Plants that Vulcanized Rubber

Parque Nacional Yaxha, Nakum and Naranjo
Reserva de la Biósfera Maya (RBM)
Petén, Guatemala

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FLAAR MESOAMÉRICA

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FOR PROVIDING STORAGE SPACE FOR OUR CAMPING EQUIPMENT AND OTHER SUPPLIES

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- ### FRONT COVER PHOTOGRAPH

  Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Parque Nacional Yaxha. Dec. 23, 2018.
  Camera: Nikon D810. Settings: 1/250; sec; f/9; ISO 1,000

Ecolodge El Sombrero,
Parque Nacional Yaxha, Nakum y Naranjo

We thank Gabriella Moretti, owner of Ecolodge El Sombrero, for providing hotel room and meals while we have been doing field work at Parque Nacional Yaxha, Nakum and Naranjo. We also appreciate the hospitality of her sons Sebastian de la Hoz and Juan Carlo de la Hoz. Every workday is exhausting because we are carrying and then using very heavy cameras and equipment.

Thus it is crucial for my health to be able to rest and totally recuperate every night in order to be ready for the following day of botanical and zoological adventures in Parque Nacional Yaxha, Nakum and Naranjo. Equally crucial is having a place to charge the batteries of the computers, plus all the cameras, and recharge cell phones. So a place with enough electricity to charge the entire mass of essential field work equipment is essential and thus very much appreciated.

We also sincerely appreciate the storage space for our camping equipment: tents, camping mattresses, cooking equipment, etc. There is no way to drive this volume of equipment back-and-forth from Guatemala City to where we may be camping in a remote area of the Reserva de la Biosfera Maya during the following months.

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What is coagulation and vulcanization?

Coagulation refers to the process in which a latex is colloidally destabilized in such a way that an aggregation or union of the particles of the dispersed phase occurs, separating from the dispersion medium (Cahueque Acosta, 2008)

Vulcanization is a chemical process in which the rubber is heated with sulphur, accelerator and activator at 140–160°C. The process involves the formation of cross-links between long rubber molecules to achieve improved elasticity, resilience, tensile strength, viscosity, hardness and weather resistance. (Nair, 2014) Basically, what vulcanization does is that changes the material from a formable viscoelastic to a highly elastic substance capable of returning to its original shape after large deformation.

Merremia umbellata
Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Parque Nacional Yaxha. Dec. 12, 2018.
Camera: Nikon D810. Settings: 1/250; sec; f/9; ISO 2,000

Merremia umbellata
Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Parque Nacional Yaxha.Dec. 23, 2018.
Camera: Nikon D810. Settings: 1/250; sec; f/9; ISO 640

Rubber tree latex sap must be vulcanized
or coagulated before it can bounce

If you collect latex sap from the Olmec and Maya native rubber tree (of Mexico, Guatemala, Belize, Honduras, etc), this latex from *Castilla elastica* is not yet rubberlike. To make latex sap become rubbery you must add a chemical, boil it, and only then the tree sap is "bounceable."

People in the USA are taught that Thomas Goodyear invented vulcanization in the 1840's. But the Olmecs of Mexico discovered how to process latex to make rubber about 3000 years before any american figured it out. The Olmecs "coagulate" the latex without needing sulfur. Botanists (Standley and colleagues), ethnobotanist (Suzanne Cook for the Lacandon Maya), ethnohistorians, and chemists (Tarkanian and Hosler) have found Aztec and Maya references to which plants were used to prepare their rubber balls. Our interest is to learn which of these plants are native to Peten (Guatemala) in general and how many of these plants we can find and photograph in Parque Nacional Yaxhá Nakum Naranjo (a large national park in Guatemala between Tikal and the Peten-Belize border).

The chemicals used by the Olmec, Maya, Aztecs, Mixtecs, Zapotecs and everyone else all are from plants that we have now discovered growing in Parque Nacional Yaxhá Nakum Naranjo (Peten area, Guatemala). The Olmecs had these plants for processing rubber in Veracruz; the Maya had these plants in Tabasco, Campeche, Quintana Roo, Belize, Izabal, Alta Verapaz and Peten. Any the other civilizations could import processed rubber from Peten, Chiapas, Tabasco, Costa Sur, etc.

The Maya, Teotihuacan, Olmec and El Tajin civilizations (of Veracruz), the Zapotecs (of Monte Alban), Mixtecs (also of Oaxaca), the Toltecs, Aztecs: they all knew how to vulcanize rubber centuries before either Thomas Goodyear or Thomas Hancock (UK) claimed patents in the 1840's. In many parts of Mexico, the local indigenous people still use local plants to coagulate latex to make the rubber bounceable. MIT chemists Tarkanian and Hosler have documented the use of chemicals from the Ipomoea alba vine as the primary coagulant. By iconic coincidence FLAAR has been doing research for many years in a remote Q'eqchi' Mayan village whose modern name. Senahu, is a Spanish mispronunciation of the Q'eqchi' Mayan word for ***Ipomoea alba.***

And, through years and years of field work, we have found other areas of Guatemala where other plants which can produce coagulation of latex (more than just *Ipomoea alba*) grow physically near *Castilla elastica* trees. During considerable library research we have learned of two plants other than just *Ipomoea alba* that can fully coagulate latex (any one of the three plants has the pertinent chemicals).

During thirteen one-week field trips to Parque Nacional Yaxhá Nakum Naranjo in 2018-2019, we located the three plants which can coagulate native Maya rubber. To our knowledge, this is the first documentation of all rubber processing plants within one area of Mesoamerica. Surely in Chiapas, Veracruz, Belize, Honduras there would be other comparable biodiverse ecosystems, but at present, Parque Nacional Yaxhá Nakum Naranjo is the first documented photographically with high-resolution digital images. Then in May of 2022, during our Reserva de la Bióffera Maya (RBM) project, we visited the La Gloria forestry concession and we found *Merremia umbellata.* This place with incredible ecosystems and the species that inhabit there have barely been studied and documented. Also, we have documented *Merremia umbellata* in Parque Nacional Laguna del Tigre.

So, let's learn about all three native Maya plants that can process latex of the native Maya rubber tree, *Castilla elastica*. We will do this in two volumes: one on the two "additional coagulants" (*Merremia tuberosa* and *Merremia umbellata*) and one volume on the already well-known coagulant, *Ipomoea alba.*

So far, most *Castilla elastica* trees that we have found are in Alta Verapaz. Both *Ipomoea alba* and *Merremia tuberosa* are also in Alta Verapaz. Ipomoea alba is common all around the Lake Yaxhá in Parque Nacional Yaxhá Nakum Naranjo.

If local people plant the tree and vines for coagulating around their homes, they can form a village cooperative to make rubber balls to sell to tourists. "Mayan Rubber Balls from authentic Mayan Rubber Trees" will become popular with visitors. FLAAR has two decades of experience in generating marketing, so we would be glad to assist local villagers.

Merremia umbellata
Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Parque Nacional Yaxha. Jan. 1, 2019.
Camera: Nikon D5. Settings: 1/250; sec; f/13; ISO 4,000

Merremia umbellata
Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Parque Nacional Yaxha. Dec. 23, 2018.
Camera: Nikon D5. Settings: 1/320; sec; f/13; ISO 4,000.

PART I: *MERREMIA UMBELLATA*

Full Botanical Name

Merremia umbellata (L.) H. Hallier

Plant family Convolvulaceae, sometimes known as *Ipomoea*

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Here are synonyms for *Merremia umbellata*

Most botanists, use the accepted name. But it nonetheless helps to know the synonyms:

- *Convolvulus aristolochiifolius* Mill.
- *Convolvulus caracassanus* Willd. ex Roem. & Schult.
- *Convolvulus cymosus* Desr.
- *Convolvulus luteus* M. Martens & Galeotti
- *Convolvulus multiflorus* Mill.
- *Convolvulus sagittifer* Kunth
- *Convolvulus umbellatus* L.
- *Ipomoea cymosa* (Desr.) Roem. & Schult.
- *Ipomoea modesta* Choisy
- *Ipomoea mollicoma* Miq.
- *Ipomoea pilosa* Houtt.
- *Ipomoea polyanthes* Roem. & Schult.
- *Ipomoea portobellensis* Beurl.
- *Ipomoea sagittifer* (Kunth) G. Don
- *Ipomoea sepiaria* Zoll. and Mor.
- *Ipomoea tonkinensis* Gagnep.
- *Ipomoea umbellata* G.F.W. Mey.
- *Merremia tonkinensis* (Gagnep.) T. N. Nguyen

Merremia umbellata
Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Parque Nacional Yaxha. Dec. 23, 2018.
Camera: Nikon D810. Settings: 1/250; sec; f/9; ISO 640.

Local names for *Merremia umbellata*

- Quilamulillo (Guatemala)
- Cajete (Guatemala)
- Amole De Venado (México)
- Bejuco Manzo (México)
- Hogvine (Belize)
- Campanilla (México)
- Cuajo De Hule (El Salvador)
- Cuelga-Tabaco (El Salvador)
- Jícama Cimarrona (El Salvador)

(Carranza, 2008)

Mayan names for *Merremia umbellata*

K'anal puyu' and it means yellow puyu' (Breedlove and Laughlin 1993: page 134)

Habit for for *Merremia umbellata*

Vine.

Merremia umbellata
Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Parque Nacional Yaxha Dec. 23, 2018.
Camera: Nikon D5. Settings: 1/320; sec; f/13; ISO 4,000.

Merremia umbellata
Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Petén, Guatemala. Jan. 10, 2022.
Camera: iPhone 13 Pro Max.

Habitat for *Merremia umbellata*

Native to humid tropics occurring along the edges of forests, in grasslands, roadsides and waterways, from sea level up to 1500 - 1600 m (Standley, 1958; Fang and Staples, 1995). Although it is common in forest situations, it favors more open situations along the edges of fields, plantations and water bodies. Barnes and Chan (1990) indicate that it also favors sandy soils.

Botanical Description of *Merremia umbellata* by Standley and Steyermark (1958)

Perennial vine with climbing or trailing stems up to 3 m or more in length, glabrous or softly hairy. Leaves alternate, petiolate, narrowly to broadly ovate, 10–15 cm long, base cordate, rarely hastate, margin entire, apex emarginate, acute to acuminate. Inflorescences umbelliform cymes, few to many flowered, on peduncle 1–5 cm long; calyx 5–8 mm long; corolla funnelform, 2–4 cm long, bright yellow, white or orange. Fruit is a capsule, ovoid to conical, 10–15 mm long. (Standley and Steyermark 1958)

Where has *Merremia umbellata* been found in the Petén?

It is found throughout Petén.

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Merremia umbellata **can be found in** Parque Nacional Yaxhá Nakum Naranjo

Merremia tuberosa we knew well before we came to Yaxhá because literally thousands of *Merremia tuberosa* vines grow along the road that we drive almost every three months to remote mountain areas of Alta Verapaz. So, it was easy for us to explain to the park rangers at Yaxhá where to expect *Merremia tuberosa* and what it would look like.

But *Merremia umbellata* I had not previously noticed in Guatemala. We found it by coincidence, by hiking into as many remote ecosystems in PNYNN as possible. Every time we found a stream bed or an aguada or humid savanna, we automatically photograph every flowering plant that we see. Then back in the office these photographs are studied by Elena Siekavizza and by Senaida Ba. They have available the FLAAR library on flora of Mesoamerica. So, month by month they found that many of the yellow flowers of vines throughout the PNYNN turned out to be *Merremia umbellata.*

Merremia umbellata in Belize

Merremia umbellata (L.) Hallier f. Habit: vine, habitat: forest

(Balick, Nee and Atha 2000: 292)

Is *Merremia umbellata* from the Highlands or from the Lowlands (or both)?

You can find *Merremia umbellata* across Guatemala, Mexico, Belize and down into lower Central America.

Click here to read more.

Merremia umbellata
Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Parque Nacional Yaxha. Feb. 16, 2019.
Camera: Nikon D810. Settings: 1/200; sec; f/11; ISO 1,600

In which States of Mexico is *Merremia umbellata* listed by Villaseñor

Merremia umbellata grows in almost every part of Mexico: CAM, CHIS, COL, DGO, GTO, GRO, HGO, JAL, MEX, MICH, MOR, NAY, OAX, PUE, QRO, QROO, SLP, SIN, TAB, TAMS, VER, YUC (Villaseñor 2016: 705-706).

Do *Merremia umbellata* also grow in home gardens?

Yes, *Merremia umbellata* is grown in home gardens (Sunshine Seeds, 2016).

Uses of *Merremia umbellata*

Is cultivated as an ornamental climber for its showy yellow (or white) flowers and has been introduced in several countries for this purpose (Austin, 1979; Smith, 1991). Arellano Rodríguez et al. (2003) report it as a melliferous plant (one that can be used by insects for producing honey) in Yucatán, Mexico.

Is there potential medicinal usage of *Merremia umbellata* by local people

Yes, *Merremia umbellata* due to its anti-inflammatory and antioxidant properties it can be used to treat infections and edema. (Castro et al., 2013)

***Merremia umbellata* has** potentially edible leaves

People in Malaysia eat the leaves

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But we have not yet located documentation of Mesoamerican people eating the leaves (so a lot more research to accomplish). But first we want to publish the presence of the two *Merremia* species at Yaxha park.

What are the primary pollinators of *Merremia umbellata* flowers?

Is majorly pollinated by bees, hummingbirds, butterflies, beetles, and bats. (Carranza, 2008)

Merremia umbellata
Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Parque Nacional Yaxha. Dec. 23, 2018.
Camera: Nikon D810. Settings: 1/250; sec; f/9; ISO 1,000

Close relative(s) of *Merremia umbellata*

- *Merremia peltata* is distributed in Africa and Southeast Asia including many islands in the Pacific where it is considered invasive (Staples, 2010). It differs in having larger, almost round, peltate leaves, up to 25 cm long, and larger flowers with sepals over 15 mm, corolla (white or yellow) 5-6 cm long.

- *Merremia bracteata*, a newly described species known only from the Solomon Islands (Bacon, 1982), is also a more robust plant with stems up to 20 m, cordate leaves about 25 cm long and yellow flowers 5 cm long, distinguished especially by the presence of bracts surrounding the flowers, up to 3 cm long (absent in *M. peltata* and *M. pacifica* and minute in *M. umbellata*).

- *Merremia pacifica*, found in several islands in the Pacific, and troublesome on the Solomon Islands, is close to *M. umbellata* in size of leaves and flowers but has a rugose leaf texture and pure white flowers. It is restricted in distribution, known only from Fiji and a few other islands, including New Georgia, Kolombangara and Gizo (Bacon, 1982).

Merremia umbellata
Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Parque Nacional Yaxha. Jan. 22, 2018.
Camera: Nikon D5. Settings: 1/800; sec; f/13; ISO 4,000

PART II:
MERREMIA TUBEROSA

Full Botanical Name

Merremia tuberosa (L.) Rendle

Plant family Convolvulaceae, sometimes known as Ipomoea

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Here are synonyms for *Merremia tuberosa*

- *Batatas tuberosa* (L.) Bojer
- *Convolvulus gossypiifolius* Kunth
- *Convolvulus kentrocaulos* Steud. ex Choisy
- *Convolvulus tuberosus* (L.) Spreng.
- *Ipomoea nuda* Peter
- *Ipomoea tuberosa* L.
- *Operculina tuberosa* (L.) Meisn.

Click here to read more.

Local names for *Merremia tuberosa*

- Bejuco de Golondrina (Guatemala)
- Foco de Luz (Guatemala)
- Quiebra-cajete (Guatemala)
- Quinamacal (Guatemala)
- Rosa de Barranco (Guatemala)
- Mala Hierba (Honduras)
- Seven Fingers (Belize)
- Woodrose

Click here to read more.

Merremia tuberosa

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Alta Verapaz. Nov. 11, 2018.
Camera: Nikon D810. Settings: 1/320; sec; f/10; ISO 2,000

Mayan names for *Merremia tuberosa*

A Mayan name is not reported online but, the Nahuatl name (Aztec) is Xixicamátic (Sahagun).

Habit for for *Merremia tuberosa*

Vine.

Habitat for for *Merremia tuberosa*

is known to grow in mesic forests from 0-1,400 m elevation. It is a climbing vine that grows over trees or other surfaces and prefers high levels of sunlight. It is also reported to require fertile, well-drained soils (Global Invasive Species Database, 2022)

Merremia tuberosa
Photo by: Moisés Pérez, FLAAR Mesoamerica, Parque Nacional Yaxha. Feb. 20, 2020.
Camera: Huawei P20

Where has *Merremia tuberosa* been found in the Peten?

Merremia tuberosa is reported in Peten near Tikal

Click here to read more.

***Merremia tuberosa* can be found in** Parque Nacional Yaxhá Nakum Naranjo

Both *Ipomoea alba* and *Merremia tuberosa* are listed for Calakmul area (a few kilometers north of the Campeche (Mexico) Peten (Guatemala border (so not far from El Mirador, a bit south of the border (CONAP 2013: 8-9)). Park ranger Teco (Moises Daniel Pérez Díaz) found *Castilla elastica* between Yaxha and Nakum and one day we found literally hundreds of *Merremia tuberosa* vines all on one hillside overlooking an inlet of Lake Yaxha (southwest portion). So hopefully in a future year we can find more *Merremia tuberosa* and more *Merremia umbellata*.

Merremia tuberosa in Belize

Merremia tuberosa (L.) Rendle Habit: vine, habitat: forest

(Balick, Nee and Atha 2000: 292)

Botanical Description of the *Merremia tuberosa* by Standley and Steyermark (1958)

Merremia tuberosa is a long, climbing vine. Its leaves are simple, and the blades are circular in outline, 6-16 cm long and wide, the base is cordate, and margins are palmately 5-7 lobed almost to the base. The lobes are 8-20 cm long, 9-20 cm wide, ovate, 3-9 cm long, 1-5 cm wide, and leaf margins are entire. Its stems are basally woody, perennial, twining, and glabrous. Flowers usually occur in clusters and fully bloom in sunlight and close under cloudy conditions and in the dark. The corolla is yellow, glabrous, funnelform, contortiplicate, enclosed by the sepals in bud, and comprised of 4 petals 5-6 cm long. It has 3 petioles which are 6-18 cm long and glabrous. Its pedicels are 15-18 mm long, claviform, glabrous, and enlarge in fruit. Its sepals are unequal, with the outer two longer than the inner three. They are oval to almost orbicular, with a rounded apex, membranous apically, somewhat herbaceous basally, and 23-25 mm long. Its sepals equally enlarge in fruit. The inner three are oblong, 12-20 mm long. Its filament is unequal, 2.5-3 cm long, glandular, and pubescent. The pistil is glabrous, 4-locular, and the stigma is globose. It has tuberous taproots. The fruits are globose to depressed globose and 3-3.5 cm in diameter. The calyx is accrescent, with fruiting sepals divergent but supporting the fruit. 1-4 seeds occur per fruit and are black to dark-brown, ovoid, 1.5-2 cm long, smooth surfaced, and covered with short, erect, puberulent indumentum (Standley & Steyermark, 1958) eported in Peten near Tikal.

Is *Merremia tuberosa* from the Highlands or from the Lowlands (or both)?

Merremia tuberosa grows perfectly between 0-1400 meters over sea level, but it can also grow in higher altitudes. So, we could say that is from both.

In which States of Mexico is *Merremia tuberosa* listed by Villaseñor

Merremia tuberosa grows primarily in the south and in the center of Mexico: CAM, CHIS, COL, GRO, HGO, OAX, PUE, QRO, QROO, SLP, TAB, VER, YUC

(Villaseñor 2016: 705).

Does *Merremia tuberosa* also grow in home gardens?

Merremia tuberosa is invasive as an unwanted weed in many parts of the world. However, we are totally content to have it taking over entire FLAAR garden and, literally, covering the entire office. *Merremia tuberosa* is the most rapidly growing and spreading vine we have introduced to our garden. It grows up over a 3-story house with ease. It grows up into trees and spreads throughout their branches. I am totally happy to have this plant wandering around my garden. It took well over a year before it decided to bloom, but finally, in October and November, it is blooming. Flowers open after 10 am, so barely a "morning glory." We have watched the flower open; it opens so fast that unless we have our fingers on the camera cable release, we miss its opening sequence.

Uses of *Merremia tuberosa*

It is one of the showier Central American morning glories and under favorable conditions attains excellent size and is covered with giant blossoms. In Guatemala, the dry capsules with their enveloping sepals are much used as decorations in houses or on altars, either in their natural brown color or embellished with silver or gold paint. (Standley and Williams 1970: 75)

Is there potential medicinal usage of *Merremia tuberosa* by local people

The grated root can be for those that have swollen bellies and whose intestines rumble; when drunk while fasting, it purges, and lowers fever (Austin, 1998)

Are any parts of *Merremia tuberosa* eaten by mammals?

This plant is considered toxic so neither humans nor animals can eat it. (Global Invasive Species Database, 2022).

What are the primary pollinators of *Merremia tuberosa* flowers?

Is majorly pollinated by bees and butterflies (Lakshminarayana & Solomon Raju, 2018).

Close relative(s) of *Merremia tuberosa*

Merremia discoidesperma: is a rarely collected and inadequately described high climbing woody liana of Chiapas, Mexico; Guatemala; Costa Rica; Hispaniola; and Cuba. There is only one record of this species being cultivated and this from Guanajuato, Mexico in 1894, though seeds are used in folk remedies. (GUNN,1977)

Merremia tuberosa
Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Parque Nacional Yaxha. Dec. 23, 2018.
Camera: Nikon D810. Settings: 1/250; sec; f/9; ISO 1,000

PART III: *IPOMOEA ALBA*

Full Botanical Name

Ipomoea alba L.

Plant family Convolvulaceae, sometimes known as *Ipomoea*

Click here to read more.

Here are synonyms for *Ipomoea alba*

- *Calonyction aculeatum* (L.) House
- *Calonyction aculeatum* var. lobatum (Hallier f.) C.Y. Wu
- *Calonyction album* (L.) House
- *Calonyction bona-nox* (L.) Bojer
- *Calonyction bona-nox* var. lobatum Hallier f.
- *Calonyction pulcherrimum* Parodi
- *Calonyction speciosum* Choisy
- *Convolvulus aculeatus* L.
- *Convolvulus aculeatus* var. bona-nox (L.)
- *Convolvulus bona-nox* (L.) Spreng.
- *Convolvulus pulcherrimus* Vell.
- *Ipomoea aculeata* var. bona-nox (L.) Kuntze
- *Ipomoea aculeata* f. bonanox (L.) Voss
- *Ipomoea bona-nox* L.

Click here to read more.

Ipomoea alba

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Parque Nacional, Yaxha. Jan. 22, 2018. Camera: Google Pixel 4a.

Local names for *Ipomoea alba*

- Bejuco de Tabaco (El Salvador)
- Camotillo (Mexico)
- Campanilla Blanca (El Salvador)
- Flor de Luna (El Salvador)
- Galán de Noche (El Salvador)
- Garza (El Salvador)
- Pitoreta (El Salvador)
- Luna Blanca (Guatemala)
- Moon Vine (USA)
- Moonflower (USA)
- Nicua (Mexico)
- Oración (Mexico)
- Panal de Niño (Honduras)

Mayan names for *Ipomoea alba*

Sakil puyu' meaning White puyu'
(Breedlove and Laughlin 1993: page 134)

Haapolin (Mexico)
Zutub (Guatemala)

Click here to read more

Habit for for *Ipomoea alba*

Vine.

Ipomoea alba
Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Parque Nacional Yaxha. Dec. 23, 2018.
Camera: Nikon D810. Settings: 1/250; sec; f/9; ISO 1,250

Habitat for *Ipomoea alba*

Within its native distribution (south-eastern USA, Mexico, Central America, and the Caribbean), it can be found growing in moist forest, rainforests, wet forests, along roads and in pastures, at elevations from sea level to 1500 m (Acevedo-Rodríguez, 2005; Missouri Botanical Garden, 2016)

Where has *Ipomoea alba* been found in the Petén?

In Peten, *Ipomoea alba* has been reported near Petén Itzá Lake, La Libertad, Saepuy, El Remate, Tikal National Park and Uaxactun.

Click here to read more.

***Ipomoea alba* can be found in** Parque Nacional Yaxhá Nakum Naranjo

As mentioned before, *Ipomoea alba* can be found in Parque Nacional Yaxhá Nakum Naranjo and is listed for Calakmul area.

Ipomoea alba in Belize

Ipomoea alba habit: vine, habitat: forest

(Balick, Nee and Atha 2000: 292)

Botanical Description of the *Ipomoea alba* been found in the Petén?

Vigorous scrambling or trailing plant stems to 10 m, glabrous, sometimes armed with soft spiny projections, sometimes subtomentose. Leaves petiolate, 5 - 15 x 4 - 14 cm, ovate, sometimes-lobed to about one third, acuminate to a fine hair point, cordate at the base, auricles sometimes with broad teeth, both surfaces glabrous; petioles 3 - 18 cm. Inflorescence of 1 - 3 - flowered, pedunculate, axillary cymes; peduncles 2 - 9 (- 20) cm, stout; bracteoles caducous, not seen; pedicels 5 - 15 mm, swollen below flower; sepals unequal, glabrous, outer sepals 15 - 25 x 4 - 6 mm, lanceolate with a long awn 5 - 12 mm in length, green with white margins inner sepals 12 - 20 mm including a 2 - 5 mm long awn, ovate, whitish with green midrib; corolla hypocrateriform, with a narrow cylindrical whitish-green tube 5 - 12 cm long and a spreading, white limb 4 - 5 cm in diam., glabrous. Capsules ovoid, c. 3 cm long, glabrous; seeds 11 - 13 mm long, glabrous. (Standley & Steyermark, 1958)

Is *Ipomoea alba* alba from the Highlands or from the Lowlands (or both)?

The same as the other plants, grows extremely good within 1-1500 meters over sea level, but it can also grow in higher altitudes.

In which States of Mexico is *Ipomoea alba* listed by Villaseñor

Ipomoea alba grows almost in every state of Mexico: BCS, CAM, CHIS, COL, GTO, GRO, HGO, JAL, MEX, MICH, MOR, NAY, OAX, PUE, QRO, QROO, SLP, SIN, SON, TAB, TAMS, VER, YUC

(Villaseñor 2016: 702).

Do *Ipomoea alba* also grow in home gardens?

Yes, we have some in the FLAAR Mayan Ethnobotanical Research Garden in Guatemala City.

Uses of *Ipomoea alba*

Ipomoea alba is a multifunctional plant, it can be used in medicine, food and of course in rubber vulcanization. Also, it's often used in landscape architecture around the world, due to its natural beauty and rapid adaptation.

Is there potential medicinal usage of *Ipomoea alba* by local people

- The whole herb is used in treating snakebite.
- Root bark is used as purgative and leaves used in filariasis.
- This species of *Ipomoea* is also known to cure constipation, boils, wounds.
- Resin glycosides are potential constraints of multidrug efflux pumps in mammalian cancer cells.
- In Cameroonian tradition *Ipomoea alba* is used as an antidiabetic agent, Laxative and improves breast milk quality and helps in losing weight.
- Antibacterial and antifungal activity along with chloroform

(Rauniyar & Srivastava, 2020)

Are any parts of *Ipomoea alba* eaten by mammals?

The leaves of this plant can be eaten fresh or cooked, and many animals consume it, as in various societies around the world. It's worth mentioning that this plant is very nutritious and should be consumed more.

(Rauniyar & Srivastava, 2020)

What are the primary pollinators of *Ipomoea alba* flowers?

As the other plants, is mayorly pollinated by bees, moths and butterflies (GALETTO, 2004)

Close relative(s) of *Ipomoea alba*

Ipomoea purpurea is a species that develops in the tropical regions of both hemispheres. It belongs to the group known as "Common morning glory" on account of the beauty of its flowers, species used by various native groups in magic - religious rituals and popularly as hallucinogenic, analgesic, anti - inflammatory and laxative, among others.

Ipomoea alba
Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Parque Nacional Yaxha. Dec. 23, 2018.
Camera: Huawei P10.

PART IV

Is *Merremia umbellata* considered to be hallucinogenic?

The Aztecs are infamous for smoking, chewing, drinking, and otherwise ingesting hallucinogenic chemicals from local plants. The Classic Maya also smoked, chewed, drank, and used clysters to inject chemicals from local plants but not many studies focus on these aspects: most studies of the Maya focus on their architecture, art, and hieroglyphic inscriptions. Our study of plants is edible and utilitarian plants: we do not undertake chemical analysis, nor do we do taste-testing (nor smoking or other means of ingesting local plants). But we are not naïve; we are fully aware of what people of Brazil ate, smoked, and drank; what people in northern Mexico ate, smoked, and drank; and the diversity of plants that were available to the Classic Maya. But these plants and these uses are not focus. There are over 600 local native plants utilized by the Maya for "medicinal" purposes and *Merremia umbellata* is a medicinal plant in many countries around the world. Latex and other parts of *Castilla elastica* tree also had many more uses than merely to make bounceable rubber balls and rain capes.

Merremia umbellata
Photo by: David Arrivillaga, FLAAR Mesoamerica, Finca Gangaduwali Dec. 17, 2020.
Camera: Sony Alpha A7R IV. Settings: 1/320; sec; f/5,6; ISO 1,600.

When are the flowers open?
When are the flowers not yet open?

In the early morning the flowers are not yet open. But before lunchtime, yes, the flowers are open. But whether this can be considered a glory of the morning (morning glory flower) is debatable because every time I went to the two aguadas near Nakum, the flowers were not open if I was there after breakfast: the flowers did not open until a bit later. Then as I did more research, I noticed the name Yellow Evening Glory on many web sites. Hmmm, are the chemicals that coagulate rubber affecting when the flowers bloom?

- *Merremia tuberosa* is a "morning glory" but does not bloom until after 10 am
- *Merremia umbellata* is a "morning glory" but does not bloom until afternoon
- *Ipomoea alba* is a morning glory size, shape, and relative, but does not bloom until nightfall.

Merremia tuberosa's name focuses on its wood-like seedpod (not on what hour of the day its flowers open). But,

- *Ipomoea alba* is named Moon Flower.
- *Merremia umbellata* is named Yellow Evening Glory.

Would be worth investigating whether any of the chemicals related to late blooming are related to being able to coagulate rubber. And whether *Ipomoea alba* has more of this chemical than the *Merremia* species.

Is Yaxhá also a name for Mayan rubber tree, *Castilla elastica*?

I always assumed that Yaxha or Yaxhá (with accent) was derived from Yax (blue or green) and há (water). But in late January 2019, while doing research on wild edible roots of the Mayan areas, I did a search for the plant I was looking for at Yaxha: what I got instead was a paragraph that clearly indicated that Yaxha was a native word for *Castilla elastica*!

I do not believe they are using the word Yaxha to indicate a location since it is in the first sentence and in italics, same as K'iche'.

Castilla elastica Cervantes. Rubber tree. Ule. Yaxha, Kiikche (Yucatan, Maya). A medium-sized tree of lowland forest; Mexico to Honduras, and perhaps farther southward. Noteworthy for its large flannel-like leaves, drooping on each side of the branches, and for its large, bright-red, showy fruits. Castilla trees are the source of Central American rubber, and most of the larger individuals seen either in the forest or in cultivation bear large, oblique gashes on their trunks that show they have been tapped. Attempts at cultivation of the tree on a large scale have not proved profitable. The wood is pale brown, light, fairly soft, not strong, perishable; not utilized. (For description see T. of T. A., pp. 128-130.) (Standley and Record 1936: 110).

WOW, I worked at Yaxha 44+ years ago together with Miguel Orrego and helpful team to map the site, and I always assumed it was "blue green Lake." But if you look at one of the best Yucatec Maya dictionaries, by linguist David Bolles, you find "yax ha nel) castilla elastica cerv. - morac.: kiche, kikaban, kikche, kiikche, yaxha -- cau., com., med." Now I Google ule "Yaxha" and get Elsevier's Dictionary of Trees: Volume 1: North America, by M. M. Grandtner, and on page 171 it lists the word yaxha as a word for *Castilla elastica* in Mexico!

So, the Parque Nacional Yaxha Nakum Naranjo has four of the major components to produce Mayan ballgame rubber balls: the rubber tree and three different plants for coagulating the latex. Was Yaxha a center of rubber production 2000 years ago? And, if rubber trees and three different vines for coagulating latex all grow within the park, this offers unprecedented potential for local villages to initiate rubber projects to raise *Castilla elastica* and the coagulating vines. Tourists will love to see the plants, will be ecstatic to watch rubber being coagulated, and then they will be very happy to buy the resulting rubber balls and sandals. Actually, the Classic Maya also used rubber to make idols and incense (the ancient Maya and the Lacandon today use rubber as an incense). So, figurines from native Maya rubber could also be sold to tourists, with images from Yaxha and nearby areas.

Let's bring native Maya rubber trees back to Peten, and the vines which allow coagulation of the latex.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Aug. 18, 2018.
Camera: Nikon D810. Settings: 1/250; sec; f/9; ISO 1,000

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Helpful web sites for any and all plants

There are several web sites that are helpful even though not of a university or botanical garden or government institute.

However most popular web sites are copy-and-paste (a polite way of saying that their authors do not work out in the field, or even in a botanical garden). Many of these web sites are click bait (they make money when you buy stuff in the advertisements that are all along the sides and in wide banners also. So we prefer to focus on web sites that have reliable information.

https://serv.biokic.asu.edu/neotrop/plantae/
Neotropical Flora data base. To start your search click on this page:
https://serv.biokic.asu.edu/neotrop/plantae/

http://legacy.tropicos.org/NameSearch.aspx
This is the main SEARCH page.

https://plantidtools.fieldmuseum.org/pt/rrc/5
SEARCH page, but only for collection of the Field Museum herbarium, Chicago.

https://fieldguides.fieldmuseum.org/guides?
These field guides are very helpful. Put in the Country (Guatemala) and you get eight photo albums.

http://enciclovida.mx
CONABIO. The video they show on their home page shows a wide range of flowers pollinators, a snake and animals. The videos of the insects are great.

www.kew.org/science/tropamerica/imagedatab
Kew gardens in the UK is one of several botanical gardens that I have visited (also New York Botanical Gardens and Missouri Botanical Gardens (MOBOT), in St Louis. Also the botanical garden in Singapore and El Jardín Botánico, the open forest botanical garden in Guatemala City).

www.ThePlantList.org
This is the most reliable botanical web site to find synonyms. In the recent year, only one plant had more synonyms on another botanical web site.

Web sites with helpful photographs and information on Merremia species

Global Biodiversity Information Facility
https://www.gbif.org/

Tropicos
https://tropicos.org

Biodiversidad de Guatemala
(This is specifically for Guatemala)
https://biodiversidad.gt/portal/

RESERVA DE LA BIÓSFERA MAYA - RBM -
DEPARTAMENTO DE PETÉN, GUATEMALA

FLAAR MESOAMÉRICA

Google Maps 2022; Asociación de Comunidades Forestales de Petén - ACOFOP - 2011; Wikimedia Commons 2019

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Isabel Rodriguez Paiz is in charge of fundraising and partnership development.

Edwin Solares is a photographer and videographer during our expeditions. Later, he edits this content to be used in our different materials.

Haniel López is a drone pilot and photographer during our expeditions.

Pedro Pablo Ranero with a degree in communication is responsible for editing videos of flora and fauna to create content on our sites.

Andrea Sánchez graphic designer who helps prepare the graphic line of our publications. She is our editorial art director.

Jaqueline González graphic designer who combines text layout and photo editing to create our reports.

Heidy Galindo graphic designer who combines text layout and photo editing to create our reports.

Cristina Ríos graphic designer who combines text layout and photo editing to create our reports.

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Juan Carlos Hernández is a graphic designer and part of the web team. Receive the material we produce to place on our sites.

María José García is a graphic designer and part of the web team. Receive the material we produce to place on our sites.

Andrés Fernández is a graphic designer and in charge of keeping our websites updated and more efficient for the user.

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Luis Molina is a professional illustrator specialized in line drawings of Maya vases, bowls, and plates.

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Rosa Sequén is an illustrator for MayanToons.

Other publications on RBM Project

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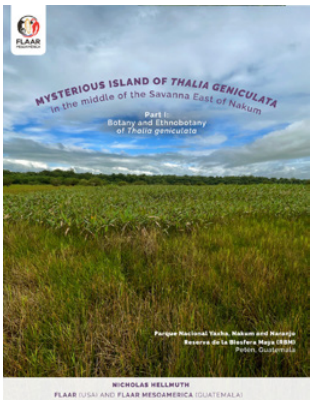

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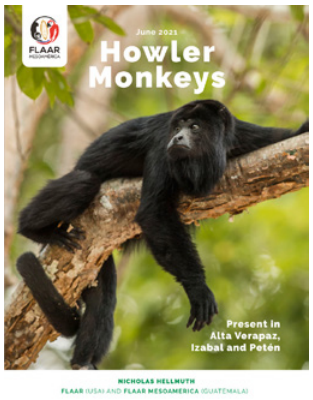

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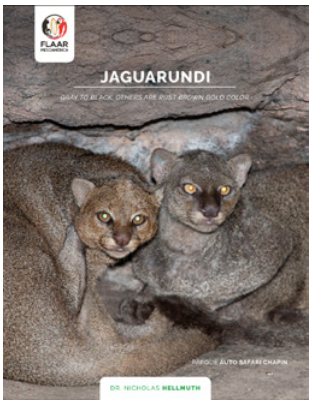

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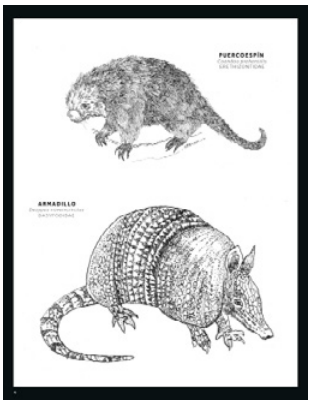

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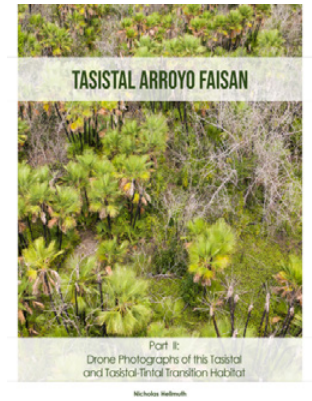

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