

Noteworthy Plants For June 1999



The Calimyrna Fig & Its Pollinator Wasp

[Growing Delicious Figs In California's Central Valley](#)

[See Unusual Hybrid Between The Common Fig & The Creeping Fig](#)

The World's Most Delicious Figs Require A Tiny Symbiotic Wasp To Pollinate Its Minute Flowers



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Ripe Calimyrna figs grown in San Diego County. Minute pollinator wasps are responsible for fruit set and crunchy seeds which impart a superior nutty flavor to these delicious figs.

Fig Cultivation Predates Cereal Domestication

Krislev, M.E., Hartmann, A. and O. Bar-Yosef. 2006. "Early Domesticated Fig in the Jordan Valley." *Science* 312 (5778): 1273-1275. 2 June 2006

The remains of parthenocarpic fig syconia (edible figs) have been discovered in archeological sites of the Jordan Valley that date back to 11,400 years bp. The carbonized syconia are clearly parthenocarpic because the drupelets are without embryos or seeds. Wild populations of *Ficus carica* are gynodioecious with male trees (caprifigs) and female trees. Edible figs are produced on female trees only if they are pollinated by fig wasps (*Blastophaga psenes*) from the syconia of male trees. The male syconia contain wasps and pollen, and are generally not eaten. They were named "caprifigs" because they were commonly fed to goats. If pollinated, seeds develop inside the drupelets within syconia on female trees. Without pollination, the immature figs are shed by the female trees. Parthenocarpy is produced by a single dominant mutant gene. Female trees expressing this gene retain their developing figs to maturity, even though they are not pollinated and contain no seeds. Parthenocarpic trees must be propagated by cuttings because they do not produce seeds. They produce sweet fig fruits without the need for male trees that carry symbiotic fig wasps within their syconia. This is very advantageous to farmers in regions where the wild caprifigs and natural pollinator wasps do not occur. The presence of parthenocarpic figs in ancient settlements indicates that people recognized these rare parthenocarpic trees and propagated them by planting branches. Evidence of such activity may mark one of the earliest forms of agriculture. Fig trees could have been the first domesticated plant of the Neolithic Revolution, which preceded cereal domestication by about 1,000 years.

1. [Figs Species Of The Holy Land](#)
2. [Sex Determination Of Common Fig](#)
3. [Pollination Patterns In Dioecious Figs](#)

Each June in California's hot San Joaquin Valley a most remarkable biological phenomenon takes place. Traveling north of Fresno on Highway 99, thousands of acres of Calimyrna fig orchards are "decorated" with small brown or white paper bags. This unusual annual event results in the delicious nutty flavor of Calimyrna figs and the crunch in your fig newtons.



Each June in California's hot San Joaquin Valley, paper bags containing wasp and pollen-bearing caprifigs are stapled to limbs in Calimyrna fig orchards. Only a few wasp-laden caprifig syconia are placed in the bags to prevent overpollination and split Calimyrna fruit.



A severely split Calimyrna syconium containing thousands of seed-bearing drupelets. Excessive pollination by fig wasps from a nearby caprifig tree caused the syconium to split open. This is why Calimyrna growers keep their male caprifig trees a safe distance from the Calimyrna orchards, and only place a few wasp-laden caprifig syconia in the paper bags that are stapled to Calimyrna trees.

[See Inside The Bag Of Caprifigs Overpollinated Calimyrna Figs That Split](#)

To fig connoisseurs, Calimyrnas are the ne plus ultra (nee-plus-UL-tra) of figs. Comparing them with other cultivated varieties is like comparing red snapper with swordfish or hamburger with filet mignon. If you don't particularly like figs, you probably have never tasted a fresh Calimyrna. Since they are extremely perishable, most of the Calimyrna crop is used for dried figs, confectioneries and pastries.



A ripe Calimyrna fig showing fleshy interior with numerous seed-bearing endocarps (drupelets). Minute pollinator wasps are responsible for the seeds which impart a superior nutty flavor to these delicious figs.



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A beautiful metal box of delicious "ne plus ultra" figs from Turkey. These are wasp-pollinated smyrna figs containing numerous crunchy, seed-bearing endocarps (drupelets).

In a strict botanical sense fig "fruits" are actually inside-out flower clusters (inflorescences) called syconia. They are hollow, fleshy structures composed of modified stem (peduncular) tissue, lined on the inside with hundreds of minute flowers. At one end is a small opening (ostiole) lined with dense, overlapping scales. Calimyrna syconia contain only female flowers and must be pollinated in order to ripen. Each tiny flower consists of a five-parted calyx and an ovary with a long style. Following pollination and fertilization the ovaries develop into minute one-seeded drupelets with a hard inner layer (endocarp) surrounding the seed. The seed-bearing drupelets produce the superior nutty flavor and crunch. Without pollination Calimyrna syconia fail to ripen and drop from the branches.

[Illustration Of Male & Female Flowers Of Ficus carica](#)
[Sex Determination In The Common Fig \(Ficus carica\)](#)

Up until the late 1800s, Calimyrna growers in California were puzzled as to why their trees would not set fruit. It was finally discovered that they needed a tiny female wasp pollinator from Asia

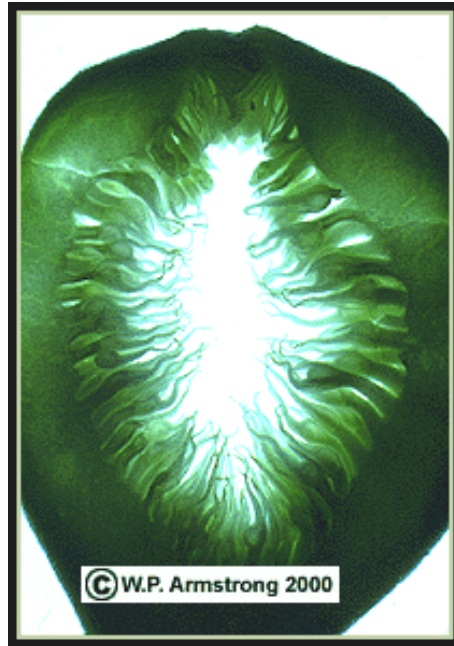
Minor (***Blastophaga psenes***) that lives inside the fruits of pollen-bearing wild figs (called caprifigs). Capri refers to goat and the inedible wild figs were apparently fed to livestock. The tiny wasps are only two millimeters long, small enough to pass through the "eye" of a sewing needle. Wasp-bearing caprifigs are now grown in California, and each summer they are placed in the little brown bags in Calimyrna orchards. This process, called caprification, is vital to the Calimyrna growers.

[See Straight Pin & Sewing Needle Used In Wayne's Word Articles](#)



Magnified view of the ***Ficus carica*** fig wasps (***Blastophaga psenes***): The winged female (left) is shiny black with a threadlike ovipositor at the tip of her abdomen. The amber male is wingless with a long, tapering abdomen. The wasps are about 2 mm long.

By June the fig wasps living inside caprifig syconia are mature. At this time the male flowers inside are shedding copious pollen and the ostiolar scales are loose and passable. The gravid female fig wasp (already inseminated by a male) becomes dusted with pollen as she crawls out of the caprifig syconium. She flies to a Calimyrna branch where she instinctively forces her way through the ostiole of a receptive syconium. As she squeezes through the pore her wings often break off and protrude from the opening. In fact, this is how you can tell if a wasp has entered the unripe Calimyrna. Only in small receptive syconia can the female wasp enter the ostiole and push through the inner layer of closely overlapping scales. After this stage the ostiole is virtually impervious to insect entry. Inside she attempts to lay an egg inside the ovary of each female flower by inserting her ovipositor (egg-laying device) down the slender style. In Calimyrna figs this turns out to be a lesson in futility because the styles are all too long (much longer than her ovipositor). She withdraws her ovipositor and moves from one flower to another. In her desperate attempt to lay eggs she inadvertently pollinates the flowers. Eventually she dies from shear exhaustion, or old age, and is broken down by a protein-digesting enzyme (ficin) inside the fig. [In French Polynesia the ficin-rich sap from a native banyan fig is used to kill parasitic worms and to treat skin cancers.]



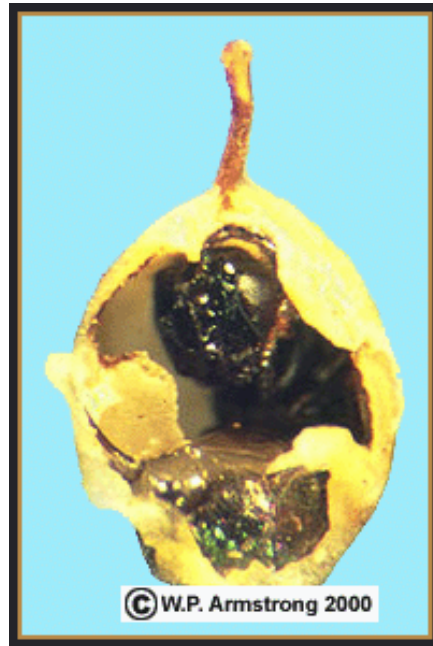
Close-up view inside Calimyrna fig syconium showing dense thicket of female flowers. It is virtually impossible for female wasp to deposit her eggs inside the ovaries, her ovipositor is too short to penetrate the long, threadlike styles.

Female wasps lucky enough to live in a grove of wild caprifigs will be able to carry out their instinctive tasks. She can easily lay eggs inside the short-style flowers of caprifigs and perpetuate her offspring. Some of these may end up in Calimyrna groves the following summer. Lucky for us she can't lay eggs in Calimyrna figs--otherwise we might have a mouthful of fig wasps.



Branch of caprifig in early summer with mature profichi syconia. The profichi crop resemble edible figs, except they are filled with wasps and pollen-bearing stamens. Caprifigs are native to Asia Minor and are grown in California for pollination (caprification) of Calimyrna figs.

Most authors refer to the short-style female flowers inside the syconia of caprifigs as "gall flowers," presumably because they are commonly occupied by a developing fig wasp; however, they are fully capable of producing normal seed-bearing drupelets, and in this respect are no different from long-style flowers of *Calimyrna* figs. A gall may be defined as an abnormal swelling or tumorous growth on plants, caused by an insect whose larvae feed on the gall tissue. The fig wasp larva is clearly a seed predator feeding inside the ovary of a normal flower.



A female fig wasp (***Blastophaga psenes***) inside the ovary of a short-style female flower ("gall flower") of a male caprifig. Wasps only develop in short-style flowers, the long-style flowers of female figs are reserved for seeds.

The "gall controversy" of fig flowers is complicated because food tissue (endosperm) for the developing larva may be initiated parthenogenetically (without pollination and fertilization), possibly by a mechanical or chemical stimulus during oviposition. In this case the flower functions like a minute gall, except there is no apparent tissue malformation as in typical insect galls. Functional male caprifigs of ***Ficus carica*** produce three crops of syconia per year: the summer profichi, fall mammoni and overwintering mamme that mature the following spring. Only the profichi crop produces pollen, and this is used to pollinate the Calimyrna orchards of California's Central Valley. [There are also reports of the mammoni crop of ***Ficus pseudocarpa*** producing pollen in the fall.] The receptive mamme and profichi syconia are not pollinated, so endosperm tissue to nourish the wasp larvae in these crops must be initiated parthenogenetically. Whether they contain a mature seed or a wasp, the short-style flowers of caprifigs appear virtually identical in structure, and do not fit the definition of a typical gall. However, proponents of gall flower terminology argue that when the wasp induces the formation of nutritive endosperm tissue, the ovary interior is literally transformed into a minute gall.

[Go To The Fig Gall Flower Controversy](#)

Many authors dating back to Aristotle and Theophrastus thought the caprifig was the wild form of **Ficus carica**, while the female trees bearing edible figs were cultivated. They are actually two natural sexual forms of the same species. Caprifigs are naturalized in moist riverbeds and creeks of southern California amidst thickets of willows and cottonwoods. They occasionally appear as seedling volunteers in urbanized areas, probably dispersed by birds. The syconia contain clusters of pollen-bearing male flowers (each with five stamens) in the ostiolar region. During wasp exodus season in June they are filled with black, winged female wasps and amber, wingless males, and literally "smoke" with pollen. Some caprifigs in northern San Diego County have smaller, purple syconia and velvety-pubescent branchlets. These trees may be the closely related **Ficus pseudocarica**. Several cultivated varieties of caprifigs are sweet and palatable, including the Cordelia and Brawley.



A profichi caprifig syconium cut open showing mass of stamens protruding from region just below ostiolar scales. In addition to pollen, these syconia also bear the male and female fig wasps, essentially to the survival and perpetuation of wild populations of **Ficus carica**.

As stated above, caprifigs of **Ficus carica** produce three crops of syconia per year: the profichi which ripen in early summer; the mammoni which ripen in fall; and the mamme which overwinter on the tree and ripen in spring. The pollen-bearing profichi crop is used to pollinate the Calimyrna figs in June. The overwintering mamme crop house wasps through the cold winter months and are quite visible on the leafless branches. Female trees produce only two crops of syconia annually, a breba crop which ripens in early summer and a second (main) crop which ripens in fall. During the

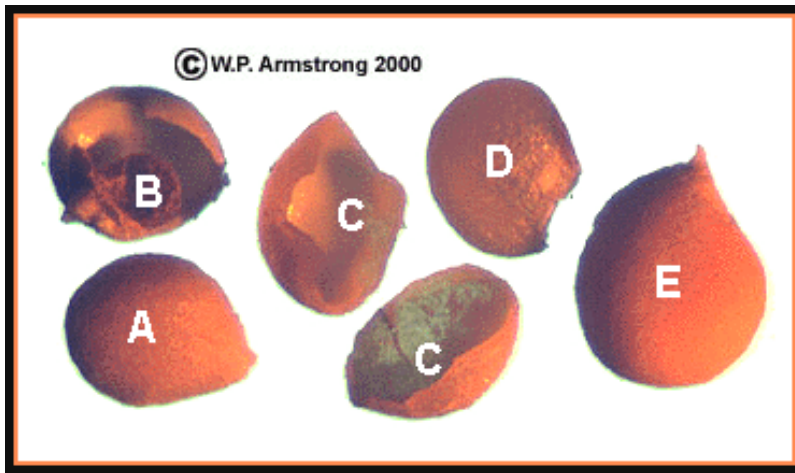
receptive (immature) summer stage, this second crop receives pollen from the mature caprifig profichi crop. Although caprifig syconia incubate and perpetuate the tiny fig wasp, seeds may also develop in the short-style flowers. This is especially true of mammoni syconia in which pollination (from profichi crop) results in some ovaries (without wasps) developing seeds with viable embryos.

[See Overwintering Mamme Crop On A Caprifig Tree](#)

One hazard of wasp pollination is the transmission of internal rot fungus or endosepsis (**Fusarium moniliforme** var. **fici**) from caprifigs to Calimyrnas. In early spring the entire mamme crop is harvested. Sound syconia are split open and dipped in a fungicide. They are placed back in the caprifig trees so emerging wasps can enter the receptive profichi crop. Since the mamme crop does not shed pollen, the mere act of oviposition stimulates endosperm formation and food tissue for developing larvae within ovaries of profichi syconia.

Most tropical species of **Ficus** bear several crops of syconia throughout the year, with short and long-style female flowers and male flowers in the same syconium. Since the female flowers are receptive several months before the male flowers release pollen, they require wasp pollination between synchronized syconia of the same or different trees. There are more than 1,000 recognized species of **Ficus** in the world, and each one has its own species of wasp. Pollination and seed production is essential for the dispersal and perpetuation of fig species and their symbiotic wasps.

In his monograph on cultivars of edible figs (**Hilgardia**: 11: 323-538, 1955), Ira J. Condit lists 471 varieties of common-type female trees of **Ficus carica** that do not require caprification. Several popular varieties grown in southern California include the Mission, Kadota, Brown Turkey and Conadria. Unlike the Calimyrna, the syconia remain on the branches and ripen without wasp pollination. The drupelets inside develop parthenocarpically and the crunchy little endocarps are generally hollow and without mature seeds. The cultivar Mary Lane has very little sclerified (woody) tissue in its endocarp and is ideally suited to denture wearers. Occasionally, female trees may produce apomictic seeds without pollination and fertilization: The seed embryo develops from an unfertilized egg (or another cell within embryo sac), or from nucellar tissue surrounding the embryo sac. Apomictic seeds enable the propagation of choice edible fig cultivars without the transmission of a mosaic virus disease through cuttings.



The most delicious figs are wasp-pollinated and contain nutty fig seeds.

A & B. Non-pollinated, parthenocarpic Black Mission Fig:
Endocarp (A) containing a rudimentary (aborted) seed (B).

C, D & E. Wasp-pollinated and fertilized Calimyrna Fig:
Endocarp (C) and (E) containing a mature seed (D).



Seed-bearing endocarps of the fig variety 'verte' at the bottom of a dish of water. Although this cultivar is parthenocarpic, it has been fertilized by a nearby caprifig. Endocarps with mature seeds sink in water.

Calimyrna figs are a high-energy, nutritious fruit, high in vitamins, calcium, phosphorus and iron. They are easily digested and are an excellent source of natural fiber. One large dried fig contains about 65 dietary calories (kilocalories). The California Fig Institute located in Fresno has prepared an extensive list of delectable fig recipes, from fig muffins and cookies to fig puddings and pies.



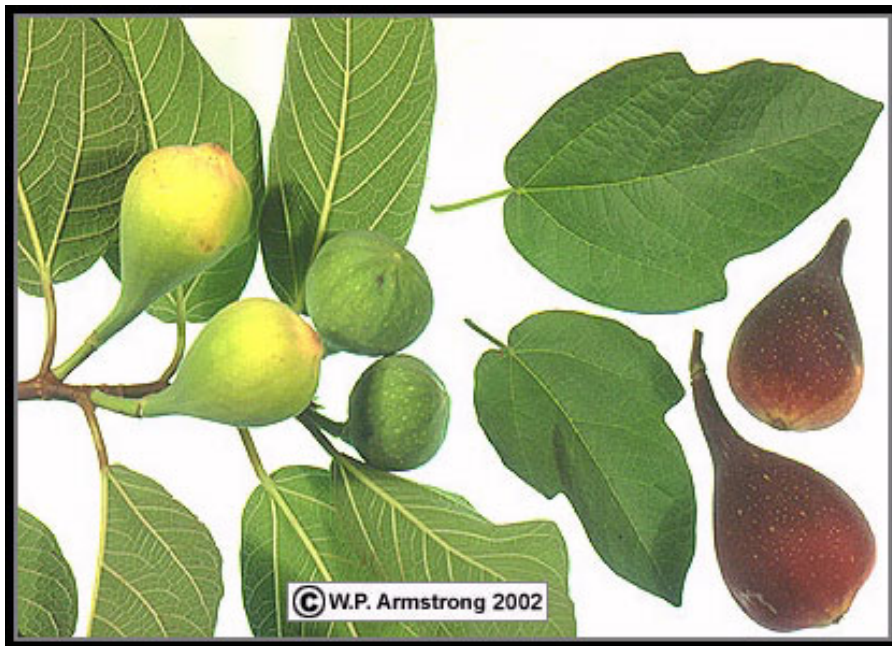
Dried figs sold at a supermarket. Calimyrna figs (left) are golden yellow and slightly larger than black mission figs. It is the opinion of this author that the mission figs in above photo have a more delectable texture and flavor than the Calimyrna figs.

So the next time you enjoy a dried Calimyrna fig, or munch on a premium fig newton, think about the female wasps that literally gave their lives to make this delicious fruit possible.

Hybrid Between Common Fig & Creeping Fig



Left: The creeping fig (***Ficus pumila***), a remarkable Asian vine that is commonly cultivated in southern California. There are two distinct types of stem growth: Young, juvenile branches and older, mature branches. The juvenile branches (with smaller leaves) produce aerial roots that adhere to concrete, stucco, masonry and even glass windows. Without pruning, a single plant can envelop a four-story building. The aerial roots secrete a clear, gummy latex that works like rubber cement. This remarkable adhesive was first described in detail by Charles Darwin in his book ***The Movements and Habits of Climbing Plants*** (1876). Older, mature branches with larger leaves produce fleshy, flower-bearing syconia. In fact, this species has been crossed with the edible fig (***F. carica***) to produce a hybrid vine (***F. x pumila-carica***) with edible syconia. **Right:** Close-up view of the aerial roots (red arrow) that develop at the nodes on juvenile branches. The roots secrete a gummy adhesive that adheres to concrete, masonry and glass. This species is commonly planted in southern California to cover the monotonous concrete walls of buildings and freeways. The following image shows the remarkable hybrid between the creeping fig and the common edible fig:



Ficus x pumila-carica, an interspecific hybrid between the creeping fig (**F. pumila**) and the common edible fig (**F. carica**). This hybrid forms an attractive climbing vine with edible syconia.

Other WAYNE'S WORD Links About Figs & Their Wasps:

1. [Bogus Fig Wasps](#)
2. [The Fig Gall Controversy](#)
3. [Fig & Fig Wasp Relationship](#)
4. [Sex Determination Of Common Fig](#)
5. [Pollination Patterns In Dioecious Figs](#)
6. [Sexuality Of Figs & Other Plants](#)
7. [Figs Of The Holy Land](#)

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