

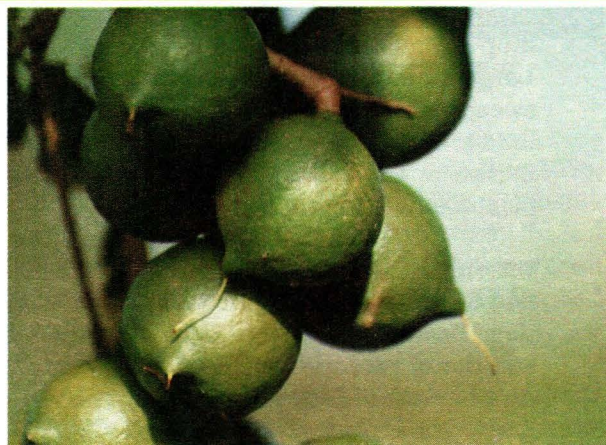
Macadamia Nut

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CROP PROFILE

SPECIES AND CULTIVARS

- The macadamia nut tree belongs to the family Proteaceae. It is a native of Australia, but commercial production is concentrated in Hawaii. Some countries in Latin America, Africa, and Asia also grow macadamia nuts. In the continental United States, trees are found in California and Florida.
- Edible nuts are from two species of the genus *Macadamia*: *M. integrifolia* (the smooth-shell type) and *M. tetraphylla* (the rough-shell type). The macadamia nut industry in Hawaii, Australia, and many other producing areas is based primarily on the smooth-shell type. The rough-shell species and hybrids of both types are grown in California.
- William Herbert Purvis is credited with the introduction of macadamia nut to Hawaii in 1881. Considerable research has gone into selection and breeding of the best cultivars for Hawaii. The College of Tropical Agriculture and Human Resources (CTAHR) recommends the following cultivars: Purvis (294), Kau (344), Kakea (508), Keaau (660), Mauka (741), Pahala (788), and Makai (800). A new cultivar, Donnison (790), performs well at elevations below 500 feet.

PRODUCTIVITY

- In Hawaii, commercial orchards are planted with grafted seedlings. Macadamia nut trees can start bearing a small crop in the fifth year after planting, and full production is reached in 12 to 15 years.

- A major concern is strong wind, which can cause severe tree loss. Narrow-profile cultivars, such as Kau and Pahala, are more wind resistant than others.
- Macadamia nut trees can be grown on deep, well-drained soils with a pH of 5.0–6.5 or on well-drained a'a lava land that is sufficiently weathered to support natural vegetation. The trees require 60–120 inches of rainfall a year and can be grown from sea level to an elevation of 2500 feet.
- The yield of in-shell nuts on poorer land in Hawaii is about 5200 lb/ac, with at least 7000 lb/ac attainable on better land. In Australia, the yield in good orchards is about 4000–5000 lb/ac.
- The shell accounts for most of the macadamia nut's weight. Hawaii's average kernel recovery rate from in-shell nuts was 23.5% during 1989–90. With an improved cracking system, better shell-kernel separators, and cultivars with a high percentage of kernel, the recovery rate could increase to 35%.
- Intercropping macadamia nuts with quicker bearing crops is one way to generate early returns. In Kona on the Big Island, coffee is sometimes grown between macadamia nut trees. An alternative is to increase the initial planting density to get higher total production in the early years. In Australia, for example, some yields peaked at 8000 lb/ac in high-density plantings before competition for light caused a decline. Tree removal or radical pruning to improve light penetration is necessary.
- Macadamia nuts are harvested manually after they have fallen. In Hawaii, the nuts typically

drop 8–9 months of the year from July to March. Large-scale producers also employ mechanical sweepers and pickup devices on relatively even land to offset the high cost of agricultural labor in Hawaii. CTAHR developed a tractor-mounted pickup device for smaller orchards.

- Interplanting with two cultivars, such as 344 and 660, improves yield through cross-pollination. Beehives near the orchard can generate additional revenue through honey production. Another possibility is the integration of animals. MacFarms of Hawaii and CTAHR are experimenting with sheep as natural lawn mowers to reduce herbicide use and weeding costs. Sheep products also provide an income.
- Of the 49 million lb of gross, wet in-shell nuts delivered to processors in 1988–89, 3.5 million lb, or 7.1%, were culled. The primary causes of loss were mold and rot (2.2% of the total crop delivered), followed by immature nuts (2.1%); stink bugs, *Nezara viridula* (1.1%); germinating nuts (0.7%); koa seed worm, *Cryptophlebia illepidia* (0.5%); and the macadamia shothole borer, *Hypothenemus obscurus* (0.5%). The figures exclude nuts culled before delivery and losses at the farm caused by rat damage, macadamia quick decline (MQD), and other factors.
- Common problems of macadamia nut in Hawaii include macadamia root rot, poor tree shape, slow decline or dieback, MQD, insect and pest damage, premature nut drop, and poor postharvest handling.

USES AND PRODUCTS

- The kernel is the main product from the macadamia nut tree. After harvesting, the husks covering the nuts are removed. The nuts are dried, the shells are cracked, and the kernels are removed to be oil-roasted or dry-roasted. Kernels are commonly sold as snack nuts and chocolate-covered candy. Ice cream manufacturers and the baking industry also use macadamia kernels as an ingredient.
- The shell and husk also have uses. Shells can be used as mulch, fuel for processing macadamia nuts, planting medium for anthurium culture, plastic manufacture, and as a substitute for sand in the sand-blasting process. Husks are used as mulch or composted for fertilizer.

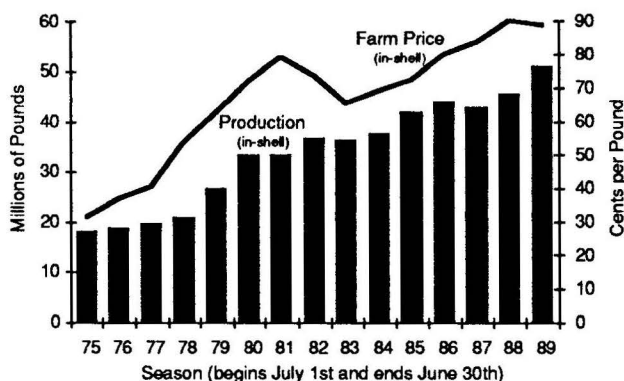
Nutritional content of an ounce of oil-roasted macadamia nuts (approximately 10–12 whole kernels)

Calories	204	kcal	Potassium	94.0	mg
Fat	21.73	gm	Sodium	2.0	mg
Protein	2.06	gm	Zinc	0.31	mg
Carbohydrate	3.66	gm	Copper	0.09	mg
Calcium	13.00	mg	Vitamin A	3.0	IU
Iron	0.51	mg	Thiamin	0.06	mg
Magnesium	33.0	mg	Riboflavin	0.03	mg
Phosphorus	57.0	mg	Niacin	0.57	mg

- Oil can be extracted from culled nuts. The cosmetic industry, especially in Japan, uses the oil in soaps, sunscreens, and shampoos. The remaining press cake might be used for animal feed.
- The highest quality macadamia kernels are free of defects and insect and fungal damage, and they contain at least 72% oil. Kernels with less than 72% oil are usually immature and harder, and they become overbrowned when roasted.

WORLD SUPPLY

- Data on worldwide production are scarce and conflicting. An estimate for 1989 indicates that macadamia nut plantings covered 54,600 ac and total production of in-shell nuts was 62 million lb. Hawaii is the major producer, accounting for over 73% of total production, followed by Australia (22%). Other producers include South Africa, Guatemala, Kenya, Costa Rica, Malawi, Brazil, Mexico, New Zealand, and China.
- About 2000 acres are planted in the San Diego area. Although not all plants have begun bearing, Southern California growers produced about 150,000 lb (in-shell) of rough-shell macadamia



Hawaii's macadamia nut production

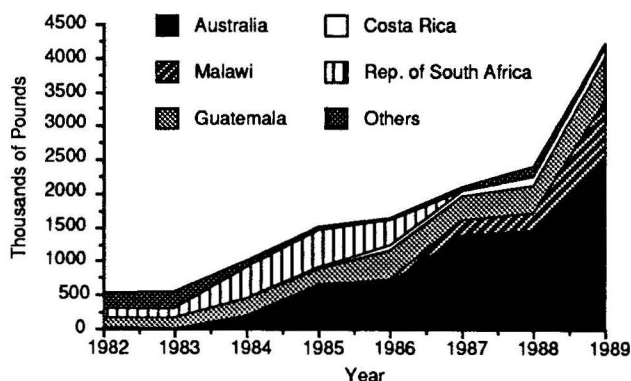
nuts in 1988 at a farm-gate price of approximately \$1.50/lb. Rough-shell nuts do not roast well; the price reflects a novelty demand for in-shell or raw nuts.

- Hawaii is the world's leader in growing and processing macadamia nuts. In 1989-90, Hawaii harvested a record 50.5 million lb of nuts (net, wet in-shell basis) for a record farm value of \$44.9 million, up from 18.2 million lb and \$5.8 million in 1975-76. The crop covered about 22,300 acres in the state, of which 18,200 acres, or 82%, were bearing acreage.
- The price of in-shell nuts has climbed along with production in Hawaii. The net farm-gate price has gone from 31.6¢ in 1975-76 to 89¢ in 1989-90.
- In Hawaii, macadamia nuts are grown by both small-scale farmers and large corporate producers. Most operations are located on the Big Island. Mauna Loa Macadamia Nut Corp. (a subsidiary of C. Brewer) and MacFarms of Hawaii are the two largest local growers and processors.
- A 1989 CTAHR study calculated annual net returns per acre in Hawaii from start-up to maturity (16 years or older) for farms of 25, 50, 100, and 500 acres. Various price and yield scenarios were used for mature orchards, showing substantial economies of scale for the larger farms. A previous study published in 1982 assessed the economic feasibility of 5-, 10-, and 20-acre farms in Hawaii. Most growers are multiple-income farm families, and macadamia nuts supply only a fraction of their income.
- Australia is the second largest producer of macadamia nuts, with an estimated 15,000 acres planted in 1989. While most of the Hawaii trees are mature, an estimated 20% of the trees in Australia are bearing. As the trees mature, Australia will become a more formidable competitor.
- In recent years, approximately 80% of Australia's macadamia nut production was exported. The primary export market is the United States, with some channeled to Japan and Europe.

SELECTED MARKETS

THE UNITED STATES MARKET

- U.S. per capita consumption of macadamia nuts increased from 0.04 lb in 1979 to 0.06 lb in 1988. Macadamia nut consumption in 1988 was somewhat comparable to that of filberts (0.09 lb) and pistachios (0.19 lb), but considerably lower than that of almonds (0.66 lb), pecans (0.52 lb), and walnuts (0.44 lb).
- In a 1985 CTAHR survey, Honolulu respondents preferred macadamia nuts to all other nuts, disregarding price. In a survey during the previous year, Los Angeles respondents preferred macadamia nuts to all other nuts except cashews, disregarding price.
- In 1989-90, U.S. (Hawaii) production of macadamia kernels was about 11.9 million lb (assuming a 23.5% kernel recovery rate). During 1989, the United States also imported 5.1 million lb of macadamia nut products, of which 4.2 million lb were shelled nuts at a CIF value (cost, insurance, and freight) of \$20.4 million. In addition, 673,000 lb of prepared or preserved nuts and 189,000 lb of unshelled nuts were imported at values of \$1.2 million and \$175,000, respectively.
- U.S. imports of macadamia kernels have increased nearly eight times, from 539,700 lb in 1982 to 4.2 million lb in 1989. Australia was largely responsible for the increase; its exports to the United States rose from 21,800 lb in 1982 to 2.4 million lb in 1989. Imports from Malawi also increased substantially, from nothing in 1982 to 945,800 lb in 1989.
- In 1989, Australia supplied 94% of unshelled macadamia nut imports to the United States.



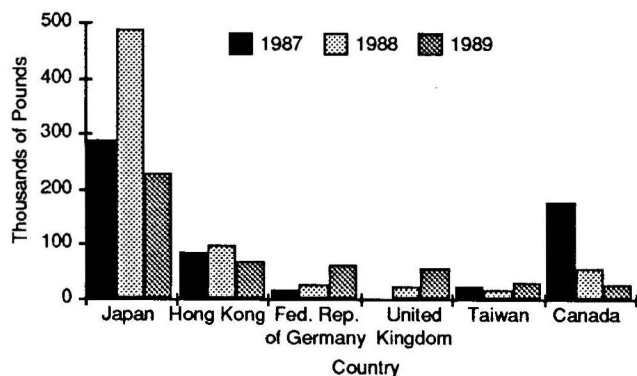
Major foreign suppliers of macadamia kernels to the United States, 1982-89

Australia also was the major supplier of shelled macadamia nuts, accounting for 58% of total U.S. imports, followed by Malawi (22%) and Guatemala (15%). Other suppliers included Costa Rica, Kenya, Zimbabwe, and Brazil.

- The average U.S. import price (CIF) of macadamia kernels was \$4.81/lb in 1989. The major ports of entry were Honolulu (32.6% of total imports), San Francisco (31.4%), and Los Angeles (28.8%).
- Hawaii is the most developed market for macadamia nuts. The estimated value of Hawaii's chocolate-covered macadamia nut wholesaling industry is over \$100 million. The snack nut market is another major outlet for macadamia nuts.
- Japanese visitors purchase a large quantity of macadamia products in Hawaii to take home. These "suitcase exports" are not included in the U.S. export statistics. The Japanese custom of giving gifts upon returning from vacations is a primary reason for large purchases.

OTHER MARKETS

- U.S. exports of prepared or preserved, shelled or unshelled macadamia nuts increased to 812,600 lb in 1988, before they declined to 564,500 lb in 1989. The decline in total exports is due primarily to the drop in exports to Japan (489,400 lb to 227,600 lb), Singapore (55,900 lb to 11,700 lb), and Canada (56,200 lb to 26,600 lb).



Major U.S. macadamia nut export markets, 1987-89

Reference to a company or product name does not imply approval or recommendation of the product by the College of Tropical Agriculture and Human Resources, University of Hawaii.

Hawaii Agricultural Experiment Station, HITAHR, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa. Noel P. Kefford, Director and Dean.

A list of references is available from the authors upon request.

- In 1989, Japan imported 1.1 million lb of fresh or dried macadamia nuts, an increase of 65% from 1983. Kenya supplied more than 75% of total imports. Other suppliers were Australia, South Africa, and the United States.
- U.S. exports of macadamia nuts to Europe increased almost nine times, from 16,500 lb in 1987 to 147,600 lb in 1989. In 1987, the Federal Republic of Germany was the only European country to import macadamia nuts from the United States. The Federal Republic of Germany and the United Kingdom accounted for about 80% of the U.S. macadamia nut exports to 10 European countries in 1989.
- Although U.S. exports of macadamia nuts to Europe have increased, the European market is relatively undeveloped, especially when compared to the market for other nuts. For example, the Federal Republic of Germany imported 145.1 million lb (in-shell and kernels) of hazelnuts and 94.4 million lb of almonds in 1987. During the same year France imported 38.6 million lb of almonds and 35.5 million lb of hazelnuts.

SOURCES OF INFORMATION

- The status, potential, and problems of the macadamia nut industry in Hawaii are discussed in the *Macadamia Industry Analysis* (No. 4 was completed by CTAHR in 1987; No. 5 will be published in late 1991). The analysis identifies various bottlenecks of the industry and devises plans to relieve them. Topics addressed include resource requirements; insect, disease, and pest control; plant nutrition requirements; harvesting; processing; cost of production; market potential and development; and public policies and regulations.
- The Hawaii Macadamia Nut Association publishes an annual proceedings of research and issues, and a quarterly newsletter, *MacFacts*.
- CTAHR's *Farmer's Bookshelf* is a computer-based information system that contains the industry analysis and a problem-diagnosing system that uses Hypercard on the Macintosh computer.