pests cause damage sporadically. Rats are particularly fond of macadamia nuts and can be a problem in some areas. In comparison with other fruit trees, relatively few diseases are serious in macadamia.

FURTHER READNG

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SUGGESTED CITATION

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