

CAPRIFICATION – A UNIQUE INSECT PLANT CORRELATION

S. UMA AND A. K. BOHRIA

DIRECTORATE OF PLANT PROTECTION QUARANTINE AND STORAGE
CENTRAL INTEGRATED PEST MANAGEMENT CENTRE
ERNAKULAM- 682 037, INDIA.
(e-mail : umabsunil@gmail.com)

Pollination is the transfer of pollen grains from anther to receptive stigma. Entomophily is the pollination aided by insects like coleopterans, dipterans, lepidopterans and hymenopterans. Fig wasps belonging to super family Chalcidoidea aids in transfer of pollen from inedible male caprifig to edible Smyrna-types fruit figs known as Caprification. Female fig wasps complete its life cycle within the plant and after emergence leave the fig tree in search of another fig tree to continue the reproductive cycle. Fig wasps enter into the Smyrna fig florets through ostiole for oviposition and facilitate pollination. The florets with long styles than the wasp's ovipositor get pollinated, and hence these florets set seed. Once the wasps reach maturity chews its way out from the galls through exit holes and emerges after mating with male. The females carry pollen and visit other young receptive figs to complete the life cycle.

Key words : Entomophily, Fig wasp, Caprification.

INTRODUCTION

Pollination is a cardinal process in plants wherein pollen is transferred from male anther to the female reproductive organs *i.e.* stigma, thereby enabling fertilization and reproduction. Both gymnosperms and angiosperms undergo pollination, although the mechanism for angiosperms is much faster and more complex. More commonly, the process of pollination requires pollinator organisms that carry or move the pollen grains from the anther of one flower to the receptive part of the stigma of another flower and the process is known as biotic pollination (Faegri & Van Der Pijl, 2013). Insects play a vital role as pollinators and about 1,500 species of birds and mammals have been reported to visit flowers which may transfer pollens from one plant to another plant. Besides birds and bats which are the most frequent visitors, monkeys, lemurs, squirrels, rodents and possums are other important pollinators (Abrol, 2012). Pollination by insects is known as entomophily which is aided by coloured petals and a strong scent to attract insects such as: bees, wasps and occasionally ants (Hymenoptera), beetles (Coleoptera), moths and butterflies (Lepidoptera), and flies (Diptera). The specificity and distinctive nature of pollination is aided by pollination syndromes wherein volatile specific traits are released by plants that differentially attract one type of pollinator or another (Marvin & Jack, 1979). There are about 2,50,000 species of flowering plants in the world which are pollinated by at least 1,00,000 species of animals (Abrol, 2012).

Fig (*Ficus carica*) is a crop of high nutritional quality with minor significance in India. It is an Asian species of flowering plants belonging to Moraceae mulberry family. Nearly 700 varieties of fig have been identified in the world. The most popular cultivar of India includes Poona, Bangalore, Bellary, Coimbatore, Daulatahad, Dindigul, Ganjam, Hindupur, Lucknow and Saharanpur.

Fig fruits are rich in calories (269), proteins, and calcium (higher than milk), iron and have highest fibre content (Campbell *et al.*, 2002). Fig has nutritive index of 11, as against 9, 8 and 6 for apple, raisin and date, respectively. The chemical composition and flavour of fig varies with the cultivar (Rubnov *et al.*, 2001). The total sugar content of fresh fig is 16% and of dried is 52%. The edible portion of dried fig (100 g) supplies protein (4 g), carbohydrate (69 g), fat (1 g), calcium (200 mg), iron (4 mg), and thiamine (0.1 mg) (Canal *et al.*, 2000). Fig is valued for its laxative properties and is used in the treatment of skin infection. The fruits help to maintain acid alkali balance of the body. Latex is useful to coagulate milk.

A fig "fruit" is derived from a specially adapted type of inflorescence. The syconium often has a bulbous shape with a small opening (the ostiole) at the outward end that allows access to pollinators. The ostiole is not connected to the tree, but it helps in fruit's development, aiding it in communication with the environment. The flowers are pollinated by very small wasps that crawl through the opening in search of a suitable place to lay eggs. Without this pollinator service fig trees could not reproduce by seed. In turn, the flowers provide a safe haven and nourishment for the next generation of wasps. This accounts for the frequent presence of wasp larvae in the fruit, and has led to a co-evolutionary relationship. This process of pollination in fig by the transfer of pollen from inedible male Capri figs to edible Smyrna-types fruit figs by fig wasps is known as Caprification.

The hermaphrodite common figs are inedible figs or Capri figs. In the female fig trees, the male flower parts fail to develop; they produce the edible figs. Fig wasps grow in common fig Capri figs but not in the female syconiums because the female flower is too long for the wasp to successfully lay her eggs in them. Unless the wasp pollinates the flower with pollen from the Capri fig it will not grow.

Female fig wasps after emergence leave the fig tree in search of another fig tree to continue the reproductive cycle. Host tree releases secondary metabolites in the form of specific volatiles which acts as chemical cues for host identification and host recognition. A chemical signal is released by the fig when it is receptive for pollination. Fig wasps gain access into the florets by means of passage known as ostiole. Female wasp has to try hard to gain entry inside the tightly closed bracts. The morphological adaptations of the body particularly extremely flattened and elongate head and thorax enables to access inside. The female wasp then proceeds to lay eggs in the ovules of some of the florets and in turn to pollinate the stigmas. This is done by inserting long ovipositor down inside of the style. The florets that have styles longer than the wasp's ovipositor are pollinated, but no eggs are laid in the ovule and hence these florets set seed. Consequently wasp larvae develops and it feeds on the endosperm tissue in the galled ovary. Once the wasps have reached maturity they chew their way out from the galls through exit holes and emerge into the fig cavity within a short period of time. The wingless males mate with the females before chewing a hole through the fig wall to the exterior to allow the females to escape. The females either actively load up pollen from ripe anthers into special pollen pockets, or in some species passively become covered with pollen, before exiting the fig in search of young receptive figs to complete the life cycle.

Once the female fig wasps have left the fig, it undergoes ripening, change colour and smell, and become attractive to seed or fruit eating birds, bats, monkeys and even lizards.

Fig trees are considered to be keystone species in many tropical and subtropical ecosystems, because of the all year round production of figs, providing food in seasons when other fruiting trees are not. Fruit eating animals play an important part in the propagation of fig trees, acting as the dispersal agents of the seeds.

ACKNOWLEDGEMENT

The authors are highly thankful to Dr. S.N. Sushil, Plant Protection Advisor, for providing necessary facilities and encouragement and to Dr Sanjay Kumar, Plant Protection Officer (PP) for suggestions and improving the manuscript; Directorate of Plant Protection, Quarantine & Storage, NH-IV, Faridabad.

REFERENCES

- ABROL, D P. 2012. Biodiversity conservation in agricultural production. *Pollination Biol.* ISBN 978-94-007-191-5:709-711
- CAMPBELL, NEIL, REECE, A. & JANE, B. 2002. *Biology* (6th edn.). Pearson Education. pp. 600-612.
- CANAL, J.R., TORRES, M.D., ROMERO, A. & PEREZ, C. 2000. A chloroform extract obtained from a decoction of *Ficus carica* leaves improves the cholesterolaemic status of rats with streptozotocin- induced diabetes. *Acta Physiol Hung.* **87**(1) : 71-76.
- FAEGRI, K., & VAN DER PIJL, L. 2013. Types of Pollination, Pollinators and Terminology. *Crops Review. Com.* Retrieve. **15** : 10-20.
- MARVIN, G. & JACK, K.C. 1979. Caprification : A unique relationship between plant and insect. *California Agriculture.* **14** : 12-15.
- RUBNOV, S., KASHMAN, Y. & RABINOWITZ, R. 2001. Suppressors of cancer cell proliferation from fig (*Ficus carica*) resin : isolation and structure elucidation. *J. Nat. Prod.* **64** (7) : 993-996.

(Manuscript Received : March 2016)