

Table A.2. Most important kiwifruit cultivars, 2002.

Cultivar	Area (ha) ^a	Main growing districts
<i>Actinidia deliciosa</i>		
'Hayward'	64,400	In all countries growing kiwifruit, including China
'Qinmei'	17,480	Mainly in Shaanxi, Guizhou and Henan, China
'Miliang No. 1'	5,500	Guizhou, Henan and Fujian, China
'Jinkui'	2,340	Hubei and Fujian, China
'Bruno'	2,000	Zhejiang, China
<i>Actinidia chinensis</i>		
'Kuimi'	3,080	Jiangxi, China
'Jinfeng'	2,720	Zhejiang and Jiangxi, China
'Zaoxian'	2,330	Jiangxi and Zhejiang, China
'Hongyan'	2,180	Sichuan, China
'Hort16A'	2,000	New Zealand
All others	12,120	China

^a Areas include the 10% of orchard canopy allocated to accompanying pollinators.

accounts for about 75% of world kiwifruit production, 97.5% of kiwifruit production outside of China. It was originally selected because its fruit are large, have a good flavour and can be stored for extended periods while still remaining acceptable to consumers. The relative flowering times of 'Hayward' and its pollinators can vary according to climate so, although 'Hayward' is grown in many different countries, the accompanying males grown may vary from country to country.

The situation in China is very different. 'Hayward' is grown but, although it is the second most widely planted kiwifruit cultivar in China, it accounts for only 13% of the total area planted in kiwifruit. 'Hayward' and the eight other most common cultivars account for only 80% of total plantings. There is a strong preference for cultivars selected locally and most are largely restricted to one or two, usually contiguous, provinces. Thus 'Qinmei' (*A. deliciosa*) comprises about 30% of all kiwifruit plantings in China but is predominantly confined to Shaanxi, the province in which it was selected. The Chinese kiwifruit industry will probably consolidate on fewer cultivars of more consistent fruit quality.

The many kiwifruit cultivars in China are selections from the wild. 'Hayward' and 'Bruno' (also from New Zealand) were selections from small seedling populations only one or two generations removed from the wild. Only one successful cultivar, 'Hort16A', has so far resulted from deliberate breeding programmes. With its distinctive appearance, its golden-yellow flesh, and its very different, sweeter, 'subtropical' flavour, 'Hort16A', commercialized under the name ZESPRI™ GOLD Kiwifruit is perceived as giving the New Zealand kiwifruit industry a competitive advantage. It is the first cultivar of *A. chinensis* to be traded internationally and its success is likely to encourage the development of competitive cultivars, either some of the existing Chinese cultivars or cultivars specifically bred for the purpose. Ross Ferguson

Further reading

Costa, G. (1999) Kiwifruit orchard management: new developments. *Acta Horticulturae* 498, 111–119.

Ferguson, A.R. (1984) Kiwifruit: a botanical review. *Horticultural Reviews* 6, 1–64.

Ferguson, A.R. (1990) Kiwifruit management. In: Galletta, G.J. and Himelrick, D.G. (eds) *Small Fruit Crop Management*. Prentice Hall, Englewood Cliffs, New Jersey, pp. 472–505.

Ferguson, A.R. (1990) Kiwifruit (*Actinidia*). In: Moore, J.N. and Ballington, J.R., Jr (eds) *Genetic Resources of Temperate Fruit and Nut Crops*. International Society for Horticultural Science, Wageningen, The Netherlands, pp. 603–653.

Ferguson, A.R. and Stanley, R. (2003) Kiwifruit. In: Caballero, B., Trugo, L. and Finglas, P. (eds) *Encyclopedia of Food Sciences and Nutrition*, 2nd edn. Academic Press, New York, pp. 3425–3431.

Huang, H. and Ferguson, A.R. (2001) Kiwifruit in China. *New Zealand Journal of Crop and Horticultural Science* 29, 1–14.

Patterson, K., Burdon, J. and Lallu, N. (2003) 'Hort16A' kiwifruit: progress and issues with commercialisation. *Acta Horticulturae* 610, 267–273.

Perera, C.O., Young, H. and Beaver, D.J. (1998) Kiwifruit. In: Shaw, P.E., Chan, H.T. Jr and Nagy, S. (eds) *Tropical and Subtropical Fruits*. AgScience Inc., Auburndale, Florida, pp. 336–385.

Steven, D. (1999) Integrated and organic production of kiwifruit. *Acta Horticulturae* 498, 345–354.

Warrington, I.J. and Weston, G.C. (1990) *Kiwifruit: Science, and Management*. Ray Richards Publisher in association with the New Zealand Society for Horticultural Science, Auckland, NZ, pp. 1–576.

ADOXACEAE

Viburnum spp. viburnums

The genus *Viburnum*, *Adoxaceae* (formerly *Caprifoliaceae*), comprises more than 200 species throughout the northern hemisphere, primarily Asia and North America, and many produce copious amounts of fleshy fruit. Many are used as ornamental plants in the landscape as they can have highly scented, attractive, showy flowers and masses of variously coloured fruit borne on attractive plants that may have deciduous or evergreen foliage. Some are extremely good food sources and none are known to be toxic, although some will cause nausea if large quantities of raw fruit are consumed. At various times, several similar species have been given the name highbush cranberry and they are commonly harvested from the wild and consumed.

Several similar edible *Viburnum* species with tart, red fruit have been given the name highbush cranberry. They are commonly harvested from the wild. Thus, *Viburnum opulus*, *Viburnum edule* and *Viburnum trilobum* are now considered to be subspecies of *V. opulus* (*V. opulus opulus*, *V. opulus edule*, *V. opulus americanum* formerly *V. trilobum*). *Viburnum opulus* will be used here as the general term. In addition to *V. opulus*, many other *Viburnum* species are considered edible. The highbush cranberry species are native to the northern hemisphere but have been scattered throughout the temperate regions of the world due to their highly ornamental characteristics. While generally a woody shrub 2–3 m tall, at the northern, very cold edges of its range it may not get any taller than 0.3 m and in ideal circumstances it may reach 5 m. Highbush cranberry is adapted to a wide range of soils but is most productive on moist, reasonably fertile soils.

In the spring, the flowers bloom on large, showy, cymes.

The individual flowers are small and white but a cyme may contain hundreds of flowers. The flowers are insect pollinated and can be fragrant. Flowering takes place in the spring and the fruit develop over the summer, finally ripening in late summer and autumn. The fruit are most typically a bright red colour, or yellowish, and individually are 0.8–1 cm in diameter. The fruit of *V. opulus opulus* are usually described as astringent, whereas the fruit of *V. opulus americanum*, while tart, are considered to have a very good flavour. Since the fruit is very tart, much like a cranberry, it is seldom eaten raw; rather it is often blended with sugar in processed jelly or sauce type products.

For commercial production in managed stands, plants should be established 2–3 m apart within rows. Irrigation is important for plant establishment and for maximum fruit yield and quality. Nitrogen fertilization will also be important for best production and plant health. No chemicals are approved for weed, insect or disease control. When grown in their native range, diseases should cause minimal problems if the plants are healthy, however, bacterial leaf spot (*Pseudomonas viburni*), powdery mildew (*Sphaerotheca macularis*) and shoot blight (*Botrytis cinerea*) have been reported as potential problems. Occasionally aphids are reported as a problem. In the early 1900s, improved cultivars with larger fruit, greater production and better fruit quality were released, these include 'Hahs', 'Andrews', 'Wentworth', 'Manitou Pembina' (syn. 'Manitou') and 'Phillips'. Nearly all fruit that is now consumed is harvested from wild stands, with locally important industries selling to speciality markets.

In Native American culture, the fruit were prized for food and the roots, bark, twigs and fruit were used to treat various maladies including use as a cold remedy, pulmonary aid, cough medicine and throat aid, anti-diarrhoeal, cathartic and others.

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Further reading

- Darrow, G.M. (1923) *Viburnum americanum* as a garden fruit. *Proceedings of the American Society for Horticultural Science* 21, 44–55.
- Moerman, D.E. (1998) *Native American Ethnobotany*. Timber Press, Portland, Oregon.
- Plants for a Future. Available at: <http://www.pfaf.org/index.html> (accessed 3 November 2006).
- Stang, E.J. (1990) Elderberry, highbush cranberry, and juneberry management. In: Galletta, G.J. and Himelrick, D.G. (eds) *Small Fruit Crop Management*. Prentice-Hall, Englewood Cliffs, New Jersey, pp. 363–382.

ANACARDIACEAE

Anacardium occidentale cashew

Cashew, *Anacardium occidentale* L. (*Anacardiaceae*), is one of the important edible nuts that is consumed worldwide. Common names include: in Arabic habb al-biladhir; in Bengali hijlibadam, hijuli; in Chinese yao guo and yao guo shu; in French acajou a pommes, noix-cajou, noix d'acajou, pomme d'acajou; in Hindi kaaju; in Malay gajus, jambu golok and jambu mede; in Nepali kaaju; in Portuguese caju and cajueiro; in Spanish anacardo, maranon, casho; in Swahili

mbibo and mkanju; in Tamil mindiri; and in Thai mamuang, yaruang. The Vavilovian South American centre VIII (Brazil–Paraguay) is considered the centre of origin.

Prior to the Portuguese colonization of Brazil, indigenous Indians consumed both the nut and the enlarged pedicel (receptacle), which is referred to as the 'cashew apple'. Juice squeezed from the cashew apples was fermented to produce wine. The Brazilian Indians roasted nuts over a fire thus burning off the toxic outer covering and the Portuguese colonizers copied this method. The trees are now often found growing wild on the drier sandy soils in the central plains of Brazil and are cultivated in many parts of the Amazon rainforest. By 1750, the cashew was widely distributed throughout tropical America. The cashew trees were planted as a backyard tree, partly for shade and established beyond their indigenous coastal distribution.

The Portuguese introduced cashew trees to India in the 18th century, where they were initially grown for producing wine and brandy and later introduced to other Asian countries. The Portuguese also exported the seeds to their colonies in East Africa in the late 18th century where they quickly became naturalized and grew wild along the Mozambique coast. From there they were introduced and naturalized in other East African countries such as Kenya and Tanzania. Soon, the African people started selling the wild harvested nuts to Portuguese traders, who in turn sold them to merchants in India for processing.

Cashews have spread widely in the Indian Ocean region and have become naturalized in seashore habitats. The trees were planted in all suitable areas of tropical India, and in the 1950s quite large orchards were planted, chiefly in the Indian state of Kerala. Trade in cashew nuts started at the beginning of the 20th century and grew particularly fast in the 1930s, being dominated mainly by Indian production. Since the 1960s, there has been rapid growth in the industry, particularly in India, Madagascar and Mozambique.

World production and yield

Cashew now grows all along the sea coasts in tropical regions starting from southern America to the West Indies, west and east Africa and India. India is the largest producer of raw cashew nut in the world (Fig. A.1). In India, the state of Kerala is the largest producer, processor and exporter of raw nuts. Other cashew-growing Indian states are Andhra Pradesh, Orissa, Goa, Karnataka, Maharashtra, Tamil Nadu and west Bengal. However, in the later part of the 20th century, other countries such as Brazil, Vietnam, Tanzania, Mozambique, Guinea Bissau, Nigeria and Indonesia also started developing cashew plantations.

Global trade in raw cashews now takes place from over 24 countries. In north-eastern Brazil, cashew is grown in the states of Ceara, Piaui and Rio Grande do Norte which together account for 90% of Brazil's cashew production. The northern province of Nampula is the major contributor to cashew production in Mozambique. In Tanzania, cashews are grown in the Mtwara, Lindi, Ruvuma, Tanga and coastal regions. In Kenya, cashew is grown in the narrow coastal belt covering the districts of Kilifi, Kwale and Lamu.

India, Brazil, Mozambique, Tanzania and Kenya together