GROWTH AND PRODUCTION OF KIWIFRUIT AND KIWIBERRY

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Contents

Summary

Kiwifruit is a rather new temperate fruit, the commercialization of which started only in the 1950s (*Actinidia deliciosa*) and 1990s (*A. chinensis*); today, it is grown all over the world. The commercialization of kiwiberry (*A. arguta*) is more recent.

The fuzzy kiwifruit is egg-shaped with a brownish skin covered with short stiff hairs (*A. deliciosa*) or rather smooth- skinned and almost hairless (*A. chinensis*). The kiwiberry (*A. arguta*) has a similar taste, composition and nutritive value but has a smooth, edible skin; it has the size of table grapes, whereas the weight of the more common fuzzy kiwifruit can reach more than 120 grams.

Temperature is a major limiting factor for cultivation. Fuzzy kiwis cannot stand temperatures below -15 °C, but in a dormant stage kiwiberry plants are resistant to temperatures below -30 °C. Soils should be well drained. On commercial plantations, a T-bar or pergola is used to support the solid canopy of foliage and fruit. As kiwiplants are dioecious, for every eight female plants, one male vine is planted.

Kiwifruit is a fast growing plant, therefore a well-considered pruning and an adequate fertilizer management and water supply are indispensable for optimum productivity. Other management factors are weed control in young vines; pest control and protection of long shoots against wind damage on plantations in full production.

Fuzzy kiwifruit and kiwiberry are usually eaten fresh, or are mixed in desserts or salads. Storage of fuzzy kiwifruit is between 3 (*A. chinensis*) and 6 months (*A. deliciosa*); for fresh kiwiberries it is limited to 6 - 10 weeks.
Italy, New Zealand, China and Chile are important producers of *A. deliciosa* and *A. chinensis*. The production of *A. arguta* is an interesting crop for the niche market. Recently, some commercial projects have been started in Switzerland and Belgium.

1. Introduction

The genus *Actinidia* is known for the famous 'kiwifruit' (*A. deliciosa* (*A. Chev*) C.F. Liang [stet] A.R. Ferguson var. *deliciosa*). Kiwifruit is native to the Yangtze Valley of China, and was originally called “Yang Tao” in China and "Chinese gooseberry" in the rest of the world. When kiwifruit farmers in New Zealand decided to market the fruit overseas, they gave it the name “kiwi” to identify it better with New Zealand. The name "kiwi” or “kiwifruit" comes from the kiwi, a flightless bird and New Zealand's national symbol, and also a colloquial name for the New Zealand people.

All *Actinidia* species are climbers. They have no specific organs enabling them to attach, but the young shoot tops curl around older woody shoots. Some of the *Actinidia* species are grown for their berries, while others are used as an ornamental plant in gardens and parks.

About 15 *Actinidia* species produce edible fruit, but there are currently only three species of commercial importance: the fuzzy kiwifruit or *A. deliciosa* (the green kiwi) and *A. chinensis* (the yellow kiwi); both are widely grown commercially. In recent years a growing attention is paid to a third species, *A. arguta* or kiwiberry.

2. Origin and Distribution

The genus *Actinidia* is widely distributed in eastern Asia. Most of the at least 76 species of the genus are represented in south-central and southwest China. Some of the species, such as *A. polygama*, *A. arguta*, and *A. kolomikta*, have broad distributions, from Japan through northeastern Asia to western China.

The genus *Actinidia* belongs to the Actinidiaceae. The four infra-generic sections in this genus are: *Leiocarpae*, *Maculatae*, *Stellatae*, and *Strigosa.* This classification is based on the characteristics of the fruit (presence or absence of lenticels), pith (lamellate or non-lamellate), and hair (simple or stellate). Although kiwifruit is now an important crop in many parts of the world, much fruit is collected each year from the wild in China.

3. Botany

All *Actinidia* species are perennial, climbing or scrambling plants, mostly deciduous, although a few are evergreen. The woody vines with young shoots can grow to a height of more than 9 m. Young shoots are covered with hairs. *Actinidia* species produce long-petioled leaves not equally shaped and colored.

Flowers appear approximately 60 days after bud burst in spring. The flowers of both the fuzzy kiwifruit and kiwiberry have white petals that become yellow as they age. There are some exceptions, but usually the plants bear only flowers of one sex, either male or female. Flowers on male vines produce viable pollen but lack a properly developed style. Flowers of female vines have a well developed style and produce non-viable pollen. In commercial plantations one male vine is planted for every six to ten female vines.

Botanically, the fruits of the various *Actinidia* species are berries. Since they are fleshy, they have many seeds embedded in the flesh, and they do not split open at maturity. The commercial interesting kiwifruits vary in size, shape, hairiness, and internal and external color **(**Ferguson, 1999). Some varieties have early-maturing fruits compared to others.

3.1 Fuzzy Kiwifruit (*A. deliciosa and A. chinensis*)

3.1.1. Structure

The species *A. deliciosa* (green kiwi) and *A. chinensis* (yellow kiwi) are very similar, and it was only in 1984 that Liang and Ferguson discovered that they represent two different varieties. The leaves of the fuzzy kiwifruit are heart-shaped. The creamy colored flowers can have a diameter up to 5 cm; they have five petals and sepals and numerous stamens (Figure 1). The stigmas are positioned radially.

The fuzzy kiwifruit *A. deliciosa* is egg-shaped with a brownish skin covered with short stiff hairs. Inside, the flesh is bright green around a white core with fine pale lines radiating from it. Numerous very small black seeds surround the whitish core.

Figure 1. Female flowers of the *A. chinensis* (photograph C. De Kezel, with permission)

Most of the yellow-fleshed fuzzy kiwifruit belong to the species *A. chinensis* and have a smooth- skinned and almost hairless fruit when ripe. The taste of this fruit is also sweeter than *A. deliciosa* and has a more aromatic flavor. Both *Actinidia* species are normally peeled before consumption because of the presence of surface hairs and a less tasteful skin.

3.1.2. Cultivars of *A. deliciosa*

Figure 2. Fruits of *A. deliciosa 'Monty'* (photograph C. De Kezel, with permission).

The most widely planted kiwifruit cultivar is *A. deliciosa* 'Hayward' selected in New Zealand in 1925. The name is derived from Hayward Wright, the Auckland nurseryman who raised this cultivar from a chance seedling discovered in the 1920s. 'Hayward' fruit represents about 90-95% of the international kiwifruit trade.

The fruits of 'Hayward' are very distinctive, being larger than any other and much wider in relation to their length. Usually, they are slightly flattened laterally. The flowers and fruits are mostly arranged in a single stand at the nodes.

Some important 'Hayward' clones for production are 'Clone 8', 'Clone K', Clone Maeba®. In addition, 'Top Star®', 'Green Light®', 'Earligreen®' and BO-Erica®' are bud mutations selected in Italy. Worth mentioning is also the Italian 'Summerkiwi®', a trade name for the early maturing selections "Summer 3373" and "Summer 4605" which are normally harvested 30-50 days before the Hayward variety.

The second most widely planted *A. deliciosa* cultivar is 'Qinmei' which is selected in the Qinling Mountains in China; it is only commercially grown in this country. This cultivar and its males represent about 30% of Chinese kiwifruit plantings or about 15% of the world total. The plant is quite resistant to cold winters and dry and warm summers.

The third most widely planted *A. deliciosa* cultivar is 'Jinkui', also grown in China as well. It is a seedling from open-pollination of a cultivar itself selected from the wild. Other significant cultivars are Abbott, Allison, Bruno, Monty (Montgomery) (Figure 2), Koryoku and Greensill.

3.1.3. Cultivars of *A. chinensis*

The most widely planted cultivar of *A. chinensis* is 'Hort16A', marketed as ZESPRI^{TM} Gold. In 2006 'Hort16A' represented about 20% of the kiwifruit plantings in New Zealand. This yellow fleshed cultivar is more productive than 'Hayward', but is more susceptible to skin damage at the time of harvest.

The second most widely planted *A. chinensis* is the Chinese cultivar 'Jintao', marketed in Italy as Jingold or Kiwigold. 'Jintao' (golden peach in Chinese) is a yellow-fleshed kiwifruit developed from the breeding program at the Wuhan Institute of Botany, in Wuhan, Hubei, China. It is a midseason cultivar selected for warmer climates.

Some other Chinese *A. chinensis* cultivars grown outside China are 'Jiangxi 79-1' (syn. 'Koushin', 'Kosuei 79-1', 'Lushan 79-1 ', 'Red Princess'), and more recently (registered in 2005) Sanuki Gold, a vigorous, early flowering cultivar, with fruits ranging from 160 to more than 180 grams each.

3.2. Kiwiberry (*A. arguta*)

3.2.1. Structure

Because of their frost hardiness, kiwiberry (*A. arguta*) as well as the less known *A. kolomikta* and *A. polygama* are commonly called hardy kiwifruit. They resist

temperatures as low as - 35 °C.

The vines of *A. arguta* are vigorous, have shiny green leaves, with green or red petioles depending on the cultivar. At the base of the young green shoots, and on second-year wood, a lot of lenticels can be seen. Flowers are smaller than those of the fuzzy kiwifruit. Both, male and female flowers have a diameter of about 1 to 3 cm (Figure 3). Female flowers can be pollinated by male selections of *A. arguta* and *A. deliciosa*. As in all *Actinidia* species, only one year canes produce fruit bearing shoots.

The fruit weight of the *A. arguta* ranges from 2 to 25 grams. The berry can vary in color from green to red blushy, or Bordeaux red. The smooth edible skin of the fruit is one of the strong commercial aspects of this fruit.

Figure 3. Leaves and female flowers of *A. arguta.*

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Biographical Sketches

Filip Debersaques is lecturer and researcher at the University College Ghent, Faculty of Biosciences and Landscape Architecture, associated with the University Ghent (Belgium). He graduated in 1985 at the above mentioned University College as industrial engineer in agriculture. His mean topics of interest are fruit growing, and nutrient management of plants. Since 1985 he coaches students in horticultural sciences for their Master thesis. As committee member of the Belgian Pomological Society he has intensive contacts with the fruit growers.

In 2006 he introduced, together with the co-author Omer Mekers, the production of kiwiberry in Belgium. In November 2008 he started together with growers from France, Austria and Switzerland an international working group to optimize the growing of kiwiberry in these countries.

Omer Mekers is professor in horticulture at the University College Ghent, Faculty of Biosciences and Landscape Architecture, associated with the University Ghent (Belgium). He graduated as Master in Agriculture in 1973 and as Doctor in Agricultural Sciences in 1986 at the University of Leuven (Belgium). His main activities have been initially on breeding and growth regulation of ornamental plants, and since 1988 on applied research and teaching horticultural sciences. He has been promoter of different MSc theses on horticultural topics related to fruit, vegetables and ornamental plants growth, tissue culture and hydroponics.