Chapter 5: Tree Fruits & Nuts and Exotic Tree Fruits & Nuts

FIG

Ficus carica L., family Moraceae

The common or commercial fig is grown primarily in California, although dooryard and small commercial plantings occur in many other States. About 54,000 tons of the fruit, valued at almost $5 million, were produced on about 18,000 acres in 1969. About one-fourth of this fruit was canned and three-fourths dried, with a small amount consumed fresh.

Plant:

The cultivated fig is a small, barely deciduous, soft-wooded, many branched shrub or tree 6 to 20 feet high, with long-stemmed, thick, three- to five-lobed rough leaves 4 to 8 inches long. The fruit, technically referred to as a syconium, is a sweet, round or pear-shaped, infolded fleshy collection of hundreds of tiny inflorescences, each only a few millimeters long. The whole fruit is 1 to 2 l/2 inches long, with a tiny opening or "eye" on the outer end. The primary cultivars grown in California include: 'Calimyrna', 8,523 acres; 'White Adriatic', 3,645 acres; 'Kadota', 2,410 acres; 'Million', 1,753 acres, and 'Conadria', 636 acres.

Inflorescence:

Hundreds of tiny florets line the inner wall of the fleshy hollow receptacle. There are four different types of flowers; pistillate, staminate, gall flowers, and mule flowers (Eisen 1897, 1901). The influence of these different types of flowers on the development of the fruit depends on the general type of fig plant. The mule flowers produce no pollen, nor do they have receptive pistils, yet the fruit develops into an edible fig. The Smyrna type fig has receptive pistils that must be pollinated, but it has no staminate flowers; therefore, pollen must come from a donor flower - in this case, the inedible caprifig (goat fig), which has pollen-producing staminate flowers near its opening and pistillate gall flowers toward its base.

Each Smyrna fig flower has a single ovary with one ovule, which, if pollinated, develops into a nutlet embedded in the fleshy wall. The flower has four microscopic petals. The style of this pistillate flower is much longer than that of a gall flower. If pollination does not occur, the fleshy part does not develop and the

fruit wilts and sheds. If pollination occurs at the time the fruit develops, two or three crops per year are produced. The first crop is referred to as breba figs, the second as profichi figs, and the third as mammoni (Condit 1926, 1941).

Pollination Requirements:

From the pollination standpoint, the figs grown commercially are basically of three types. The *common* type (for example, 'Mission' cv.) develops its fruit parthenocarpically. The *Smyrna* type (for example, 'Calimyrna' cv.) must be pollinated with pollen from the inedible caprifig. The *San Pedro* type produces its first crop of the season parthenocarpically, but its second crop develops only if its flowers are pollinated (Eisen 1897, Condit 1932, 1938). The 'Kadota' cv. is a common type that will produce fruit parthenocarpically, but if pollinated its seeds will develop, a feature that is desired if the figs are to be dried, but undesired if they are to be preserved (Condit 1927).

Pollinators:

Smyrna (and second crop San Pedro) figs are pollinated exclusively by the hymenopterous fig wasp (*Blastophaga psenes* (L.)), which overwinters in the caprifig fruit (fig. 111). The use of this wasp is the oldest form of man-manipulated insect pollination, a system referred to as caprification. With the exception of date pollination (see "Dates"), this is the oldest form of controlled pollination in plants (Condit and Enderud 1956). According to Betts (1940) the part these insects play in fertilizing the fig was known in 1782, just 11 years before the noted Sprengel published his treatise on insect pollination. This relationship was later challenged and "proved a myth" by the Italian government (Reasoner 1891). In 1887, when the astute Gustav Eisen announced in Fresno, Calif., the necessity of importing these wasps, he was "hooted down and some of the mob whistled" (Condit and Swingle 1947), but the need for these insects is now an undisputed fact.

It was common knowledge that Turkish fig growers since time immemorial had tied a few caprifigs on a string at a certain time of the year and hung them in their fig groves to assure a crop (Condit 1920). When Smyrna figs were brought to California, however, they failed to produce; and when the wasps were brought over and released, they failed to winter over. After 20 years of research, sometimes including intrigue, astute observation, patience, and diplomacy, caprifig plants infested with these wasps were successfully established in California and satisfactory pollination and fruit set was achieved (Eisen 1891, Howard 1900). Then, however, a second problem arose. Growers had difficulty in

obtaining Caprifig fruit infested with wasps at the desired time, and in disgust many began the destruction of their orchards. To assist them, the USDA began a program of releasing such figs to growers by the box for pollination purposes (Rixford 1918).

The systematic distribution of the infested caprifigs tended to stabilize the fig-growing industry, but after a time the growers found that the wasps were the cause of a rot condition in the figs, called endosepsis. To prevent the damage by this contamination, the rearing of the wasps in the laboratory was developed, and wasps could be induced with proper heat control to emerge at desired times into sterile containers where they could live for a couple of weeks (Smith and Hansen 1927, Metcalf and Flint 1962). Now, when the endosepsis problem arises, the adult wasps are laboratory reared and delivered to growers at specified times in sterile containers (Bishop 1952). Most growers, however, continue to maintain their own source of caprifigs and two or three times during the pollination period suspend, a perforated bag or wire basket in the orchard, a few of the caprifigs with wasps ready to emerge.

The wasps overwinter in the immature stage in the gall flowers of the caprifig. The wingless and practically blind male wasp is the first to emerge as an adult. He crawls about within the caprifig, finds a gall flower containing a female still in her cocoon, gnaws a hole through the top of the cocoon then another hole through the side, inserts his abdomen, and fertilizes the female (Sisson 1970). The males lives only about a day, does not leave the fruit in which it emerged and consumes no food. The female emerges from her cocoon shortly after copulation and immediately leaves the fruit.

As she passes the pollen-laden male flowers near the fig opening, her moist body becomes coated with pollen. She also has the ability to carry 2,000 to 3,000 pollen grains in her corbiculae (Ramirez 1970). She then begins a search for other figs in which she can oviposit. If she finds a caprifig, she enters the small opening, inserts her ovipositor into the short style of a gall flower, and deposits an egg near the ovary.

If she enters a Smyrna fig, she searches about for short-styled gall flowers, but finds only the long-styled ones in which she is unable to oviposit. In her search, she accidentally leaves pollen on the stigmas and fertilization results by the "mess and soil" principle (Faegri and van der Pijl 1966*) rather than the more precise method of pollination caused by bees. In the caprifig, she finds gall flowers and deposits 200 to 300 eggs, then she dies. If she emerges in a Smyrna fig grove, she searches about unsuccessfully for gall flowers, cross-pollinating the flowers in her attempts until she dies of exhaustion.

The symbiotic relationship of the fig and the wasp, each dependent on the other (Ramirez 1969) similar to the yucca moth and the yucca plant (Riley 1878) is a strange and difficult to explain phenomenon in the plant- insect relationship.

[gfx] FIGURE 111. - Fig wasp greatly enlarged. A, adult female; B, female still in gall; C, and D, males.

Pollination Recommendations and Practices:

The number of wasps released in Smyrna fig groves depends upon the size of the tree. Simmons and Fisher (1947) recommended one caprifig (yielding 200 to 3001900 wasps) per 18 ft^2 of fig-bearing tree surface, (about five figs for a tree 10 feet in diameter) for highest yield of 'Calimyrna' figs. Because the wasps tend to remain mostly in the tree where they emerge, the infested fruit is placed in about every other tree. An estimated three to five wasps are needed for each fig harvested. The female usually looses her wings struggling to enter the fig opening, and they remain stuck among the opening scales. A good indication that pollination is adequate in the orchard is the presence of these tiny wings, protruding like a ring of feathers from this hole in the fig.

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