Factsheet
Botanical Data: Camu Camu

Myrciaria dubia (H.B.K.) Mc Vaugh

Project

Drafting botanical monographs (factsheets) for five Peruvian crops

Factsheet – Botanical Data: Camu camu – Myrciaria dubia (H.B.K.) Mc Vaugh

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I. BOTANY

Genus. *Myrciaria* Berg includes fifteen species (21) and belongs to the Myrtaceae family. It is an exclusive New World genus, distributed from Mexico to Uruguay. *Myrciaria* species are shrubs or trees with inflorescence in axillary glomerulus containing 4 – 6 hermaphroditic flowers which hold a tetramerous perianth with bracteoles fused to one-third of its length. Calyx falls after anthesis, and embryons with fused cotyledons develop inside its seeds.

Morphology. *Myrciaria dubia* (Kunth) McVaugh [= *Psidium dubium* Kunth] is a tall evergreen shrub or short evergreen tree, 3 (- 8) m tall, growing along riverbanks of black water rivers and oxbows in seasonally flooded, Amazonian riverine forests. There it forms dense stands amidst semi-open vegetation. Trunk is smooth, 10 cm – 15 cm in diameter, very ramified, with profusely developing basal offshoots; branches are thin and droop slightly. Trunk bark is coffee to grayish colored and regularly shed in thin layers (1, 16, 21, 22).

Leaves are opposite, simple, entire, without stipules and have one petiole, 1.5 mm – 3 (- 6) mm long and close to 1 mm wide. Leaf blades are lanceolate to elliptical, 4.5 cm – 10 cm long x 1.5 cm – 4.5 cm wide, with acute tips, rounded base, glabrous sides, and covered with glands. Upper side is dark green and somewhat shiny, while lower side is opaque and light green.

Venation consists of one prominent main vein and up to twenty pairs of secondary veins. The latter are set at a 45º angle to the main vein and curve towards the tip. Axillary inflorescences normally have four hermaphroditic flowers, in two opposite pairs along the 1.0 mm – 1.5 mm long axis.

Bracts and bracteoles persist. The roughly 2 mm x 2 mm calyx is comprised of four sepals, has a widely rounded tip, and falls circumscissily after anthesis. Four white, ovate petals are 3 mm – 4 mm long with a ciliated margin. There are close to 125 stamens per flower, 7 mm – 10 mm long with 0.5 mm – 0.7 mm long anthers. From the inferior ovary sprouts a simple, 10 mm – 11 mm long style (8, 21, 22,).

Tree produces a very tart, edible, round berry, 1 cm – 3 (- 5) cm in diameter, which has a rounded hypanthial scar at the top, and, when mature, is reddish brown to purplish-black; inside, the soft pulp envelopes 2 – 3 (-4) seeds, which are kidney shaped, 8.5 mm x 5.5 mm – 11 mm. Fruit is particularly high in Vitamin C, reaching maximum levels when these are mature (1, 20, 23).

Variability. Largest natural populations, most varieties, and greatest genetic variability are found in Peru's Amazon, and it is highly probable species originated in its western sector (1, 20). Results of germplasm tests describe the origin of twenty-three different populations located in towns around these rivers: Ucayali, Tapiche, Yarapa, Nanay, Itaya, Ampiyacu, Apayacu, Oroza, Napo, Tahuayo, and Amazon, all within the department of Loreto (10). Characterization has led to identification of five ecotypes, with varying fruit yields.

II. DIAGNOSTIC FEATURES AND POSSIBLE CONFUSIONS.....

Aside from M. dubia, only one Myrciaria species is recognized in Peru: Myrciaria floribunda (West ex Willdenow) Berg, known by the vernacular name of "camu camu tree" (3, 21, 22). Differences between M. dubia and M. floribunda are in leaf morphology, height, and population density. For example, petiole of the M. floribunda leaf is remarkably shorter (0 mm – 1.5 mm long). Leaf tip is acute to largely acuminate. Secondary veins are set at a 60º angle to the main vein and curve towards the leaf margin. Also, M. floribunda is generally a tree growing to fifteen meters in height. M. dubia populations are made up of many individual trees, whereas M. floribunda trees normally live in isolation.

Table 1: Diagnostic features of Peruvian *Myrciaria* species (21, 22)

Feature	***M. dubia***	***M. floribunda***
Petiole of the leaf	1,5 mm – 3(- 6) mm	0 – 1,5 mm
Secondary veins	45º angle to the main vein; curve towards the tip	60º angle to the main vein; curve towards the margin
Leaf tip	Acute	Acute to largely acuminate
Height	3 m (—8) m	To 15 m
Population density	Dense stands	Generally isolated individuals

III. DISTRIBUTION.....

Worldwide distribution. M. dubia is an important component of the vegetation de los bosques riparios= RIPARIAN FOREST in Peru (Loreto and Ucayali) Brazil, Venezuela, and Colombia's seasonally flooded, riverine forests. It is also found in Ecuador (12, 18), Bolivia, and the Guyanas, reasons why there is a large diversity of vernacular names: camu camu, camocamo (Peru), algracia, guayabillo blanco, guayabito, limoncillo (Venezuela), azedinha, cacari, miraúba, and muraúba (Brazil).

Distribution in Peru. Species is highly abundant in the Peruvian Amazon where it grows on lakeshores and on riverbanks associated with the Napo, Nanay, Ucayali, Marañón, and Tigre rivers (16, 20, 21). It is also cultivated in Satipo (Junin) (6).

Table 2: Estimates of frequency and distribution of *M. dubia* in Peru, based on herbarium specimens from USM, HUT, HAO, AMAZ, CUZ, HUSA and on field observation.

Region	**# of specimens**	**# of provinces**	**Estimated frequency**
Amazonas	-	0 / 0	Unknown
Cuzco	-	0 / 0	Unknown

Junín	-	0 / 0	Unknown
Loreto	26	3 / 6	Locally abundant
Madre de Dios	-	0 / 0	Unknown
San Martin	-	0 / 0	Unknown
Ucayali	1	1 / 4	Rare

IV. ECOLOGY AND POSSIBLE CULTIVATION AND HARVESTING AREAS.....

Habitat. Natural area for *M. dubia* is riverine vegetation in seasonally flooded, Amazonian forests, especially along the Peruvian-Brazilian border. It often forms large thickets of up to 8700 individuals/ ha in the floodplain of rivers there (16). Associated species are, for example, *Eugenia inundata* DC. (Myrtaceae), *Laetia americana* L. (Flacourtiaceae), and *Symmeria paniculata* Benth (Polygonaceae). *M. dubia* grows only in regions with more than 1.5 mm of annual precipitation and temperatures above 20º C. Altitudinal limit of its natural distribution appears to be 200 m – 300 m (8).

There are no available population studies of this species, yet four *Myrciaria floribunda* stands in the Ucayali River basin floodplain were found to contain between twelve and thirty-one individuals/ ha, where distribution pattern of the individuals is grouped (5) and greatest number of trees grow in depressions with poor drainage.

Growth. *M. dubia* flowers in yearly cycles, usually beginning in the dry season. Production continues as the rivers rise and ends with the flood waters. Moreover, there is a direct relationship between flooding and fruiting where the longer it takes for flooding to reach its zenith, the more the tree fruits (16). Total phenological reproduction cycle takes seventy-seven days: flowering lasts fifteen days and fruit formation and maturation takes sixty-two days. Effective flower fertility of those that produce mature fruit is 27% (11).

Initial seedling growth is slow, so much so that trees do not surpass 50 cm until after one year; then they are ready for planting. Once in the ground, it grows quite rapidly to a height of 1.5 m – 2.0 m. First fruits are produced during the second or third year but could be prolonged until the fifth in less than optimal cultivation areas (8, 13).

V. CULTIVATION AND USE

Camu camu is a popular fruit throughout the Peruvian Amazon, and there is a growing market for it in the city of Iquitos (16).

Cultivation. *M. dubia* has been cultivated since 1996 (15), and one experimental crop in Peru, sown around 1997, has shown promising results. However, the crop has not yet been commercially successful for two reasons. First, farmers have not received proper technical support (19), and, second, seeds were not adequately selected at the start, i.e. not considering the best mother plants (elevated fruit production, good color, high Vitamin C content). On another note, cultivation has been tested in non seasonally flooded areas with promising results, showing a prolonged harvesting period from November to May (20).

Camu camu can even be cultivated in clayey oxisols above the flood line yet only in lower elevations (< 500 m). Nevertheless, better proven cultivation methods that produce large volume, high quality harvests and facilitate early fruiting should be chosen and consider such factors as fruit size, color, and Vitamin C content.

Soil. *M. dubia* flourishes in nutrient rich, clay soils in the Amazon floodplain as well as in nutrient poor, sandy soils on the banks of Amazonian black water rivers (16, 23).

Sexual propagation. This Amazonian tropical fruit propagates through seeds without any problems. The advantage here is the amount of seeds made available for massive seedling production, yet the downside is genetically non-uniform seedlings on account of its allagamous nature. Seed drying and cold storage destroy its capacity to germinate. Therefore, that seeds retain that capacity longer, they need to be stored in warm moist places (20º C at 45% humidity) (7).

When seeds are sown two days after having been taken from the fruit, they germinate rapidly (two to three weeks). After three days, germination rate drops below 90%; after one month, rate is 0% (8). If seeds are stored in fresh water (changing this every week), they can survive up to six months (13). Sowing should be done after seeds germinate in plastic bags filled with a layer of sawdust.

Vegetative propagation. Camu camu can be propagated through grafting. Bud grafting was the first technique attempted, and it achieved satisfactory results; yet, the plant did not develop typical shrub-like characteristics since lower branches did not belong to the graft and thus had to be lopped off (4). Grafting has spread throughout the Ucayali region (city of Pucallpa), and tests run in commercial plots have demonstrated good results; however, plants still need to be pruned to give them the desired architecture, and basal shoots of the stock also need to be frequently eliminated.

Preliminary testing in the department of Loreto shows that grafts do not develop the intended architecture. Wood grafts have been cited but without further commentary about their pros or cons.

Second technique consists of rooting cuttings, i.e. stem and branch portions of a tree taking root in regularly irrigated farm land covered with sawdust. Best results were gotten from 2.5 cm – 3 cm diameter cuttings. In three months, 40% - 50% had taken root. The only downside is the high mortality rate in the final field. Aerial layering has also been attempted (9); this method is used when tree or shrub species present difficulties in rooting cuttings and consists of developing roots from a stem or branch without cutting it from the mother plant. At the San Roque Experimental Station in Iquitos, Peru, they have set up an experimental field named “Muyuy” where experiments on different types of aerial layering and wrapping have been conducted.

Both methods produce early fruiting, yet tree cultivation is frequently far from satisfactory and cuttings show elevated mortality rates after planting. It is not yet known if using young stems as scions might help overcome the last problem.

Harvesting and yield. Harvesting natural *M. dubia* populations is technically difficult since flood season and harvesting season occur at the same time (December – March) and only fruits above the water line can be reached from canoes (1, 20), meaning there is a limited number of available fruit. As well, natural populations only produce 9.5 tons – 12.7 tons/ ha/ year (17), whereas productivity in orchards is much more elevated.

Sustainability. Using canoes to help harvest the fruit assures harvested volumes will have a very limited influence on future population development. Moreover, a common harvesting technique for ease of harvesting fruits, yet very damaging as well, is the lopping off of branches or felling of complete trees, which will lead to natural population degradation. This method should be halted and replaced with others that do not threaten natural populations.

VI. POST HARVEST

Fresh fruits have a limited shelf life, lasting just a few days, so when it comes to large orchards or an extensive harvest of natural populations, this only makes sense if there is a nearby market and/ or processing or preserving facility (especially refrigeration) (19). Chemical analysis uncovered that camu camu fruit is exceptionally high in Vitamin C, containing 1500 mg – 2000 (- 3130) mg of ascorbic acid per 100 gr. of fresh pulp (1, 2, 16). In mature fruit, potassium is the major element and can be classified as important in terms of nutritional physiology (23). Similarly, percentage of ascorbic and dehydroascorbic acid, simple sugars (fructose and glucose), and some amino acids (serine, valine, and leucine) in pulp of mature fruit is considerably higher than in immature or semi-mature fruit.

Therefore, fruit should be harvested when they are ripe and either sold or processed within the next three to four days (8). Sometimes, fruit is eaten with salt in South America (16).

1: Camu camu cultivation

2: Habit

3: Branch with flowers

4: Flower

5: Branch with flowers

6: Fruit

Photos: 1: GTZ; 2, 3, 4, 5: Zoila María Vela Clavo; 6: José Roque

VII. LITERATURE

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