Virola koschnyi Warb.

E.M. FLORES
Academia Nacional de Ciencias de Costa Rica, Costa Rica

MYRISTICACEAE (NUTMEG FAMILY)

Virola merendonis Pittier (Contributions from the US National Herbarium 20: 453; 1922)

Banak, bogabani, bogamaní, cebo, cedrillo, cedro bastardo, drago, fruta dorada, miguelarillo, mollejo, sangre, sangre drago, tabeque, wild nutmeg (Flores 1992c, Longwood 1971)

Central America, including Belize, is the natural range of *Virola koschnyi* (Duke 1962a, 1962b; Standley and Steyermark 1946). The tree is common along the Atlantic and Pacific lowlands and is an element of the upper canopy in the lowland moist and wet tropical forests. It is also frequent in primary and secondary forests.

Virola koschnyi is a tree that reaches 30 to 45 m in height and 1.0 to 1.5 m d.b.h. The bole is straight and cylindrical in the distal two-thirds; the basal third has heavy buttresses of 1.0 to 3.0 m. The branch system extends horizontally and forms an extended flat crown over the strong monopodial axis (Flores 1992c). The bark is reddish or brownish red, with a moderate or rough texture and small vertical fissures. The inner part is smooth and spongy and contains sour, watery, yellow-red latex. The exudate acquires a brownish red color. The average bark thickness is 1.0 to 1.3 cm (Flores 1992c). The leaves are simple, petiolated, alternate, exstipulated, coriaceous, obovate or lanceolate shaped, with a symmetrical or attenuate base, cuspidate or acuminate apex, entire margin, and pinnate brochidodromous venation. It reaches the best growth in zones with alluvial or sandy soils, where it forms monospecific stands; however, it can be found growing in clay soils, poor in litter, acidic (pH = 5.0 to 5.7), with high levels of iron and aluminum and a low content of primary elements such as phosphorous and potassium (Chávez and others 1991, Flores 1992c). The tree grows where temperatures range from 24 to 35 °C and the annual rainfall is 3500 to 6000 mm. The elevation range of the species if 10 to 1200 m, with the highest density found below 500 m. It inhabits the lower part of hills and the edges of rivers and ravines.

The transition from sapwood to heartwood is gradual. The sapwood is clear yellowish gray in green condition, and the heartwood is grayish orange; in dry condition, the heartwood is light and golden brown, grayish orange or grayish red. It resembles some of the light-colored mahoganies (Longwood 1971). Growth rings are seen easily as narrow, regular, dark bands. The wood has moderate texture, homogeneous and uniform, straight grain, low luster, and attractive figure due to the combination of the silver jasper with the dark-colored rays. The green wood is slightly aromatic and tasteless (Flores 1992c). It is moderately light (green weight 725 to 780 kg per m^3; with 77 to 102 percent moisture content; basic specific gravity is 0.44) (Herrera and Morales 1993, Llach 1971, Longwood 1971). The wood has good dimensional stability; air-drying is fast; it is easy to saw and has excellent brushing properties. It does not present defects when worked by hand or by machine. The wood has low resistance to fungal and termite attacks, as well as attacks from other insects; however, it is easy to impregnate and preservative penetration is fast, complete, and uniform. After cutting, it cannot remain on the ground for long periods because it is attacked severely by fungi (*Polyporus, Hexagonia, Pignoporus, Xylaria, Candelaria, Daldinia, Trametes*) (Flores 1992c). The wood is used primarily in plywood; however, it can be used also in boards, panels, cabinetwork, furniture, poles, boxes, matches, and ship ornaments (Flores 1992c, Llach 1971, Longwood 1971). According to Peteri's coefficient of elasticity and the Runkel factor, the wood corresponds to group II and is suitable for the production of pulp for paper (Van der Slooten 1971). The South American Indians were aware of the hallucinating properties of the resins obtained from the bark, the fruit, and the leaves of different species of *Virola*. Diverse Indian tribes have used these resins and extracts in their rituals and ceremonies for several centuries (Flores 1992c, Schultes and Hoffman 1983, Schultes and Raffauf 1990).

The trees bloom from September to November, although they frequently bear flowers in December. The trees bloom intensively every 2 years. Anthesis occurs in the early

morning and pollination is entomophilous. Flowers are unisexual, actinomorphic, small, pedicellated, and clustered in short axillary panicles. Fruit development lasts 6 months. Fruit ripening occurs primarily in February and March, although there is a smaller crop in June. Fruits are fleshy, bivalve, subglobose or elliptic, dehiscent, 22 to 30 mm wide, and 30 to 35 mm long. There are variations in fruit size among different trees growing in the same area as well as on the same tree. Most seed dispersal is carried out by birds and mammals; gravity causes some fruits to fall. Some tropical fish disperse the fruits that fall into rivers (Flores 1992c, Howe and Vande Kerckhove 1980). Seeds are ovate, 15 to 25 mm long by 14 to 20 mm wide, surrounded by a laciniate aril, exostomic, funicular in origin, and reddish orange.

Seed weight varies from 1.6 to 3.4 g, and seeds average 400 to 600 per kg, depending on size and moisture content (Flores 1992c). Seed behavior is recalcitrant. Germination is 80 to 85 percent, and seed viability lasts 1 to 12 days. In fresh seeds, the moisture content is 26 to 28 percent. Seed viability declines when moisture content is reduced by more than 20 percent. Germination is epigeal and seedlings are cryptocotylar (Flores and Rivera 1989a). Radicle protrusion occurs in 11 to 14 days (Flores 1992c).

Under natural conditions, 95 percent of seedlings die in the first 12 weeks due to insect and mammal predation. Seedlings are shade tolerant but demonstrate a vigorous growth in forest clearings. Seedling growth is slow the first 4 years and then increases. Six-month-old seedlings have an average height of 50 cm; 6-year-old saplings have an average height of 10 to 11 m and a diameter of 13 to 14 cm (Chávez and others 1991, Flores 1992c).

Fresh seeds without an aril must be sown in sand beds or plastic bags filled with substrate. Production in bags takes about 5 months. The species can be used in monospecific plantations or mixed with other species. The planting distance commonly used is 3 by 3 m. The site must be cleaned every 4 months during the first year after seedlings are transplanted. Soil fertilization with nitrogen-phosphorous-potassium (10-30-10; 50 g per tree) improves growth and sapling vigor (Flores 1992c).

ADDITIONAL INFORMATION

The genus name derives from the Latin *viriola* (bracelet), in reference to the aril surrounding the seed.

The midvein is thick, straight, secondary veins are parallel among them and uniformly spaced, each 1.0 to 1.1 cm; the angle of divergence with respect to the midvein is moderate and uniform. Tertiary veins are simple and transverse. Petioles are adaxially grooved. Young leaves and twigs are pubescenct and ferruginous; hairs are of the candelabrum type. The leaves are hypostomatic; stomata are of the paracytic (rubiaceous) type.

The panicles have membranaceous, deciduous bracts, 4 to 5 mm long. Floral perianth is reduced; calyx is trimerous, campanualte, tepaloid, gamosepalous, yellowish, and 2 to 3 mm long; sepals are crenate, with ciliate margin, and adaxially strigose. Staminate inflorescences have several flowers; each flower has three monadelphous, syngenesious stamens 2.0 to 2.5 mm long; anthers are elliptic and basifixed, with longitudinal dehiscence. Pistillate inflorescences have three to seven flowers; female flowers are hypogynous and monocarpic; the unilocular gynoecium encloses a single ovule; the ovule is anatropous, bitegmic, crassinucellated, and nearly sessile. Placentation is pseudobasal (Flores 1992c).

Fruit exocarp is coriaceous and brown-ferruginous, with stellate trichomes; mesocarp-endocarp is whitish, fleshy, with essential oils strongly aromatic and irritating. These oils are formed by benzofuranoid neolignans (Lemus and Castro 1989). The epidermal tissue surrounding the locule is shiny and irregular due to the impression left by the seed aril.

Seedcoat is formed by a hard testa and a ruminate tegmen. The exotesta is creamy or light brown, soft, and vascularized; the mesotesta is black, hard, lignified, and highly vascularized. The endotesta is sclerenchymatous and lignified. The tegmen is fleshy, massive, highly vascularized, and ruminated penetrating the endosperm. It dehydrates and thins with fruit ripening, acquiring a papiraceous texture (Flores 1992c). The endosperm is white, ruminated, massive, and oily. It is nuclear in the immature seed and cellular in the mature seed. The seed lacks perisperm. The embryo is straight, basal, capitate, and minute (1.0 to 3.0 mm long), with vestigial and divergent cotyledons. They develop and become haustorial during germination (Flores 1992c).


1cm
2cm
2cm
3cm