Arabica Coffee
Coffea arabica

Without doubt, Arabica Coffee is preferred by coffee drinkers around the world, but it comes with a particularly interesting ancestry. There are about 125 species of *Coffea*: most occur in tropical regions from continental Africa (41 species), Madagascar (59) and adjacent islands (4). Even more surprisingly, there is an Australian native species, *Coffea brassii*, from the forests of far north Queensland.

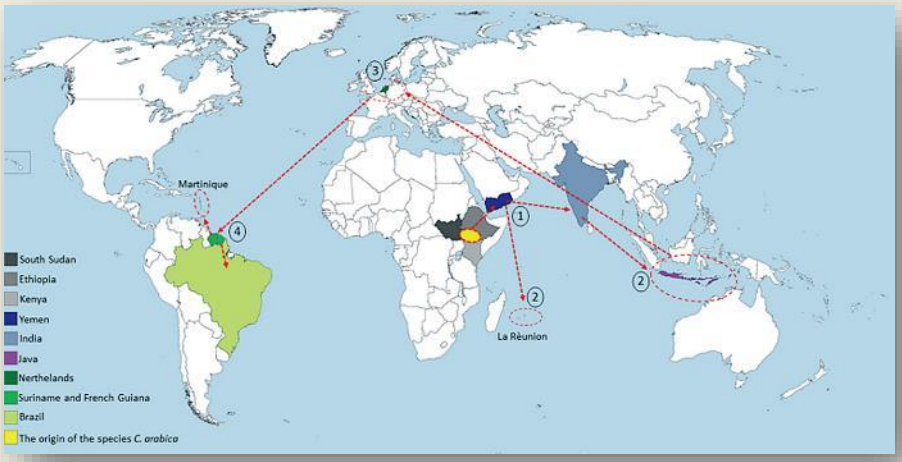
There are only two *Coffea* species of economic importance: *Coffea arabica*, known as *Arabica coffee*, has a fairly limited distribution, from the highlands of southwestern Ethiopia, the Boma Plateau of Sudan, and Mount Marsabit in Kenya; and the less popular but hardier *Coffea canephora* (syn. *Coffea robusta*), known as *Robusta coffee*, is far more widespread, from equatorial Africa to northern Angola and Tanzania.

The origin of *Coffea* is estimated at between 150,000 to 350,000 years ago, with the centre of origin and speciation believed to have been in Lower Guinea in west equatorial Africa, also the richest centre of endemism (genetic diversity) for the genus. Coffee is now grown in tropical and subtropical regions around the world and is the second most traded commodity in the world after oil.

Original distribution of *Coffea* species.
Grey: distribution on the African continent and nearby islands
Dark green: distribution in Asia and Australasia, including *Coffea brassii* in far north Queensland.
Red circle: probable place of origin in West-central Africa
Map: Ferreiraa T, Shulerb J, Guimarãesb R, Farah A. 2019.

Wild coffee was introduced to Yemen from Ethiopia more than 2,500 years ago, where *Coffea arabica* diverged into two distinct botanical varieties, *Coffea arabica* var. *arabica*, referred to as *Typica*, and *Coffea arabica* var. *Bourbon*. The *Typica* variety originated

from a single plant taken from Yemen to India, subsequently to Java, then Amsterdam, then to the Americas.



Coffea arabica – Centre of origin in Africa (yellow circle).
575 from Ethiopia to Yemen, then to Réunion, India and Java.
1770 coffee was introduced to Europe via Amsterdam.
1718 coffee was introduced to South America (Suriname, Martinique, Brazil)
Map: Ferreiraa T, Shulerb J, Guimarãesb R, Farah A. 2019

Molecular biologists have untangled much of the complex genetics of *Coffea arabica*, which is characterised by extremely low genetic variation in both wild and cultivated plants. In fact, it has the lowest level of genetic diversity reported for any crop species. *Coffea arabica* is now known to be an *allotetraploid* species (four sets of chromosomes from two distinct parents), the result of hybridization between two close ancestors of *Coffea canephora* and *Coffea eugenioides*.

Most tropical tree crops can be propagated clonally (cuttings, grafting), but not *Arabica coffee* which is grown from seed. The flowers are self-fertilized leading to high levels of inbreeding, the self-pollinating resulting in relatively uniform seedlings which vary little from the parent plants. In contrast, *Robusta coffee* is self-incompatible and plants need to cross pollinate, so varieties and hybrids are more conveniently propagated vegetatively by striking stems.

Caffeine has significant physiological properties, such as lessening sleep, stimulation of the central nervous system, and stimulation of the heart muscle. *Arabica coffee* has less than half the caffeine content of *Robusta coffee*, which is more commonly used in instant coffee or coffee blends.

Coffea arabica flowers on Réunion Island.
Photo: B.navez, CC BY-SA 4.0
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Caffeine content varies considerably amongst *Coffea* species when related to the geographical distribution of plants. In Africa there is a trend to increasing caffeine content towards West Africa. Worldwide, there is a similar trend, with a progressive east-to-west increase in caffeine content. And genetics also determine caffeine content. The

presence or absence of caffeine is controlled by one gene comprising two alleles (variations in the DNA sequence of a single gene); the *recessive* allelic form leads to the absence of caffeine.

In 1802, Robert Brown, botanist on the HMS Investigator commanded by Matthew Flinders, collected a rather nondescript plant specimen from Goods Island (Palilug Island) in Torres Strait. This turned out to be the *only* coffee species known from Australia. Initially it was named *Paracoffea brassii,* later *Psilanthus brassii,* and forty years later, botanists from Kew determined that it more appropriately belonged in the coffee genus, and it has now been reclassified as *Coffea brassii*. It's also known from the New Guinea Highlands. It is still not known whether this newly recognised coffee contains caffeine. Because of their very low genetic diversity, Arabica coffee crops are already under threat from disease and climate change. Crossbreeding with genetically diverse wild populations of coffee species, such as the Australian *Coffea brassii,* may alleviate the negative impacts of climate change, minimising the harmful effects of high temperatures, drought, increased rainfall, and associated changes in pests and diseases.

Alison Downing, Brian Atwell, Karen Marais, Kevin Downing

Australian Tropical Rainforest Plants: https://apps.lucidcentral.org/rainforest/text/entities/coffea_brassii.htm
Crouzillat D. 2015. Caffeine-Free Species in the Genus *Coffea*. In Preddy V R (Ed.), *Coffee in Health and Disease Prevention*, pp.39-44. Elsevier.
Ferreiraa T, Shulerb J, Guimarãesb R, Farah A. 2019. Introduction to Coffee Plant and Genetics. In: Farah A (Ed.) *Coffee: Production, Quality and Chemistry*. Royal Society of Chemistry.
Global Coffee Report, 2011: *Arabica & Robusta, meet your new friend Brassii.* https://www.gcrmag.com/arabia-robusta-meet-your-new-friend-brassii/
Wikipedia**:** http://en.wikipedia.org/wiki/Coffee
Wikipedia: https://en.wikipedia.org/wiki/Coffea
Wikipedia: https://en.wikipedia.org/wiki/Coffea_arabica

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