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ECOLOGICAL STUDIES OF THE *PAUROPSYLLA DEPRESSA* CRAWFORD GALLS ON *FICUS GLOMERATA* ROXB. PLANT LEAVES

S.C DHIMAN AND SHALU*
ENTOMOLOGY RESEARCH LAB.
DEPARTMENT OF ZOOLOGY, DEPARTMENT OF BOTANY*
M.S. COLLEGE, SAHARANPUR-247001. INDIA
(e-mail : dhimansc@yahoo.com)

Pauropsylla depressa Crawford (Homoptera : Psyllidae) is a gall making insect which forms leaf galls on this tree causing extensive damage to the foliage of the plant. Galls are formed on the dorsal surface of the leaf because upper part of the leaf gets proper sunlight necessary for photosynthesis. Tender leaves are heavily infested. Gall is a cumulative expression of a suit of adaptation achieved by the host plant for accommodating the inducing insect. A gall provides shelter and nutrition to the inducing insect. *P. depressa* forms monolocular and multilocular galls develop on dorsal side of the leaf and in severe infestation entire leaf turns a agromerated mass. Maximum infestation occurs from August to October and minimum during March to June. A newly formed gall is green in colour but as the gall grows it changes to pale green. Lateron it develops brownish spots. A mature gall turns pinkish due to formation of some phenolic compound which trap sunlight during winter for keeping proper temperature inside the gall. Newly formed gall measures 2.2 mm in diameter, mature gall measure 10-12 mm in diameter, medium sized 6-8 mm in diameter. Maximum no. of galls were found in the middle area of the tree foliage while minimum no. of galls were found on the bottom of the tree. In the increase in temperature after winter, number of galls increased up to October. Thereafter, on the decrease in temperature after November, no. of galls also decreases up to February. However, one or two galls on a leaf do not interfere much in the photosynthesis but when entire leaf turns gallinaceous and badly distorted this activities is greatly affected.

Key words : *Pauropsylla depressa Crawford, Ficus glomerata Roxb.*, gall, ecology, photosynthesis.

INTRODUCTION

Ficus is a genus of about 800 species of woody trees, shrubs, vines, epiphytes and hemi-epiphytes in Moraceae family. *Ficus glomerata* Roxb. is a medium tall tree. Galls are formed on the tender leaf of *Ficus glomerata. Pauropsylla depressa* Crawford (Homoptera : Psyllidae) infests the leaves of this tree by making galls. *P. depressa* causes changes in the morphology, histology, physiology and biochemical components of the host plant leaves in the form of galls. This causes stunted growth of the host plant. Galls are abnormal growths that occur on leaves, twigs, roots or flowers of many plants. Most galls are caused by irritation or stimulation of plant cells due to feeding or egg laying by insect such as aphids, midges, wasps or mites. Some galls are the result of infections by bacteria, fungi or nematodes and are difficult to tell a part from insect caused galls. Generally, galls provide shelter and nutrition to the inducing insect, where it can feed, get shelter and develop. The galls are usually formed on meristemetic tissue and are the result of abnormal cell multiplication. It is generally believed that some enzymes of salivary secretion from the nymphs stimulate gall formation when saliva is poured into host's tissue during feeding.

Earlier studies on this psyllid are carried out by Mani, (1935, 1954, 1964, 1973 & 2000); Mathur, (1975); Richards & Davies, (1977); Dhiman & Arora, (2002 & 2006); Arora, (2005) and Dhiman & Shalu, (2006, 2007, 2008a & 2008b). In present paper an effort has been made to describe ecological aspects of galls made by this injurious psyllid.

MATERIALS AND METHODS

Ecology of *P. depressa* gall was studied in Saharanpur district and adjacent areas where the main host plants, *Ficus glomerata* Roxb. are found in good number. For this, different plants were randomly selected from the field area. Infested leaves were plucked from the plants during different months of the year and infestation percentage was noted. Number of galls, shape and size, colour of gall, types of gall, temperature and humidity data.were also recorded. Dial hygrometer and field thermometer were used for noting field temperature and R.H.

RESULTS AND DISCUSSION

Ficus glomerata Roxb. (Moraceae) is a woody tree and native throughout the tropics with a few species extending into the warm temperate zone. Hence, it is mainly found in temperate zone. In Saharanpur district of western U.P. the Gular tree occurs in all the blocks and suffer heavy infestation of *P. depressa* galls (Fig 1). Female of *P. depressa* laid eggs singly near the midrib or side veins on the ventral side of the leaf. After hatching, first instar nymph starts sucking plant sap from the leaf and mean while inject saliva which stimulate gall formation due to the presence of some enzymes. Controlled metaplasia occurs in the leaf tissue surrounding the nymph. Size of the gall grows by the feeding with the advancing stages of the nymph (*i.e.* 1st, 2nd, 3rd, 4th, and 5th instar). Large size of gall is attained harbouring the 5th instar. Mature 5th instar nymph emerges out of the gall through lacerated opening of the leaf and moults into imago on exposure to air. Following aspects of gall were studied.

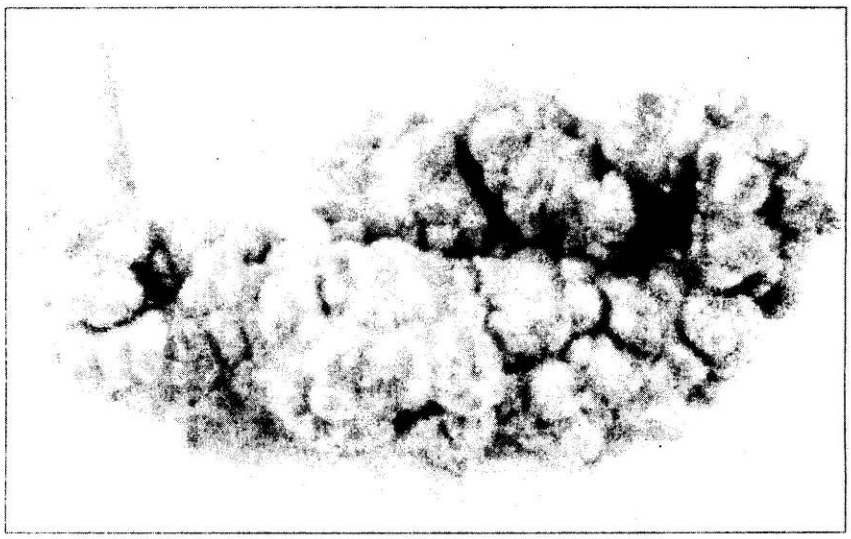

Fig. 1 : Infected leaf of *Ficus glomerata*

Colour of gall : Main part of gall occurs on dorsal side of leaf and only conical projection in which lacerated opening develops later on occurs on ventral side of the leaf (Table I). Tender leaves are found more suitable for gall formations which are full of fresh sap. Only one instar develops within the gall, but rarely two instars may also develop together inside the gall having 1st and 2nd instars which are green in colour matching with the colour of leaf. But, as the gall grows due to the metaplasia induced by the feeding of instar and saliva injection, it changes to pale green. Later on, it develops brownish spots. Then, the colour turns greenish brown in 4th and 5th instar stage.

During winter, mature gall turns pinkish due to formation of some phenolic compounds which help in trapping sun heat to warm the gall and make suitable temperature for the development of instar inside the gall. Mature gall contains a lacerated opening or aperture on the lower conical surface of the gall from which 5th instar nymph escapes out for moulting into imago. The empty gall turns brown in colour, which gradually changes into brownish black and become hard and woody.

Earlier, Arora, (2005) also observed colour changes in the gall induced by this insect. However, she did not mention sequencial change in the colour of gall and other factors.

Number of gall : Maximum infestation occurs from August to October at temperature ranging form 19 to 32°C and relative humidity 55 to 93% while minimum infestation occurs from March to June at R.H 13 to 78%, and at an average temperature 13 to 39°C. The number of galls are reduced during unfavorable condition (winter months, November to mid February). Maximum number of galls are found in middle area of the tree foliage, while minimum number of galls on the bottom. Further, direction wise maximum galls have been observed in east, west, and south parts of the tree foliage because these parts gets proper sunlight which is necessary for photosynthesis and development of the foliage on the tree. It was further observed that maximum number of galls occurs on the Gular plant situated in open area exposed to direct sunlight while minimum galls occurs on the plants situated in shadow area and surround by other tree species.

Arora, (2005) recorded minimum 1 and maximum 123 galls per leaf. But, in present case maximum 151 galls were observed with an average of 21 galls of 100 infested leaves during peak period. However, one gall per leaf is of rare occurrence. In many cases, entire leaf was turned into agglomerated mass having multilocular galls (Fig. 1).

Shape and size of gall : A newly formed gall measure 2.2 mm. in diameter, mature gall measures 10-2 mm. in diameter, medium sized 6-8 mm. in diameter, multilocular gall attains maximum size 20 to 23 mm. A newly formed gall appears like a pimple but a mature gall is of pea size and appearance. Vertically gall measures 1.2 to 5.0 mm. in size with an average of 3.3 mm. Galls are of two types monolocular and multilocular. Monolocular galls having one cavity and multilocular galls having more cavities.

Effect of temperature on gall formation : Temperature has direct influence on population built up of *P. depressa* and galls formation. Meteorological data taken for 2007 indicate that as the temperature increases after February, there is a gradual increase in the gall formation which reaches on peak during July to September and thereafter, gradually decreases and attains low level during winter months late November to mid

Table I : Colour change in the gall induced by *P. depressa* Crawford.

Days	Stage of instar in the gall	Types of gall	Colour of gall	Lacerated opening
1st & 2nd	1st instars nymph	Newly formed gall	Green	Absent
4th	2nd instars nymph	Young	Green	Absent
6th	2nd late instars nymph	Young	Pale green	Absent
10th	3rd instars nymph	Mature	Pale green	Elevation of opening
14th	4th instars nymph	Mature	Pale green with brownish spot	Elevation of opening
18th	5th instars nymph	Mature	Brownish	Opened
26th	Empty gall	Old	brown	Opened

February. It was further observed that along with temperature, humidity also influence gall formation. During rainy months in this region temperature remains 19 to 32°C and R.H. 55 to 93%. Not only this, adult population is also affected by environment temperature. In winter most of the adults dies and laid eggs entered in diapause which is broken in late February only, hatched 1st instar nymphs initiate gall formation by their feeding. Peak is attained by adults during July to September and low level during March and April and October to November.

Effect of gall on host plant : Galls are abnormal structures on the plant leaves which provide hinderances in the photosynthetic activities of the plant. Hence, galls are always injurious to plant and growth of the plant is adversely affected or stunted. Most of *the Ficus glomerata* leaves bear many galls. Leaves are perform photosynthetic activities. The leaves not only produce carbohydrate with the help of sun rays, carbon dioxide and water but also perform respiration with the help of stomata which are found mostly on lower surface of the leaf. Hence, gall formation affects these two activities of the plant. However, one or two galls on a leaf do not interfere much in the photosynthesis but when entire leaf turns gallinaceous and badly distorted this activity is greatly affected. The leaves become unfit for photosynthetic activity and growth of the twig is stunted. Moreover, when the entire plant was infested by galls, then the vegetative growth of plant was seen adversely affected.

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