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DIVERSITY OF GALLSAND ASSOCIATED INSECT ORDERSIN MANJERI AND NEARBY AREAS

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Abstract: Galls are pathologically developed cells tissues and organs of plants, which have resins mostly by hypertrophy and hyperplasy, under the influence of parasitic organisms. The present study deals with the insect and mite galls on plants and associated insect orders in Manjeri and nearby areas. In this study, 7 plant galls have been collected and identified, of these 5 were leaf galls and two were stem galls. Out of the 5 leaf galls 4 were caused by insects and one by mite. Galls are an excellent model for studying inter-specific interactions and gall inducer attack is a major factor that shapes the evolution of many structural traits of gall.

Keywords: Galls, symbiosis, parasitism.

INTRODUCTION

All those organisms which include members of the same or different species, as a part of each other's environment or ecological communities or ecosystem comes under the intra and inter specific interaction. Intra specific relations exhibit association of similar forms or sexes, parental care, social life, cannibalism. Inter specific relation exhibit association between different kinds of species which include competition, symbiosis, parasitism, predation, commensalism, phoresy etc. (Ashwathi, 2013). This relation sometimes benefits to both organism while in some cases it harms to both or any one of the organisms.

Reciprocal interactions over evolutionary time between phytophagous insects and their food plants, or between pollinating insect and the plant they pollinate, have been described as coevolution. Due to parasitism some parasitic organisms especially insect which secrete chemicals that causes abnormal growth in the host plant. Such abnormal growth in the host plant is called galls. These chemicals act like natural plant growth hormones. It involves enlargement and proliferation of host cells and provides both shelter and food or nutrients for the invading organism (Redfern and Shirley, 2002). Insects, mites, nematodes, bacteria, fungi and viruses produce these plant deformities.

Galls are pathologically developed cells tissues and organs of plants, which have resinsmostly by hypertrophy and hyperplasy, under the influence of parasitic organisms (Mani, 1973). Galls are also called cecidia. Study of plant galls are known as cecidology. In general, there are two types of galls. Open and closed. Open galls are produced by insects with piercing, sucking mouth parts – aphids, psyllids and scales as well as mites. These galls have an opening through which the gall makers escape. Gall maker reproduction occurs within the open galls. Closed galls are made by insect with chewing mouth parts- larvae of beetles, flies, wasps and moths. None of this insect reproduces within the galls. Because these gall makers have chewing mouth parts they are able to chew and opening to the outside upon completion of development.

Based on the parts on which infection occurs, galls can be classified differently. There are different types of galls. They are leaf galls, stem galls, twig galls and bud or flower galls. Leaf galls are appearing on leaf blades or petioles. These are most common galls and may appear as leaf curls, blisters, nipples or erineums (hairy felt like growth) on the upper or lower leaf surface. Stem and twig galls are deformed growth restricted to stem and twig; ranking from slight swelling to large knot like growths. Bud or flower galls are

deformed bud or flower structures; the size and shape of these structures is altered.

The gall cavity is lined by small, closely packed mass of cells, lacking chlorophyll, but rich in cell contents. This zone constitutes the so called nutritive tissue of a gall. The nutritive zone is surrounded externally by more or less thick sclerenchyma, followed by parenchyma with pigment and vascular bundles.

The colour of galls varies from grey or white through pale or dark green, yellowish-green, bright orange, brown to red and deep violet.

OBJECTIVES

Identification and documentation of insect-induced plant galls and associated insects from Manjeri and nearby areas.

MATERIALS AND METHODS

Study area

Specimens were collected from Manjeri and nearby areas in Malappuram District. The geographical coordinates of Manjeri are 11°7'0" North 76°7'0" East. Manjeri consists of hill slopes, flatlands and fields. The floral community of the area is secondary vegetation.

Methodology

Monthly field surveys were carried out from June 2019 to February 2020 at the selected sites of Manjeri. Plant galls of various developmental stages were collected along with other part of the plant organ, brought to lab in zip lock polythene bags. Relevant details, such as site name, and date of collection were recorded. Both vegetative and reproductive (if available) parts of the host plant were also collected and taxonomically determined up to the genus/species level. The identification of the collected Plant galls was done based on Mani, 1973.

RESULTS

The present study on galls deals with the insect and mite galls on plants in Manjeri and nearby areas. In this study 7 plant galls have been collected and identified, of these 5 were leaf galls and two were stem galls. Of the 5 leaf galls, 4 were caused by insects and one by mites.

1. **Leaf gall on *Alstoniascholaris* R. Br.** (Family: Apocynaceae) (PLATE: I)

Diagnosis: Pouch gall induced by *Pseudophacopterontuberculatum*Crawf. (Homoptera). Semiglobose, conical or obtusely conical on one side of the leaf and truncated conical on the opposite side; about 2.5mm in diameter at tip and 3mm at base; glabrous, hard; scattered irregularly in large numbers on the leaf and sometimes as covering galls on petioles also; ostiole is very narrow in immature galls but widens out as development proceeds. Pale green when young and yellowish when mature.

Distribution: India, Burma, Thailand, Malaya, Java and Philiines.

Importance of *Alstoniascholaris* R. Br. :Medicine, Timber, Fibre, Fuel and food .

2. **Stem gall on *Calycopteris floribunda* Lamarck** (Family:Combretaceae**)**(PLATE: I)

Diagnosis: Stem gall induced by Dipterans. Subepidermal erupting rinden gall; hemispherical or lenticular, soft, fleshy, solid, deciduous, sessile swellings on branches; epidermis bursts when mature under pressure of growth and cell proliferation. Size 8cm in diameter.

Distribution: India.
Importance of *Calycopteris floribunda* Lamarck: Medicinal importance.

3. **Leaf gall on *Garuga pinnata*Roxb.** (Family: Burseraceae) (PLATE: I)

Diagnosis: Galls on *G. pinnata* are induced by *Phacopteronlentiginosum* Buckton (Homoptera). Epiphyllous, simple, free and often densely clustered and bunched; subglobose, ovoid or subcylindrical, unilocular galls, strongly constricted basally into a short, neck like stalk, inserted in a cuplike outgrowth from leaf blade near midrib or larger side veins, close to leaf base. Size 20mm long and 10mm in diameter.
Distribution: India.
Importance of *Garuga pinnata*Roxb.: The bark is a source of tannins, timber value.

4. **Leaf galls in *Mangifera indica* Linnaeus** (Family: Anacardiaceae) (PLATE: I)

Diagnosis: Leaf galls are caused by unknown Dipterans. Epiphyllous, rarely hypophyllous; cylindrical, often obtusely conical, sessile, glabrous, shiny, hard unilocular, indehiscent galls; apically with a cap-like, black, red-rimmed operculum that falls off, leaving a clean large circular hole in old galls. Brown to dark reddish brown in colour. Size 1-2.5mm high and 1mm thick basally.
Distribution: India, Java, Sumatra, Sebesi.
Importance of *Mangifera indica* Linnaeus: Timber value, dried flowers have medicinal value.

5. **Leaf galls on *Pongamiapinnata* Linnaeus** (Family: Leguminosae) (PLATE: II)

Diagnosis: Leaf galls in *Pongamia pinnata* are caused by *Eriophyescheriani*Massee (Acarina). Eriophyllous, very rarely hypophyllous; subcylindrical or obliquely obpyriform, cephaloneon pouch gall; lopsided, usually simple and free and only rarely 2-3 agglomerate, glabrous, green, unusually pubescent or very rarely tomentose; hard unilocular, indehiscent; ostiole hypophyllous and minute and obstructed by downwardly directed erineal hairs. Size 10mm high, 1-2mm thick at base and 5mm thick apically.
Distribution: India, Java, Sumatra, Sebesi, Salajar, Celebes, Burma.
Importance of *Pongamiapinnata* Linnaeus: Medicine,
Remarks: On some plants the entire blade of leaflets are turned into dense clusters of conspicuously pubescent and yellowish-brown galls, without a trace of free blade.

6. **Leaf galls on *Tectona grandis* Linnaeus** (Family: Lamiaceae) (PLATE: II)
Diagnosis: Leaf gall induced by Dipterans. Hypophyllous, depressed, circular, discoid, lenticular pouch gall; solitary, shortly stalked and conspicuously covered with dense long, straight, simple, white pointed hairs; thin walled and indehiscent; ostiole minute; on upper surface of leaf, site of the gall of leaf indicates a small fleshy tubercle. Size 3-4mm in diameter and 1mm high.
Distribution: India.

7. **Stem gall on *Tectona grandis* Linnaeus** (Family: Lamiaceae)(PLATE: II)

Diagnosis: Stem gall induced by *Asphondyliatectonae*Mani (Diptea). Irregularly globose, verrocose, usually agglomerated, solid, hard, woody, indehiscent, persistent, unilateral rindengall; rough. Brown colour. 100-200 mm long and 20-50 mm thick.
Distribution: India.
Importance of *Tectona grandis* Linnaeus: Timber value.

Table 1 Details of the plant galls collected infected parts and gall incitant.

No.	Plant	Plant Family	Infected Plant part	Gall incitant
1	*Alstoniascholaris* R. Br.	Apocynaceae	Leaf	Homoptera
2	*Calycopteris floribunda*Lamark	Combretaceae	Stem	Diptera
3	*Garuga pinnata*Roxb.	Burseraceae	Leaf	Homoptera
4	*Mangifera indica* Linnaeus	Anacardiaceae	Leaf	Diptera
5	*Pongamia pinnata* Linnaeus	Leguminosae	Leaf	Acarina
6	*Tectona grandis* Linnaeus	Lamiaceae	Leaf	Diptera
7	*Tectona grandis* Linnaeus	Lamiaceae	Stem	Diptera

DISCUSSION

According to Narendran et al. (2007) major families of chalcidoids such as Aphelinidae, Encyrtidae, Trichogrammatidae, Eupelmidae, Mymaridae, Ormyridae, and Chalcididae are the main insect taxa associated directly or indirectly with plant galls. Leaf gall from *Alstoniascholaris*was already reported from India and also found in Burma, Thailand, Malaya, Java, Sumatra and Philippines (Mani 2000). Complex two tier gall induced by*Phacopteronlentiginosum*(Hemiptera: Phacopteronida) on the leaves of*Garuga pinnata* and sea urchin shaped echinate gall on the vegetative shootapical meristem of *Hopeaponga*(Dennst.) Mabb. induced by *Mangaloreahopeae*Takagi (Hemiptera: Beesonidae) are also reported. In India foliar galls are abundant in *Mangifera indica* and many of the south Indian foliar galls are also found in Malayan regions like Indonesia. The discontinuous distribution of these gall inducing midges are one of the many unresolved questions in cecidology.Fabaceae host large number of gall inducing insects from various genera. Four galls have been recorded during this study from *Pongamiapinnata*. The ovary gall and fusiform stem gall were also recorded from Coimbatore, Tamil Nadu. (Mani 1959). Four cecidomyiid galls of *Tectona grandis* reported from south India (Jayaraman 1982) was also collected from the study area, showing that these galls are common in south India.Galls are an excellent model for studying inter-specific interactions. Galls constitute discrete microhabitats that bear relatively closed communities of specialist denizens (Askew 1965; Narendran 1984). Parasitoids approach the gall inducer insect through the gall tissue and their attack is a major factor that shapes the evolution of many structural traits of gall. Parasites and their natural enemies have long been accepted as major selective agents in the evolution of variety in host defences.

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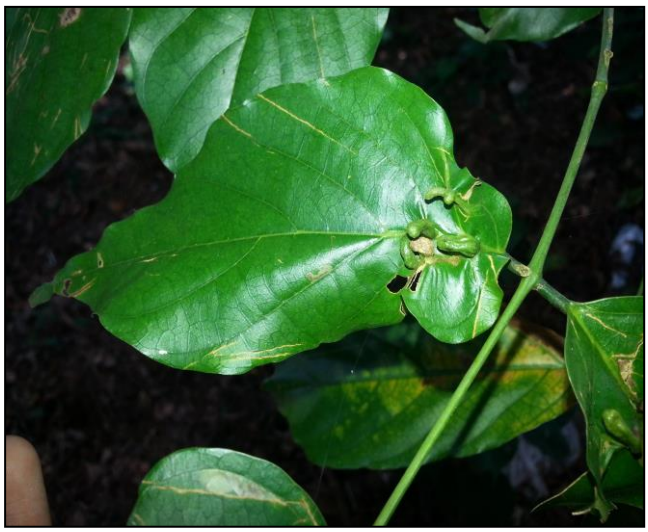
PLATE I

Leaf gall on *Alstoniascholaris*R. Br

Stem gall on *Calycopteris floribunda* Lamarck

Leaf gall on *Garugapinnata*Roxb.

Leaf galls in *Mangifera indica* Linnaeus



Leaf galls on *Pongamiapinnata* Linnaeus

Leaf galls on *Tectona grandis* Linnaeus

Stem gall on *Tectona grandis* Linnaeus