

**LOCAL NAMES**

Arabic (kâkâû); Burmese (kokoe); Dutch (Cacaoboom); English (cocoa,cacao,chocolate tree,Nicaraguan cocoa shade); French (cacao,cacaoyer,cacaotier); German (Kakaobaum); Indonesian (coklat); Italian (Cacao (albero)); Khmer (kakaaw); Malay (pokok coklat); Sinhala (maikona gaha); Spanish (cacao forastero,cacao criollo,cacao amarillo,cacao); Tamil (kona maram); Thai (kho kho); Vietnamese (cây ca cao)

**BOTANIC DESCRIPTION**

*Theobroma cacao* is cauliflorous and semi-deciduous. The tree is low, reaching an average height of 5-10 m. The main trunk is short; branches in whorls of 5, dimorphic; vertical chupons growing from the trunk have leaves arranged in 5/8 phyllotaxy. The lateral branches (fans) have 1/2 phyllotaxy.

Petiole with 2 joined pulvini, one at the base and the other at the point of insertion of the leaf. Stipules 2, deciduous. Lamina elliptical-oblong or obovate-oblong, simple, 10-45 cm long; generally smooth, sometimes hairy, rounded and obtuse at the base, pointed apex.

Inflorescence dichasial; primary peduncle very short, often thick and lignified. Flower peduncle 1-4 cm long. Sepals 5, triangular, whitish or reddish in colour. Petals 5, joined at the base into a cuplike structure, whitish-yellow with dark purple bands adaxially; ligules spatulate, yellowish. Stamens 5, fertile, alternating with 5 staminodes, the 2 whorls uniting to form a tube. Anthers 2, stamens fused. Ovary superior with a single style terminating in 5 sticky stigmatic surfaces.

Fruit variable in shape, ovoid, oblong; sometimes pointed and constricted at the base or almost spherical, with 10 furrows of which 5 are prominent. Axial placentation, seeds embedded in mucilage, flat or round with white or purple cotyledons.

The generic name comes from the Greek 'theos' (god), and 'broma' (food) and means the 'food of the gods'.

**BIOLOGY**

Cacao is naturally out-breeding, and various insects are associated with its pollination, the main ones being thrips, midges, ants and aphids. It has a complex system of self-incompatibility. After successful pollination, fertilization takes place within 36 hours; the sepals, petals and staminodes drop away and the stamens and pistil wither. The young pod, known as the cherelle, begins to develop by longitudinal elongation, followed by increase in width. The period between fertilization and pod maturation varies from 150 to 180 days, depending on the variety. The pod turns light yellow when ripe and is ready for harvesting at this stage.



*T. cacao*, pound variety in CATIE germplasm collection, Turrialba, Costa Rica. (David Boshier)



*T. cacao*, drying seed, Limon, Costa Rica. (David Boshier)



*T. cacao*, dry seed. (David Boshier)

**ECOLOGY**

In its natural habitat, *T. cacao* is an understorey plant of forest in the wet humid tropics.

**BIOPHYSICAL LIMITS**

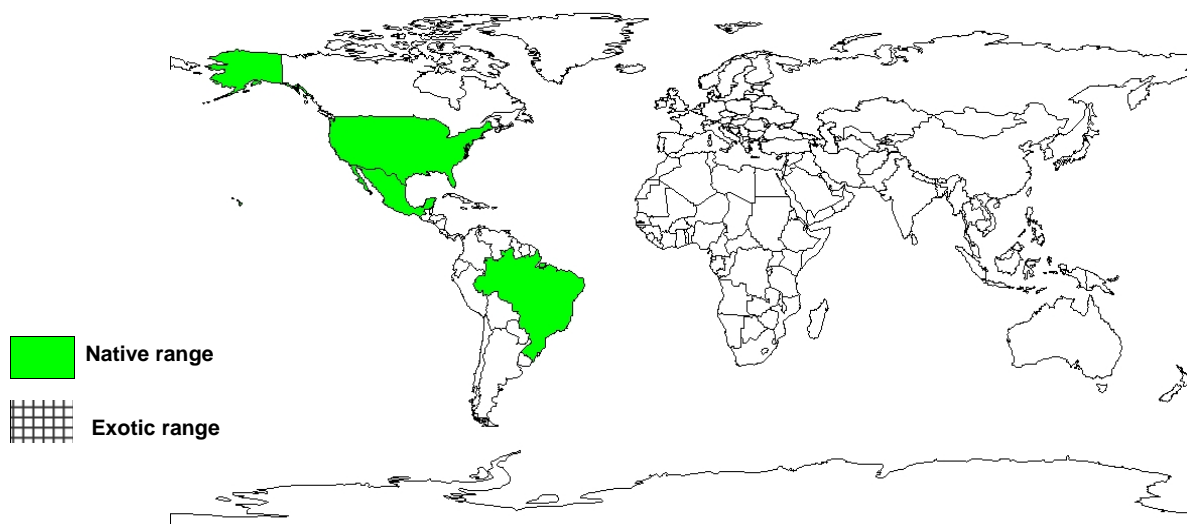
Altitude: 100-300 m, Mean annual temperature: 26 deg. C, Mean annual rainfall: 1 000-3 000 mm

Soil type: Cocoa is a tap-rooted plant and requires deep well-drained soils, free from iron concretions, high in nutrient content and a topsoil rich in organic matter.

**DOCUMENTED SPECIES DISTRIBUTION**

Native: Brazil, Mexico, US

Exotic: Belize, Cameroon, Colombia, Congo, Costa Rica, Cote d'Ivoire, Democratic Republic of Congo, Dominica, Ecuador, Gabon, Ghana, Guinea, India, Indonesia, Jamaica, Madagascar, Malaysia, Nigeria, Papua New Guinea, Philippines, Samoa, Sao Tome et Principe, Sierra Leone, Sri Lanka, Surinam, Tanzania, Togo, Trinidad and Tobago, Uganda, Venezuela



The map above shows countries where the species has been planted. It does neither suggest that the species can be planted in every ecological zone within that country, nor that the species can not be planted in other countries than those depicted. Since some tree species are invasive, you need to follow biosafety procedures that apply to your planting site.

**PRODUCTS**

**Food:** The cocoa bean, with up to 50% fat, is a valuable source of vegetable fat, cocoa butter. The residual cocoa powder is used in cakes, biscuits, drinking chocolate and other confectioneries.

**Fodder:** The cocoa-pod husk has a low alkaloid content, while tannin is practically absent. The crude fibre content is low; it is completely unignified and compares favourably with *Panicum maximum* and *Centrosema pubescens*.

**Fuel:** The cocoa bean testa has a calorific value of 16 000-19 000 BTU/kg, a little higher than that for wood.

**Lipids:** The ash from pod husks contains potassium oxide, which can be extracted in the form of potassium hydroxide, a useful alkaline in the saponification process. Cocoa-bean fat from unfermented cocoa beans can be extracted and used in soap making.

**Alcohol:** The cocoa-pod husk can be hydrolysed under pressure for fermentation into alcoholic drinks.

**Medicine:** The rural people in Amazonas State, Brazil, rub cocoa butter on bruises.

**SERVICES**

**Soil improver:** There is considerable nutrient cycling through the development of a deep leaf litter under the cocoa canopy.

**Intercropping:** Cocoa has traditionally been established in thinned forest following logging and 1-3 years of food-crop production before the canopy closes. Crops such as maize, cocoyam, yams and plantain are commonly intercropped with cocoa in Ecuador, Jamaica and West Africa.

**TREE MANAGEMENT**

Weeding and temporary shade are essential within the 1st 3-4 years of establishment before the canopy closes. Plantain appears to meet most of cocoa's requirements in this respect, whereas bananas compete heavily for moisture during the dry season. The young trees should be mulched before the onset of the 1st dry season to conserve soil moisture. Light pruning is recommended to remove low-hanging, broken and dead branches, as well as for the regeneration of fallen or damaged trees. Farmers plant cocoa at high densities of 3000-4000 trees/ha because the resulting tall trees develop fewer lateral branches and more vertical suckers. This encourages flowering on the main stem at the expense of branches, particularly suitable for some lower Amazon Forastero varieties.

**GERMPLASM MANAGEMENT**

Seed storage behaviour is recalcitrant. Storage temperature between 4 and 15 deg. C is damaging to seed viability and germination. Optimum storage temperature appears to be 17 deg. C. Seeds tolerate desiccation to 25% mc when dried at 20 deg. C, while only about 40-60% survive when dried at 10 deg. C; seeds stored in pods at 5 or 10 deg. C are killed within 2 days, and there is 100% survival when stored in pods at temperatures of 15-30 deg. C for 3 weeks. Viability is reduced from 92% to 18% on desiccation from 45% to 36.7% mc; no seeds survive desiccation to 26% mc; 24% germination after 8 months subimbibed storage (41-42% mc) at 98% rh and 20 deg. C with Thiram fungicide. Similarly, no seeds survive desiccation to below 20% mc, and no fresh seeds survive in storage at 4 deg. C or 15 deg. C.

**PESTS AND DISEASES**

Pests include cacao mirids, which feeds on pods and branches, earia (*Earias biplaga*), mealybugs, stem borers and shot-hole borers.

Diseases that attack cocoa, causing considerable damage, include the swollen shoot disease, a viral disease spread by mealybugs, whose symptoms appear as stem and root swellings; black pod disease caused by *Phytophthora palmivora*, causing rotting both large and small pods in the wet season; charcoal rot caused by *Botryodiplodia theobromae*; root rots caused by *Armillaria mellea*, *Fomes noxius* and *F. lignosus*; twig and leaf diseases such as pink disease caused by *Corticium salmonicolor*, thread blight disease caused by *Marasmius scandens*, calonectria die-back caused by *Calonectria rigidiuscula*; and cushion gall disease caused by the same organism.

**FURTHER READNG**

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**SUGGESTED CITATION**

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