Luffa aegyptiaca (L)M.Roemd.

Monograph

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# **Chapter 1: Introduction**

The *Luffa aegyptiaca* is also known as the *Luffa cylindrica* or *loofah*. Besides being a plant, it is edible, and its fibers are very useful for what it commonly known, bath sponge. In this monograph, you'll find about its ecology; distribution, environmental factors and vegetation components. You will also find its biology starting from its chromosome complements, to its life cycle and phenology, and also its productivity. Here you will find as well the propagation and management of a Luffa and its value and market such as uses for both fibers and food.

# **Chapter 2: Ecology**

#### 2.1 Distribution

The *Luffa aegyptiaca*, also known as smooth loofah or sponge gourd, is a species of luffa that is widely cultivated around the tropic for commercial and decorative purposes and has been naturalized all the way from China to tropical Africa. Even though the plant grows worldwide it is native to the south east of Asia (Figure 1, below).

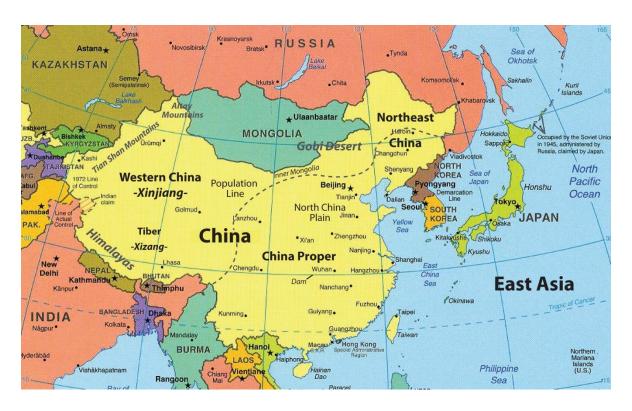


Figure 1: Map of South East Asia

## 2.1.1 Affinity and origin

There is not a lot of information about the origins of the *L. aegyptiaca*. It is believed that it comes from Tropical Asia. But has spread all over tropical regions of Asia and was later introduced to Africa and America. The plant was first described by Johann Veslingius in 1638 who named it "Egyptian cucumber", however the botanical authority is William

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Roxburgh. Nonetheless there are mosaics in the Roman and Byzantine empires that date from

359-600 CE which depict the *Luffa aegyptiaca*.

Class: Magnoliopsida

**Superorder:** Rosanae

**Order:** Cucurbitales

Family: Cucurbitaceae

**Genus:** Luffa

**Species:** aegeptica

2.1.2 Present distribution

Today the *Luffa aegyptiaca* is extensively cultivated for many purposes around the

globe. It is used as food, decoration, but most popularly as bath sponges. Though the plant is

originally from Tropical Asia, its cultivation has spread all over the tropics. According to

EOL (Shaprio, 2014) (Encyclopedia of life) it was first grown commercially in Japan around

1890. Though it has been brought and naturalized to Tropical Africa and Oceania. It is also

widely grown for sponges and its edible fruits and flowers all the way from South America,

especially Guatemala and Colombia, up to the southern United States. Today the biggest

commercial producers of the Luffa aegyptiaca are China, Korea, India, Japan, and Central

America. The *Luffa* in also the main source of fiber with piaçava and curauá in Brazil.

All the following countries have reported cultivation of this plant: Algeria, Argentina,

Australia, Belize, Benin, Bhutan, Bolivia, Brazil, Burkina Faso, Burundi, Cameroon, Chad,

China, Colombia, Comoros, Costa Rica, Côte d'Ivoire, Ecuador, El Salvador, Egypt,

Equatorial Guinea, Ethiopia, French Polynesia, Georgia, Germany, Ghana, Guatemala,

Guinea, Guyana, Honduras, India, Iraq, Italy, Jamaica, Japan, Kenya, Kyrgyzstan, Laos,

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Liberia, Libya, Madagascar, Mali, Myanmar, Mexico, Nepal, Nicaragua, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Portugal, Russian Federation, Senegal, South Africa, Spain, Sudan, Suriname, Switzerland, Tajikistan, Tanzania, Thailand, Trinidad, Tunisia, Uganda, Ukraine, UK, USA, Uzbekistan, Venezuela and Vietnam.

#### 2.2 Environmental Factors Affecting Distribution

#### 2.2.1 Elevation and Climate

The *Luffa aegyptiaca* is a plant that grows best in the tropical and subtropical areas worldwide. It is a fast growing vine that can grow in forests, woodlands, thickets and grasslands anywhere from sea level to an altitude of 1800 meters above sea level. This plants do better in placer where annual temperatures are about 23-27°C. It is especially sensitive to cold climates, frost and excessive water, during flowering or fruiting. Annual rainfall should be between 1000 and 2000 mm.

## 2.2.2 Geology and soil

The best soil for the *Luffa aegyptiaca* is a well-drained soil with high organic matter (Figure 2, below). The Luffa is a plant that is affected heavily by excess water, so the terrain must drain well. The soil moisture should be around 10-15%. The soil must also be warm for the seed to germinate properly. If there is too much water in the soil during fruiting season it could ruin the yield due to problems like mold.

Figure 2: A good soil for *L. aegypticaca* 

#### 2.3 Vegetation Components

#### 2.3.1 Soil environment and effects on soil

The *Luffa aegyptiaca* will tolerate soil with a pH level up to 7.5 but grow better around a pH value of 5.5 - 6.8Due to its worldwide cultivation this plant can withstand many different types of soil but it does its best with a rich soil of medium texture with high organic matter content and good draining medium. Sandy loams can also work for cultivating the *Luffa aegyptiaca* as long as sufficient nutrients and organic material are added. This plant also needs soil with a very low salinity. About 4dS/m

#### 2.2.1 Interaction of Plant roots and relationship with animals.

The *Luffa aegyptiaca* is a really fast-growing vine that can be very aggressive. The plant can grow in open areas and disturbed areas such as parks or roadsides. The plants yellow flowers (Figure 3, below) are pollinated by insects such as bees but it can also be naturally self-pollinated. Its flowers are large and yellow to ensure that the pistillate flowers are pollinated. The fruit of the *Luffa aegyptiaca* contains many smooth, black seeds. These seeds are the ones that propagate the plant. They are spread by animals who eat the fruit such as birds or mice but they are also spread by human agriculture. This plant is heavily attacked by *Tetranychus urticae* also known as spider mites (Figure 3, below).



Figure 3. Tetranychus urticae on L.aegypticaca flowers.

L. aegyptiaca (L) Roemd. Monograph Valentina Oganaga

# **Chapter 3: Biology**

#### **3.1 Chromosome Complement**

L. aegyptiaca is a cultivar species with a diploid chromosome number of 2n=26, endemic to different parts of the province from Jammu (India). It has a somatic chromosome complement.

#### 3.2 Life Cycles and Phenology

This sponge gourd is versatile in climate and soil conditions, it requires summer warmth and constant sunlight. It grows best in the tropic and subtropical areas, with low humidity but well-distributed rainfall. Germination can occur in warm soils; this luffa is sensitive to frost and excessive rainfall, which impede fruit or flowering processes. It is common that flowering goes from November to January and blooms on summer, fruiting happens in January, and from July to August. Once the vine gets near 2 m long it starts producing male flowers.

https://www.cabi.org/isc/datasheet/31693

http://eol.org/pages/487006/details#cyclicity

#### 3.2.1 Seedling Protection

Seedlings are protected by the seedpod (loofah), which has a thick spongy inner form and a rather hard but smooth outer crust. Epigeal germination occurs in this type of plants, meaning that the cotyledons when the seed is germinating expand, exit the loofah by the dilated operculum and start a photosynthetic process above the soil. When cotyledons ovate they reach up to 5 cm long, according to the PROTA database.

https://www.prota4u.org/database/protav8.asp?g=pe&p=Luffa+cylindrica+(L.)+M.Roem.

#### 3.2.2 Flower production

The *Luffa aegyptiaca* produces flowers along the cucumber-shaped fruits with a noticeably light golden yellow colour. The maturing flowers usually have curved edges facing the inside. Male flowers of this species inflorescence are about 20-25 cm long, its hypanthium is only 2-4 mm long and its petals are up to 2 cm long. The flowers are monoecious, meaning it has both female and male organs by themselves. The staminate (male) flowers are produced in racemes of 4-20 while the pistillate (female) flowers are born individually in a separate node or sometimes in association with staminate racemes. Orderly, the lower nodes carry only staminate flowers, the middle nodes carry both, and upper nodes only pistillate flowers. According to E. Taha it has a much greater number of male ones, with sex ratio of 1: 20 (Female: Male). Male flowers usually have 5 petals.

#### 3.2.2.1 Flowering and fruiting

M. W. Silva et al. (date) conducted several investigations for Luffa *aegyptiaca*'s growth and cultivation, results conveyed flowering started 6-7 weeks after seeding. And observed the same ratio mentioned before of 20:1 male to female flowers. Ripen fruits reach 17-20 cm long sponges with (when dried), conserved "densely arranged fibers and average sponge weight was  $0.88 \pm 3.07$  g" (M.W. Silva et al, 2012). But normally, these cylindrical oblong fruits or loofahs can reach 60 cm in length.

## 3.2.3 Foliage and Growth

According to O. T. Okusanya (1978) high light intensity and temperature are a key factor in seedling growth, its general growth rate and the leaf area. This herbaceous climber trails itself up to 15 m with a considerably fast growth ratio as an annual plant. The *Luffa aegyptiaca*'s foliage distributes consequently with its vine attribute, it has palmately-lobed dark green leaves, which grow in hairy stems. Optimal soils are low in salinity, with neutral pH, well-drained, and preferably sandy loams.

#### 3.2.4 Seed Pods

The Seedpod of the Luffa *aegyptiaca* is the loofah gourd itself which carries hundreds of black flat seeds (from 30 to 250 seeds per pod) in a parietal placentation form, meaning the sponge rigid structure is hollow inside leaving space for ovule development outgrowing the internal walls of the fruit. The mature pod "is covered by a thin crispy exocarp".

#### **3.2.5** Harvest

Because of its industrial uses, Loofah sponges are grown in vines and the traditional way of harvesting is by hand twisting until the vine breaks. When the fruit gets ripen, a clear indicator is a light green or yellow colour, also it feels much lighter because of dryness. The skin is easy to peel when its ready, slamming it against a hard surface will knock the seeds

loose leaving the sponge for economical or medical purposes to undergo. Young stages of fruit growth offer a nutritional value as well when boiled as vegetables.

# 3.3 Productivity and Biology 3.3.1 Pollen

Luffa aegyptiaca uses a biotic pollination method, meaning bees carry pollen for reproduction. Pollen loads are bright yellow and, according to E. Taha the mean weight of one load is 7.75 mg. It is isopolar with a spheroidal shape. It has the stamens attached to the base of the hypanthium meaning insects must pass between hairy filaments. Insects are attracted to the nectar producing disks at the base below the staminodes.

#### 3.3.2 Sexuality and reproduction

Sponge Gourds are monoecious plants, meaning they inseminate themselves in some cases and reproduce

#### 3.3.3 Pollination and potential pollinators

The flower stigmas are very hairy allowing insects to pollinate even the same plant, as they don't differentiate different plants, so "20-40% self-pollination can be expected" (CABI, 2017). Given the cross-pollination property and the monoecious morphology of the

loofah it naturally happens this self-pollination phenomena. Bees are the primary pollinators looking for nectar stored at the base of the flowers, which have a narrow space for pollen to be surely delivered. Potential pollination technologies arise as the Luffa Aegyptica becomes popular in worldwide markets, because of this in vitro pollen production has been tested and it doubles in vivo conditions of pollen grain production.

#### 3.3.4 Anthesis

Flowers start to open before dawn and start closing at 16:00. In this time pollinators (Bees, Bumblebees, etc.) carry the pollination process. Although there is a fewer ratio of pistillate flowers, the fertilization peak occurs at noon between 12:00 and 13:00,

#### 3.3.5 Fruit development and seed set

This Cucurbitaceae vegetable produces fruits with a fibrous vascular system forming a sponge-like gourd structure. They grow as an ellipsoid

#### 3.3.6 Ovule development

According to S. C. Gupta from the University of Dehli, the ovules in the *Luffa aegyptiaca* are anatropous (ovulates in an inverted structure), bitegmic (with two integuments), and with a flask-shaped nucellus. Short after fertilization, the inner integument degenerates partially, however it is the outer integument that forms the seed coat by itself.

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# **Chapter 4: Propagation and management**

# **4.1 Nursery Propagation**

The Luffa nursery and management requires a stem for climbing while growing, should be kept fertilized against common cucurbit diseases like powdery mildew, downy mildew, between others. For commerce, loofah's production usually regulates plants spacing, fruit number per plant and fruit size. Luffa *aegyptiaca* is a rather flexible specie to accommodate under uncontrolled soil conditions. Nevertheless, pests as the red spider mite, or pumpkin flies can penetrate the fruit skin and dries the tissue when it attacks immature fruits, darkening them and impeding them to develop normally.

#### **4.2.1 Propagation from seed**

Propagation in the Luffa *aegyptiaca* is by seed. Under mature conditions, the seeds leave the loofah and are carried not so far by the wind. Although in cultivation the PROTA4U organization claims that seeds are saved from a previous crop, and that plantations can be established by transplanting or direct sowing. Its recommended to plant the seeds 1 cm apart.

#### 4.3 Planting

Luffas are an annual tropical or subtropical climbing vines. Aside from being a fruit, Loofahs can be used as

# **Chapter 5: Markets and uses**

#### **5.1** Uses

Due to luffa's odd yet specific characteristic, the *L. Aegyptiaca* has a multitude of abilities and uses. One of the oldest uses of Luffas come from their fibers, that can be boiled in water, which is then used as medicine. From helping to prevent colds too helping arthritis pain, most modern medicine wouldn't exist without the luffa. The second largest use for luffa's are for skin care products. In which it can be rubbed against the skin to remove dead cells, bacteria and more. It can eve be used to turn into "luffa charcoal" which works as a revolutionary form of moisturizer.

#### **5.2 Marketing**

Depending on the size of the sponge and the amount of 'value-added' to it, a sponge should sell from \$1-5. If a grower has several thousand sponges to sell, he/she might consider selling them to local health food stores. *Luffas* are not massly transported to anywhere, most *luffa* consumption is in countries with *luffa* farms. 87% of *luffas* bought in the USA are grown there too, ignoring the fact that there are very little *Luffa* farms in North America

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