

## Floral Biology of *Myristica fragrans* Houtt

Seema V.<sup>1\*</sup> and Manimekalai V.<sup>2</sup>

<sup>1</sup>Ph.D. Scholar, Register Number 12523, PG and Research Department of Botany, Sri Parasakthi College for Women, Courtallam (Affiliated to Manonmaniam Sundaranar University, Abhishekapatti, Tirunelveli) (Tamil Nadu), India.

<sup>2</sup>Assistant Professor and Head, PG and Research Department of Botany, Sri Parasakthi College for Women, Courtallam (Affiliated to Manonmaniam Sundaranar University, Abhishekapatti, Tirunelveli) (Tamil Nadu), India.

(Corresponding author: Seema V.\*)

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**ABSTRACT:** *Myristica fragrans* Houtt is an evergreen aromatic tree belongs to the family Myristicaceae. It is a dioecious tree. It is growing up to 5 to 13 meter high. Leaves are dark green and alternate. Flowers are pale yellow, fleshy and bell shaped. Male flowers are arranged in groups of one to ten. Female flowers are arranged in smaller groups of one to three. Fruits are oval or pyriform and yellow. Nutmeg is the seed kernel inside the fruit and mace is the red coloured covering of the kernel. The flowers are collected and morphological characters were analysed under a dissection microscope. At the time of flowering and fruiting period the tree was observed. Macro photographs were taken by using camera Nikon cool pix P600. Nikon binocular Eclipse- Niu model microscope with light and fluorescent option system was used to take micro photographs. The present study revealed that biology of male and female flowers of *Myristica fragrans*. The study about the floral biology is very useful to improve the pollination and crop improvement. It also helps to understand the fruit setting of the plant.

**Keywords:** *Myristica fragrans*, dioecious, nutmeg, mace, kernel.

## INTRODUCTION

Spices are defined as a strongly aromatic substances of vegetable origin obtained from tropical plants. A spice is a dried seed, fruit, root, bark, or vegetative material used in flavouring, colouring or preserving food (Rathore and Shekhawat 2008). Spices are good source of minerals and vitamins. India is one of the major producers of spices in the world (Padmanabhan, 2018). Indian spices are prized for their odor, flavour and texture. India is the world's largest producer, consumer, and exporter (Pooja and Narayanpur 2022).

*Myristica fragrans* belongs to the family Myristicaceae. It is a medium sized family of angiosperm shrubs and trees. It consists of 21 genera and nearly 500 species (Sauquet and Le Thomas). *Myristica fragrans* is an aromatic tree. It is commonly called nutmeg. The plant is native of eastern Moluccas Island near Indonesia. Now it is cultivated in Malay, Sumatra, Java, Sri Lanka, West Indies, and other tropical countries (Purseglove *et al.*, 1981). It produces two spices, nutmeg, and mace. Nutmeg is the seed kernel inside the fruit and the mace is the fleshy red covering (aril) on the seed. It is an evergreen tree. The bark is brownish grey and smooth. The leaves are green and alternately arranged. It is a dioecious tree; male and female flowers are borne on different plants; occasionally male and female flowers are found on the same tree (Everett, 1981). The flowers are bell shaped and pale yellow, inconspicuous, small,

composed of three sepals. Male flowers are arranged in groups of one to ten and female flowers are arranged in smaller groups. Female tree produces ovoid fruits. The fruit has a fleshy husk. When mature the fruit husk split into two halves along a ridge running the length of the fruit. The seeds are exposed with its aril. Seeds are purple brown, shiny and covered with net like red aril. The seeds are hard and strong. The colour of mace is an important factor, influencing the commercial value. The red pigment of mace was identified to be lycopene by thin layer chromatography and absorption studies (Gopalakrishnan, 1997). When fresh the aril is bright and fleshy but when dried it become more horny, brittle, and yellowish brown in colour. Inside the seed contains a large fleshy kernel. There is presence of a small embryo and ruminant endosperm in the kernel (Kumari *et al.*, 2021).

Nutmeg is widely used as a traditional medicine. Pharmaceutically nutmeg has been used as a stomachic, stimulant, and carminative. The essential oil from *Myristica fragrans* showed antibacterial activity. In addition to these properties, it is also used as an antithrombotic, anti-inflammatory, anti-rheumatic, anti-swelling, and anti-carcinogenic agent (Latha *et al.*, 2005).

Nutmeg and mace are the rich sources of essential oil. The oil is used in soap, tooth paste, candle, and hair lotions. Both the nutmeg and mace are used as condiment and medicine (Jaiswal *et al.*, 2009). Nutmeg is more pungent and sweeter than mace. The nutmeg and mace are used in baking and culinary industries as a spice (Honey *et al.*, 2016). It is used as a major constituent in the preparations of medicine such as nausea, vomiting, malaria, rheumatism, dysentery, and early stages of leprosy (Gupta *et al.*, 2022). Nutmegs contain volatile oil (5-10%), fat or nutmeg butter (30-40%), proteins, phytosterine, starch, amyloextrin and colouring matter. Nutmeg seeds are a good source of moisture, ash, fats, fiber, and minerals. So, it is used as substrates deficit in either of these nutrients (Rancy Ann Thomas and Krishnakumari 2015). Mace contains mace lignin. It inhibits melanin biosynthesis. So, mace is used as a skin whitening agent (Naeem *et al.*, 2016). Malabaricon C obtained from *Myristica fragrans* has the inhibitory activity against several types of aerobic and anaerobic microbes (Verma *et al.*, 2021).

The major chemical compounds of *Myristica fragrans* are alkyl benzene derivatives (myristicin, elemicin, safrole), myristic acid, terpenes, beta-pinene and alpha-pinene (Wang *et al.*, 2004.) Nutmeg also contains about essential oil, it is composed of myrcene, phellandrene, camphene, terpinene, and limonene (Manju *et al.*, 2013). Nutmeg essential oil shows antibacterial property. So, the essential oil used in traditional medicine to improve the health care (Saxena and Patil 2012). Essential oil of leaf, mace, kernel, and seed were used as Ayurvedic medicine and fragrance (Ashok Kumar *et al.*, 2022). Overconsumption of nutmeg in sometimes risky, which cause nausea and weak pulse, vomiting and hallucination. Due to the presence of myristicin it causes intoxication (Hallstrom and Thuvander 1997). Myristicin poisoning can induces the convulsions, body pain, palpitations, and dehydration (Elizabeth Margarete and Neeraja 2016).

## MATERIALS AND METHODS

The present study was carried out in *Myristica fragrans* male and female flowers. The male and female flowers of *Myristica fragrans* were collected from households of Puthoor in Kollam district of Kerala in the month of June. The specimens were prepared for morphological and anatomical observation. The morphological characters of the flowers analysed by collecting them at different stages of flowering and observing them under a dissection microscope. At the time of flowering and fruiting period the tree was continuously observed. Nikon binocular Eclipse- Niu model microscope with light and fluorescent option system was used to take micro photographs. Macro photographs were taken using camera Nikon cool pix P600.

## RESULTS AND DISCUSSION

### A. Morphology of the Tree

*Myristica fragrans* is a spreading aromatic tree with a height 5 to 13 cm. There are numerous branches arising with the main branches on the low trunk. The bark is brown in colour and it contains a watery pink sap. The

leaves are dark green, elliptic, and lanceolate. The petiole is about 1cm long. The tree is dioecious. The flowers are in umbellate cyme. The flowers are small, bracteolate, fragrant and produce nectar. The fruit is ovoid and sub globose. The pericarp is yellow and fleshy. When mature the aromatic pericarp is equally splits into two halves. The brown shiny seed is covered with scarlet coloured net like structure called aril.



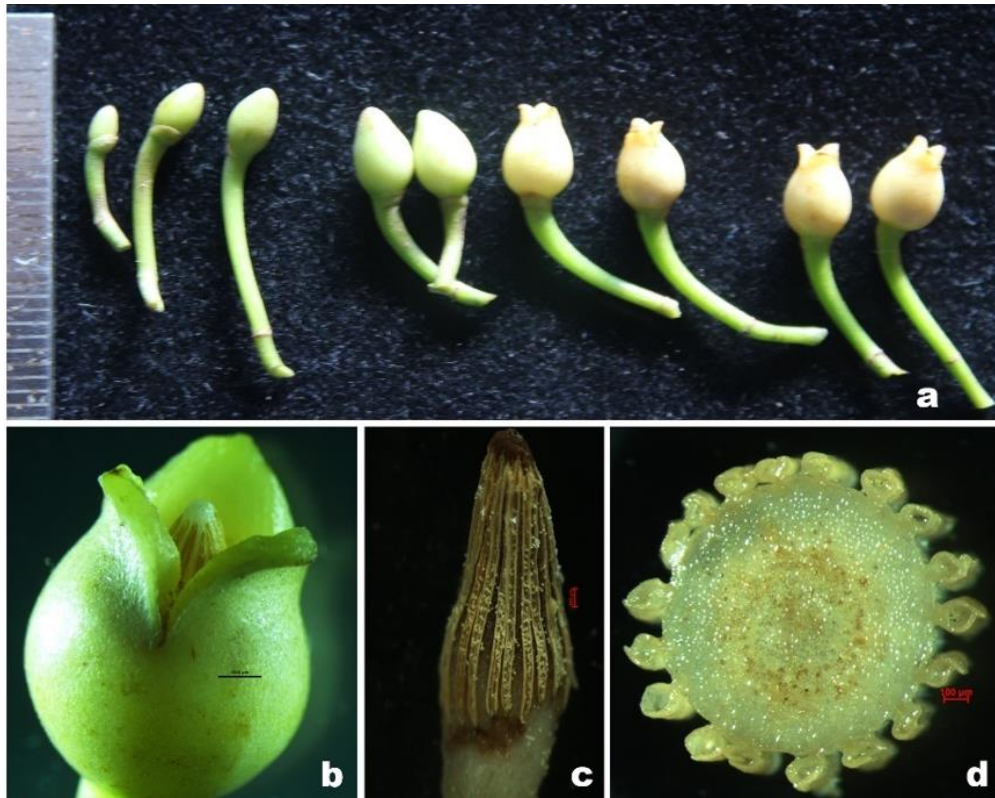
**Fig. 1.** Habit of the *Myristica fragrans* Houtt.

**Morphology of the Flowers.** The flowers are dioecious, drooping, pale yellow, fragrant, bell shaped with fleshy and waxy. The male and female inflorescences are similar glabrous and axillary cyme. The main axis is 1-1.5cm long and usually unbranched. The pedicel is pale green. There is no method for determining the sex of the plant until the flowering takes place. The calyx is bell shaped, nectariferous with three reflected triangular lobes with no petals. Male flowers are 5-7mm long and are arranged in groups of one to ten. Female flowers are up to 10mm long and in smaller groups, one to three. The flowers are bracteate and bracteolate. Bracteoles are found on the pedicels. The perianth is strigose with appressed hairs. It consists of a single thick whorl of fleshy valvate tepals. In *Myristica fragrans* the perianth opening is close around the stigma.

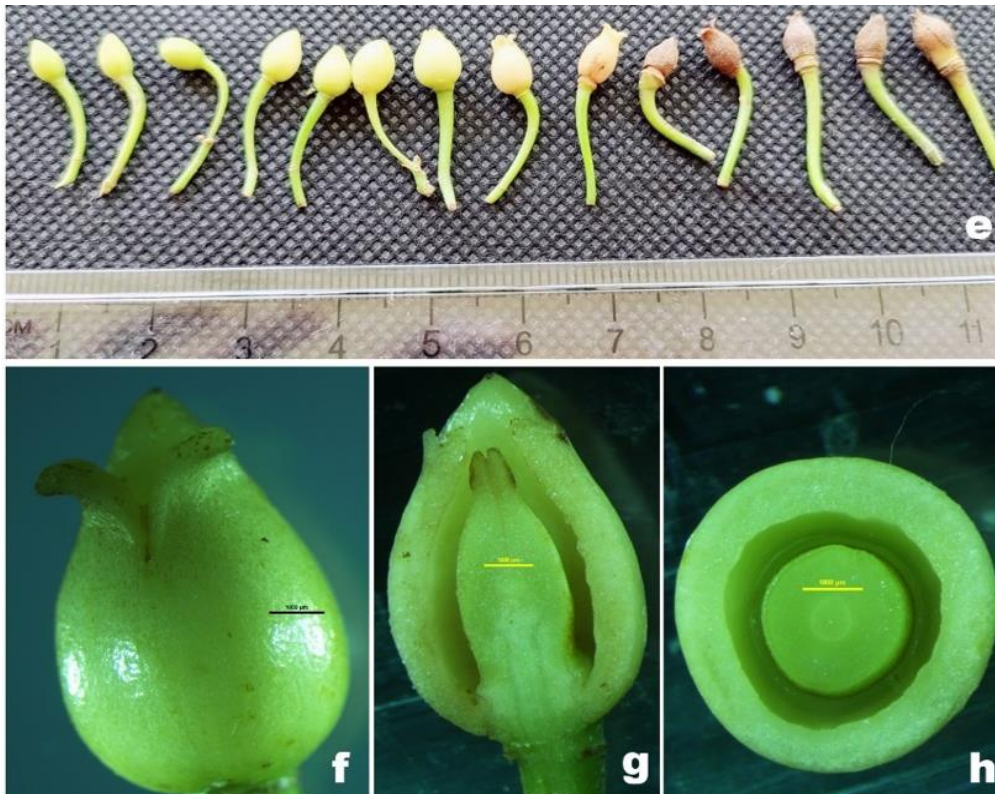
**Male flowers (staminate flowers).** The male flowers are smaller than the female flowers. Inflorescence of male flower is an axillary raceme. The flowers are creamy yellow. The androecium is up to 7mm long consist of androphore which is connected a few bilocular anthers. The androecium is glabrous with a 2mm stalk. The androecium is acute at the apex. There are 14-20 anthers are present which are fused to various degrees of a central column. At the tip of the androphore two anthers are found in a groove. The anthers are adnate to the androphore by a thin ridge of tissue. The microsporangia are surrounded by a lignified hypodermal layer called endothecium. Each anther has a longitudinal extrose dehiscence.

**Female flowers (carpellate flowers).** The female flowers are 1 cm long. The single pistil is flask shaped with a short to non-existent style and bilipped stigma. There is a one single centrally located locule containing

single anatropous ovule, basally attached. The ovary is superior, sessile, and single celled. Once fertilized the unicarpellate ovary develops into an elliptical fruit.



a) Different stages of male flower. b) Close up view of male flower. c) Stamen. d) C.S. of androecium. Morphology of male flowers of *Myristica fragrans* Houtt.



e) Different stages of female flower. f) Close up view of female flower. g) L.S of female flower. h) C.S of ovary. Morphology of female flowers of *Myristica fragrans* Houtt).

**Fig. 2.**

Flowering pattern of male and female flowers are differed. In male tree produces flowers throughout the year, but the female tree produces flowers continuously 5-7 months. The female flowers took 4-5 months for complete development but male flowers took 2.5-3 months for complete development. The peak time of the flowering is in July to October in male and female trees.

The flowers of the *Myristica fragrans* produce a strong and pleasant odor and nectar. The chief attractant sign is the floral fragrance so the flowers are pollinated by thrips, beetles, insects, and small flies (Maya *et al.*, 2004). A group of small beetles (Anthicidae) was an effective pollinator in nutmeg flowers (Armstrong and Drummond 1986).

The anther dehiscence occurs about 24 hrs prior to anthesis. The stigmatic receptivity lasts for six days after anthesis. After fruit set the fruit attained maturity within 8 months. The high rain fall, average temperature, maximum temperature, rainy days, and solar radiations are affected by the success of fruit set (Suman *et al.*, 2015).

## DISCUSSION

*Myristica fragrans* is an aromatic plant. Nutmeg and mace are widely used as spices. The leaves are pointed, dark and alternately arranged. Flowering pattern of male and female trees differ. The flowers are unisexual. The male and female inflorescences are similar. Perianth is fused into an urn-shaped enclosure (Asgarpanah and Kazemivash 2012). Male flowers are seen in the groups of 1 to 10 and female flowers are seen in the groups of 1 to 3. There are 14-22 anthers are present (Wilson and Maculans 1967). In this study 20 fused anthers are found. Several research works reported that the gynoecium is monocarpellate. Some studies have reported the bicarpellate gynoecium (Joshy, 1943). The present study proved that the gynoecium is monocarpellate. Fruits are yellow, smooth, and fleshy. When mature the fruit splits in to two equal halves and the fruit contains a brown shiny seed (nutmeg) and surrounded by a bright red coloured aril (mace). The plant is a unique tree spice because it produces two different spices nutmeg and mace.

## CONCLUSION

*Myristica fragrans* is a medium sized tree. The flowers of the tree produce a strong and pleasant odor and nectar. The fruits of the nutmeg contain odoriferous secondary metabolites. Both the nutmeg and mace contain volatile oils. This oil constitutes have a variety of pharmacological effects (Parimala and Amarjyothi 2013). Nutmeg shows anticonvulsant, anti cancer, anti inflammatory and analgesic activities. It is also used in the treatment of diarrhea, dysentery, vomiting and abdominal distension (Ibrahim *et al.*, 2019). The flowers of *Myristica fragrans* are small and unisexual. With reference to the floral studies the male flower has androecium with twenty stamens and the female flower has gynoecium with unicarpellate ovary.

## FUTURE SCOPE

The flowers of the *Myristica fragrans* were the material used for the present study. Flowers are dioecious. The present study suggested that the biology of flowers is helpful to study the fruit setting and development.

**Conflict of Interest.** There is no conflict of interest.

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