

Flowering and Pollination Behaviour of Fig

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Introduction:

The Fig (*Ficus carica* L.) is one of the earliest cultivated fruit trees in the world, is grown in many parts of the world with moderate climates, it is ordinarily deciduous and commonly referred to as “fig”. Fig (*Ficus carica* L.) probably originated in the Middle East and naturalized in many places is nowadays an important crop worldwide. Wild forms are found in Mediterranean, Arabia, Iran, and Asia Minor as well as in Central Asia and Transcaucasia. It's considered as sacred fruit in all holy books and it played an important role in the mythology of many societies. Botanically identified as *Ficus carica* L., the common fig belongs to the family of Moraceae. The somatic chromosome number is $2n = 2x = 26$ (Storey, 1975; Jona & Gribaudo, 1991). It's considered morphologically gynodioecious but functionally dioecious and has its specific pollinating wasp. Its common edible part is the fruit which is fleshy, hollow, and receptacle. The dried fruits of *F. carica* have been reported as an important source of vitamins, minerals, carbohydrates, sugars, organic acids, and phenolic compounds.

The fresh and dried figs also contain high amounts of fibre and polyphenols. Mediterranean diets are characterized by abundant intake of this fruit (Solomon *et al.*, 2006), which can be eaten fresh, dried or used as jam. Figs are an excellent source of minerals, vitamins and dietary fibre; they are fat and cholesterol-free and contain a high number of amino acids (Veberic *et al.*, 2008; Solomon *et al.*, 2006). Figs have been traditionally used for its medicinal benefits as laxative, cardiovascular, respiratory, antispasmodic and anti-inflammatory remedies (Guarrera, 2005). Leaves' organic acids profile presented oxalic, citric, malic, quinic, shikimic and fumaric acids, while in pulps and peels quinic acid was absent. Epidemiological studies have consistently shown that there is a clear significant positive association between intake of these natural products and reduced rate of heart disease mortalities, common cancers and other degenerative diseases. Organic acids are primary metabolites, which can be found in great amounts in all plants, especially in fruits. These

compounds also have antioxidant properties (Silva *et al.*, 2004; Valentao *et al.*, 2005a, 2005b). Citric, malic and tartaric acids are commonly found in fruits and berries, while oxalic acid is present in higher amounts in green leaves (Oliveira *et al.*, 2008). Ascorbic acid is probably the most widely distributed water-soluble antioxidant in vegetables (Naidu, 2003; Seabra *et al.*, 2006; Sousa *et al.*, 2009).

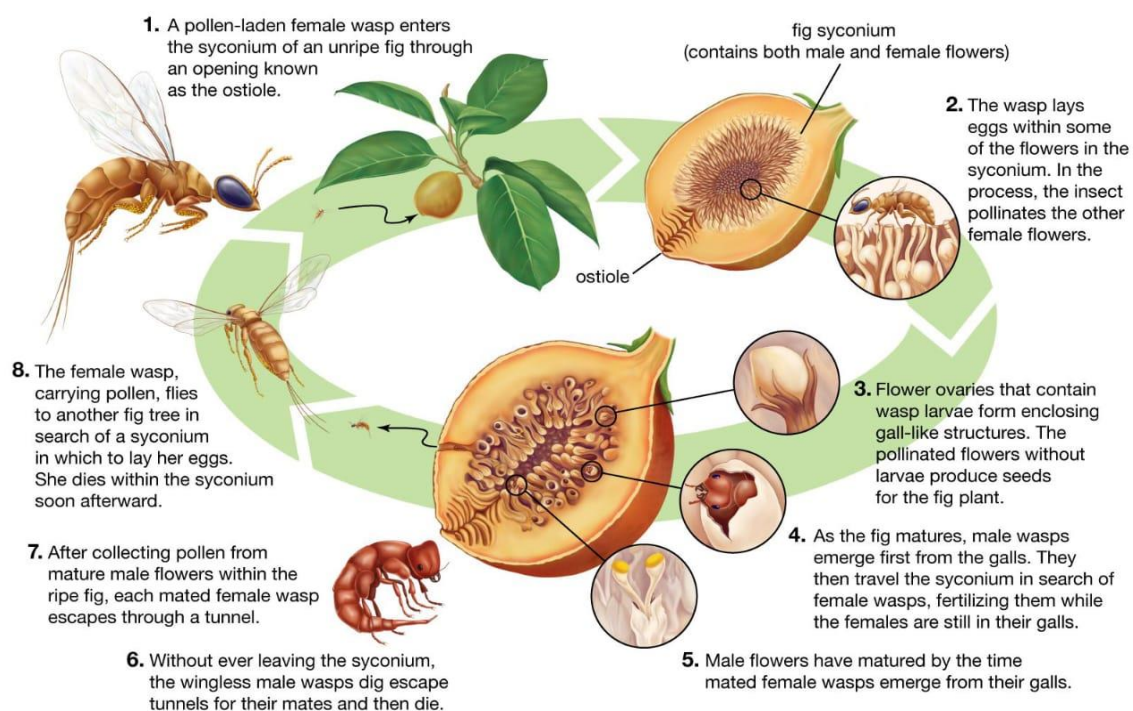
Floral Biology and Horticultural Classification: -

Ficus carica is characterized by species having unisexual flowers only and by gynodioecism (Storey, 1975). The inflorescence of fig is unique to the genus, consisting of a syconium inside which are implanted the flowers that may give the true fruits, tiny pedicellate drupelets usually called the "seed" of the fig (Storey, 1975; IBPGR, 1986). *Ficus carica* is considered morphologically gynodioecious but functionally dioecious. According to the sex of the flowers in the syconium, two main types of trees can be distinguished. The first one is the caprifig is monoecious in which the syconia contain short styled pistillate flowers distributed over most of the inner wall and staminate flowers massed around the interior of the ostiole. The other one is the common fig or domestic fig is pistillate in which the syconia containing only long-styled pistillate flowers (Storey, 1975). Smyrna fig inflorescence produces abortive hermaphrodite flowers at the same position as the male flowers in caprifig (Back and Lard, 1987).

The fig commonly grown in India are parthenocarpic in nature and do not need any cross-pollination with wild fig (Capri fig), which is very common practices in other countries. Normally, only the domestic or common fig produce edible figs (Valdeyron, 1967; Storey, 1975). Common fig, as each *Ficus* species, has its own specific pollinating wasp (*Blastophaga psenes* L., Hymenoptera, Agaonidae). It's indigenous in areas of traditional fig cultivation. In other areas, it was necessary to introduce the wasp or to only grow those cultivars which able to set fruits without pollination. Pollination is a prerequisite for the development of the syconia in certain cultivars. The receptive female phase of individual syconia may last more than two weeks, being marked by the production of long distance attracting volatile substances which are detectable to fig wasps for several days (Kjellberg *et al.*, 1983; Kjellberg *et al.*, 1988). Pollination at any time during this period may result in fruit setting and seed development. Each female syconium is visited by several wasps, one of them carry out almost all pollination (about 80%). In fact, Smyrna type figs will never set fruits without pollination from caprifig.

Syconia receptivity stops quickly after pollination (Valizadeh *et al.*, 1987; Khadari *et al.*, 1995a). Kjellberg *et al.* (1988) indicated that *Blastophaga psenes* females can survive at least two days out of their natal fig under natural conditions in South France.

In the female tree, the syconia of the main crop were initiated on 10-15 March, initiation of the pistillate flowers was observed on 22 April. At the end of May, some fig wasps entered the syconia and pollinated the pistillate flowers. On 21 June, the style had turned brown, the ovule was swollen and the testa was hardened. In the male trees, in early and mid-April, the wasps released from the mammoni crop entered into the syconia of the profichi crop and laid their eggs into the ovary. The gall and male flowers already mature (mid-April and early June respectively) when the female flowers were initiated at the time when the wasps were ready to emerge and enter the syconia of the mamme crop to lay eggs.



Inflorescence of fig

Gall-inducing wasps use fig flowers or inflorescence tissues, which are found within a globoid or urn-shaped inflorescence called a syconium. This enclosed fig inflorescence probably developed from the folding in of a flat flower-bearing capitulum (Thorogood *et al.*, 2018; Clement *et al.*, 2020). In simple terms, female pollinators that enter the fig flower through a small opening often get hurt. These injured females, known as foundresses, can usually only

visit one fig inflorescence and then they die. Fig inflorescences can grow in different ways – they can be attached to the side of the plant, grow directly from the trunk, or be located underground on roots (Bajinath and Ramcharun, 1983). Range varies from size of syconia from a few mm in diameter to 21 × 18 cm. Syconia contain thousands of flowers (Verkerke, 1989). Fig species can be categorized as either monoecious, where plants have syconia (figs) containing both male and female flowers, or gynodioecious, where plants have syconia with either only female flowers (female trees) or both male and female flowers. About 52% of fig species are monoecious, while 48% are gynodioecious (Basso-Alves *et al.*, 2014; Rasplus *et al.*, 2020). In monoecious fig species, all figs contain both male and female flowers, producing seeds, pollen, and wasps. In gynodioecious species, figs on female trees only produce seeds, while figs on “male” trees only produce wasps. This separation of seed and wasp production is due to the longer style lengths of flowers on female trees, which prevent female wasps from laying eggs at the ovule level, leading to reproductive failure for female wasps in female tree figs. In monoecious figs and male tree figs in gynodioecious species, there is a significant time gap between the development of female and male flowers, with female flowers maturing first. This likely evolved as an adaptation for the mutualistic relationship between fig plants and their pollinating wasps, ensuring successful fertilization of female flowers by pollen brought in by the pollinators.

Types of Fig cultivars:

Depending upon the nature of flowers and the method of pollination, there are four pomologically distinct classes of fig.

Smyrna Fig:

In this type fig have only female flowers, the fruit do not develop unless the flowers are pollinated with pollen carried from the male flowers of the caprifig by the tiny wasp. Of these four types, Smyrna fig is commercially most important and is extensively grown in Europe and USA. It usually does not produce breba crop (first crop). Syconia of the main crop (second crop) form and ripen only if pollinated. Calimyrna (Sarilop) is a typical variety of this group.

San Pedro fig:

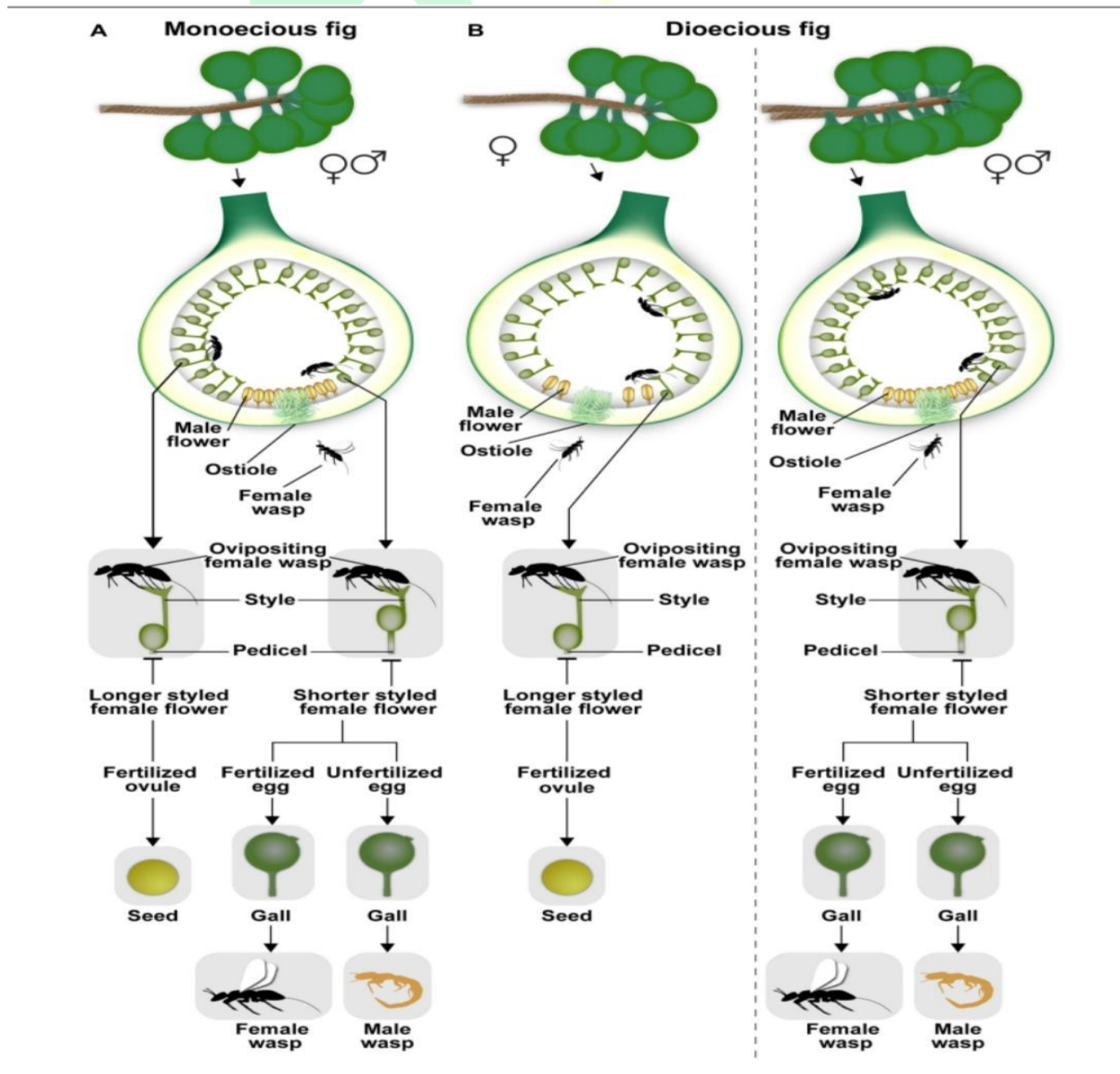
It is intermediate type in which the first crop known as ‘breba’ crop, is completely parthenocarpic and does not require pollination and fertilization of flowers, but the second crop requires pollination to develop to maturity and if it was not pollinated did not give second crop as in case of Smyrna type. San Pedro, King and Gentile are the typical varieties of this group.

Common fig:

In this type the individual flowers are pistillate and the fruits develop without the stimulation of pollination and fertilization. It may or may not initiate breba crop. The second crop is abundant and develop to maturity without pollination. Some cultivars of this type are kadota, Mission, Adriatic, Brown Turkey, Canardia etc.

Capri fig/ Male fig/ Wild fig:

It is the most primitive type with short- styled pistillate flowers and functional staminate flowers. Most caprifig is not edible but are grown for pollination and setting of fruits. It produce three flower in a year that is Profichi (spring flower), Mammoni (summer flower) and Mamme (autumn flower).



Classification of Fig

Features	Wild fig	Common fig	Smyrna fig	San Pedro fig
Comman Name	Male /goat /Capri fig	Adriatic fig	Lov of angir	-
Male flowers	Male and female	No Male flower	No Male flower	No Male flower
Female flower	Male and female	Only female flower	Only female flower	Only female flower
Pollination required	Required	No	Required	Main crop: - Required Breba crop: - Not required
Parthenocarpic	No parthenocarpic	Parthenocarpic	No parthenocarpic	Both parthenocarpic and none parthenocarpic
Season for taking crops	3 (crop/year) Profichi, Mammoni,Mammae	Only 1 (crop/year) same time 2	Only 1 (crop/year)	2(crop/year) Main crop (Motha crop) Breba crop (khatta crop)
Style length	Short style pistillate (Wasp can lay egg)	Long style pistillate (Wasp can't lay egg)	Long style pistillate (Wasp can't lay egg)	Long style pistilate (wasp can't lay egg)
Edible quality	Not good	Good	Good	Good
Varieties	Samson, Stanford, Brawely	Brown turkey, Conardia,excel , poona fig	Calimyrna, zidi	King gentile, Lampeiria

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