

Macadamia Nut

A fruit with splendid taste

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Macadamia is a medium size tree indigenous to Australia, originally found in the rain forest all along the coast of north-eastern Australia. While the trees had long been known to the aborigines, who called it gyndli or jindilli and boombera. It was named Macadamia nut after John Macadam, who died in a ship injury before he was able to taste the nuts. Macadamia is a member Proteaceae family. It is grown for its edible nuts. There are several species of Macadamia that exist in Australia but only two species, *Macadamia integrifolia* and *M. tetraphylla* and their hybrids are grown commercially. Trees of macadamia are evergreen and grow as high as 10 m. *M. integrifolia* and *M. tetraphylla* are cultivated but *M. integrifolia* is more common and known as smooth shelled type which has almost spherical, smooth surface kernels while *M. tetraphylla* is known as rough-shelled type and produces slightly elliptical or spindle shaped kernels with pebbled surface. The edible part, a white cream coloured kernel or embryo is enclosed in one piece very tough spherical brown seed coat or shell which is surrounded by a green, fibrous pericarp or husk. The macadamia nut resembles cashew in taste but is more oily and globular in shape.

Raw macadamia nuts are rich in carbohydrates (14%), fat (76%) and protein (8%). One hundred gram of macadamia nuts provides 740 kilocalories. It is rich in



thiamine, vitamin B₆, manganese, iron, magnesium and phosphorus. Compared with almonds and cashews, macadamia nut has high total fat and relatively low protein. It has a high amount of monounsaturated fats (59%) including 17%, omega-7-palmitoleic acid. Macadamia nuts are used as a snack and are also used in the confectionary, baking and ice cream industries. Macadamia shells by-product may be used in skin creams, biochar and as carbon filters.

Area and production: The global industry is quite small, with macadamia nuts accounting for just over 1% of the total tree nut volumes produced internationally. In 2018, South Africa was estimated as the leading producer of macadamia nuts, with 54,000 tonnes out of global production of 211,000 tonnes. Macadamia is

commercially produced in many countries of Southeast Asia, South America, Australia, and North America having Mediterranean, temperate or tropical climates. Macadamia is one among the limited number of well-known tropical nuts of the world. It is delicious and nutritious nut indigenous to the eastern Australia. It is also called Australian nut or Queensland nut and is popularly grown in Australia, Hawaii, California, Florida and South Africa. Cultivation of macadamia has been attempted with good success in some isolated orchards in Kerala, Tamil Nadu, Karnataka and Orissa.

Climate and soil: Macadamia trees require a hot non-humid subtropical climate with high summer and low winter temperature. Macadamias prefer fertile, well-drained soils, a rainfall

of 1,0002,000 mm (4080 in), and temperatures not falling below 10 °C, although once established, they can withstand light frosts, with an optimum temperature of 25 °C. The roots are shallow and trees can be blown down in storms. Trees have to be protected from strong winds. Trees are also susceptible to *Phytophthora* root disease. As macadamias are susceptible to decline and trunk canker disease in poorly drained soils, check the depth of well-drained soil across the orchard site. The sites having long dry season and well-drained sandy loam light soils with 5.57.5 pH may be preferred for the macadamia cultivation. Generally it comes up well where guava and orange thrive well.

Varieties: Some of the notable ones are: Kakea, Ikaika, Keaau, Keauhou, Kau, Purvis, Makai and Mauka (*M. integrifolia*); Greber, Renown, Anamour, Mammoth, Sewell and Probert 2 (*M. tetraphylla*) and Beaumont, Nelmak I and Nelmak 2 (hybrids). It is better to plant at least 2 cultivars in an orchard, although self-pollination occurs. Kakea and Keaau grow well under Bangalore conditions and good scope exists to test more number of recent standard cultivars. In South Africa, Beaumont is the most widely planted macadamia nut cultivar, followed by A4, 816, 814, Nelmak



2, 695 and 842. Cultivars Nelmak 2, 842, A4, 695 and 814 are favoured for their precocity and subsequent high yields, whereas Beaumont is favoured for its drought tolerance and 816 and A4 for its nut quality.

Beaumont: It is a commercial *Macadamia integrifolia* / *M. tetraphylla* hybrid cultivar, widely planted in Australia and New Zealand; it was discovered by Dr. J. H. Beaumont. It is high in oil, but is not sweet. New leaves are reddish, and flowers are bright pink, borne on long racemes. It is

one of the quickest varieties to come into bearing once planted in the garden, usually carrying a useful crop by the fourth year and improving from then on. It crops prodigiously when well pollinated. The impressive, grape-like clusters are sometimes so heavy they break the branchlets to which they are attached. In commercial orchards, it has reached 18 kg per tree by 8 years old. On the downside, the macadamias do not drop from the tree when ripe and the leaves are a bit prickly when one reaches into the interior of the tree during harvest. Its shell is easier to open than that of most commercial varieties.

Maroochy: A pure *M. tetraphylla* variety from Australia, cultivated for its productive crop yield, flavor and suitability for pollinating 'Beaumont'.

Nelmak II: A South African *M. integrifolia* / *M. tetraphylla* hybrid cultivar, has a sweet seed, which means it has to be cooked carefully so that the sugars do not caramelize. The sweet seed is usually not fully processed, as it generally does not taste as good, but many people enjoy eating it uncooked. It has an open micropyle (hole in the shell), which may let in fungal spores. The crack-out percentage (ratio of nut meat to whole nut by weight) is high. Ten-year-old trees produce an average 22 kg (50 lb) per tree. It is a popular variety because of its pollination of 'Beaumont' and the yields are almost comparable.

Renown: A *M. integrifolia* / *M. tetraphylla* hybrid, this is a rather spreading tree. On the plus side, it is high yielding commercially with 17 kg (37 lb) from a 9-year-old tree and the nuts drop to the ground. However, they are thick-shelled, with not much flavor.

Propagation: Although macadamia nut can be

Nutrients in macadamia nut (edible portion per 100 g)

Nutrients	Quantity	Nutrients	Quantity
Protein	7.9 g	Calcium	85 mg
Fat	75.8 g	Potassium	368 mg
Carbohydrate	13.8 g	Iron	3.69 mg
Fibre	8.6 g	Magnesium	130 mg
Ascorbic Acid	1.2 mg	Manganese	4.1 mg
Niacin	2.473 mg	Phosphorus	188 mg
Riboflavin	0.162 mg	Zinc	1.30 mg
Thiamine	1.195 mg	Moisture	1.4 mg
Vitamin E	0.54 mg	Energy	740 k calorie



propagated by seeds, the commercial production of nut is almost exclusively from grafted trees of known varieties. Seedling trees have proven to be unsatisfactory due to great variation in productivity and kernel quality.

They also have longer juvenile phase and sometimes produce bitter nuts with low oil content. The grafted trees produce 34 times more nuts on an average, providing 15% higher kernel yield. Macadamia is propagated by wedge grafting on seedling rootstocks. The well mature husked nuts should be used for raising the rootstocks. In-situ grafting can also be practised, if more attention and care are taken.

Rootstocks : Most commonly used rootstock in South Africa is Hinde (H2). It is easily propagated and produces vigorous and uniform seedlings.

Planting: Orchard design usually favours long rows to maximise land use and machinery operation. Planting distance can vary from

high density (6 x 3m) to low density (10 x 4m) depending on tree variety, soil conditions and topography. Staggered planting within rows to form equilateral triangles is favoured by some, but the main trees usually form long hedgerows.

High-density crops will have a greater blossom density and as such would require a greater amount of bee hives to ensure best possible pollination (AMS, 2009). Traditional grafted macadamia trees take 24 months from seedling rootstock to grafting and field planting whereas mini-grafted trees take 10-12 months from seed to field planting. The much newer micro-grafting technique can take only 8-12 months to field planting.

Manuring : An annual dose of 450 : 150 : 500g of N:P₂O₅:K₂O/tree (in 2 splits) is recommended in addition to 4050kg of farmyard manure.

Irrigation : The amount of water to be supplied depends on rainfall, evapo transpiration, soil type and

plant vigour. The soil should be kept moist, but not wet, to a depth of at least 1m.

Pruning : Pruning is required to get a tree form with a single main stem and a framework of horizontal branches, starting just above ground level and from there, at spacing of 0.5 meter is recommended. In each of the 3 leaf axils of a node, 3 buds are found in a vertical row. All the 3 upper buds get activated and start growing straight when a stem is pruned. One of these is allowed to grow while the other two are clipped off which induces the buds below them to grow in a horizontal direction. From time-to-time, weak and damaged branches, if any, are removed.

Pollination

Flower biology : Macadamia flowers are largely self-compatible and protandrous with anthers opening several days before the stigma is receptive. Initial and final nut set are positively correlated with insect visitation rates and orchard yields may be increased by inter planting varieties. Flowering occurs from July to September. Flowers arose from lateral buds on 1-year-old shoots. The ivory white flowers are produced in a long simple raceme about 17.9 cm long and are borne in groups of three or four numbering on an average 175.6 flowers per raceme. The individual flower is 15 mm long. Flowers are perfect, each having four stamens and a pistil. The stamens are attached to the sepals. The style forms a sharp loop in its mid-section just before the flower opening to get pollinated. The time of anthesis was 4:30 6:00 hrs. The initial fruit set is 1.71 % only. The number of days taken from flowering to initial fruit set was 52 days. Because macadamia trees flower heavily, large numbers of insects are attracted which results in higher levels of cross-pollination



than would be achieved if fewer flowers were presented. Macadamia flowers are protandrous (have bisexual flowers) and are partially self-compatible.

In Australia, the major pollinators in commercial macadamia plantations are from two genera of social bees: the introduced honey bee, *Apis mellifera*, and native bees of the genus *Trigona*. The studies done at Chettalli found that among the different pollinating insects, *Apis cerana indica* was found visiting flowers throughout the day and was the dominant one over other insects. Visit of other insects such as, *A. florea*, *A. dorsata*, *Trigona spp.* was either minimum or nil.

Harvesting and Postharvest management

Trees do not begin to produce commercial quantities of seeds until it is 7-10 years old, but once established, may continue bearing for over 100 years. The tree is slow to come to bearing. On an average, 7-year-old trees start bearing. However, 20-year-old ones give full yield and continue to yield for about 40-60 years. Under Bangalore conditions, flowering occurs during March, July, October and fruits are ready in October to March under Bangalore

conditions. The fruits are borne in clusters and on maturity; the husk begins to dry and split, exposing the inner brownish nut. The fruits naturally drop and can be gathered by hand. Even shaking the trees or branches makes the mature fruits to fall. In some countries, harvesting is mechanized or is done by using suspended nets. In Hawaii, a yield of 8090 kg nuts/tree after 18 years of planting has been recorded.

At ICAR-IIHR, Bangalore, we have identified one promising seedling selection MN III- 0101, aged 12 years old with 5.5 m height with East west canopy of 3.15 x 4 m and north south canopy of 4.2 x 3.85 m. The girth at base is 90 cm and girth at first branching is 45 cm. It has registered yield of 20-22 kg mature nut with an average fruit weight >12g with nut seed weight- 8g and 3g kernel weight.

Once the fruits are harvested, the husking and drying operation should begin immediately. After cracking the hard shell, raw kernels are dried to about 1.5% moisture, which can be held satisfactorily for about a year.

Although the kernels are edible as such, the usual practice is to consume after roasting and salting; roasted nuts can be used

in chocolate-coated nut candies, bakery products and ice-creams. Alternatively, the kernels are deep fried in oil for 15 minutes at 135°C and used in various ways.

Pest and disease management

Pests : The major pests likely to cause problems in young trees are macadamia felted coccid, scale insects (mainly latania scale and long soft scale), macadamia twig-girdler, macadamia leaf miner, red shouldered leaf beetle (*monolepta beetle*), hares and kangaroos/wallabies.

From planting, inspect trees regularly for these pests. Low levels of scale insects, twig-girdler and leaf miner can be tolerated without spraying and will often be effectively controlled by beneficial insects. It is only if infestations become severe, that spraying is necessary. However, felted coccid and red shouldered leaf beetle are much more dangerous and if detected, spraying is generally required immediately.

The rats are major problem in most of the orchards. The rats damage mature fruits and eat kernels.

Diseases : The only major disease of young trees is trunk canker. Where cankers are small, pare back the affected bark and wood with a sharp knife, and thoroughly soak trunks with a registered copper fungicide mixed with white, water-based paint.

This helps to maintain contact with the fungicide and seals the wound. Where cankers are more extensive, and paring back affected bark and wood is impracticable, spray affected areas with metalaxyl and copper oxychloride. Alternatively, spray the affected trees with phosphorous acid. Repeat the treatment two to three months later to control the disease. ●