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# Anatomical Study on Mite Induced Gall on *Dichrostachys cinerea*

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*Eriophyes dichrostachia* Tuck. (Acarina = Eriophyidae, induces cylindrical gall in between consecutive leaflets of *Dichrostachys cinerea* W.&A. The gall arises as two juxtapposed circular zones of trichomes of the two leaflets. The trichomes form a dovetailing system resulting in a closed cylindrical chamber, inside which the mites breed. The lining layer of the gall cavity has unique cytological features and functions as the nutritive tissue . The zone where the trichomes originate represents the region of optimum concentration of cecidogenetic stimulus.

Key Words Dichrostachys Epidermis Eriophyes Gall Trichrome

Among the gall-inducing animal parasites, the eriophyid mites occupy a significant place. It is not merely due to the fact that a large number of eriophyid species are gall formers, but also due to their ability to produce galls of different structural complexities comparable to those caused by the insects. The phytophagous mites, especially the cecidogenetic species, are plant parasites throughout their life. They have five mouth stylets of which the front stylet pair is presumably the cheliceae which bores into the plant cells by pressure and by alternate forward impulses (Jeppson *et al.* 1975). The average eriophyid cheliceae can penetrate plant tissue 15-35 μm causing very little mechanical damage to the host. However, the stimulus introduced by them into the host tissues establishes a graded system of hypertrophy and hyperplasia resulting in the formation of quite conspicuous neoplastic outgrowths. Among the varied types of mite galls, felty outgrowths of dense epidermal hairs (erineum) or papillae are common symptoms. A remarkable gall has been reported to occur on the leaflets of *Dichrostachys cinerea* W. & A. caused by a mite, *Eriophyes dichrostachia* Tuck. (Mani, 1973). The present contribution concerns with the anatomical study of this gall.

**MATERIALS & METHODS** The material was collected from the scrub-forests in the outskirts of Madras. Galls and normal leaflets were fixed in FAA, and processed through routine methods of dehydration, clearing and paraffin embedding. Sections cut at 10 μm thickness were stained with tannic acid-ferric chloride and safranin.

**OBSERVATIONS: STRUCTURE OF THE GALL** The gall is either a cylindrical or barrel-shaped body formed between and bridging two consecutive leaflets of the same side (Fig.1). Though the galls are small, the galled leaflets sometimes become pink rendering them quite conspicuous. Several leaflets may be galled continuously in a vertical series (Fig.2). More than one gall may occur side by side in between a pair of leaflets. The outer surface of the gall is either smooth or minutely pubescent.

The gall has a wide smooth cavity in which a large number of mites and their eggs occur (Fig.3.9). When two galls develop very close to each other, they become coalesced externally, but a central partition always persists separating the two gall chambers (Fig.9). The lining layer of the gall chamber consist of large radially elongated palisade-like cells with dense granular cytoplasm and hypertrophied nuclei. These cells form the nutritive layer of the gall (Fig.5,6,11). The gall region of the leaflet consists of a uniform mass of compactly arranged cell not differentiated into palisade and spongy tissues as elsewhere in the lamina.

**ONTOGENY** In the compound leaf of *D.cinerea* the small leaflets are arranged very closely in a succubous manner on the secondary rachis. The microscopic mite enters into the narrow space between two contiguous leaflets and feeds on the two juxtaposed layers of epidermal cells. The infestation usually occurs on young leaflets in which tissue differentiation has just set in. The abaxial and adaxial surfaces of the two consecutive leaflets form the sites of infestation and affected epidermal cells enlarge and acquire dense granular cytoplasm and prominent nuclei. The epidermal cells elongate radially and form distinct palisade-like layer (Fig.5,6,11). The embryonic ground tissues of the leaflets mature directly into large compactly arranged parenchymatous cells without differentiating into the usual components of the meso-

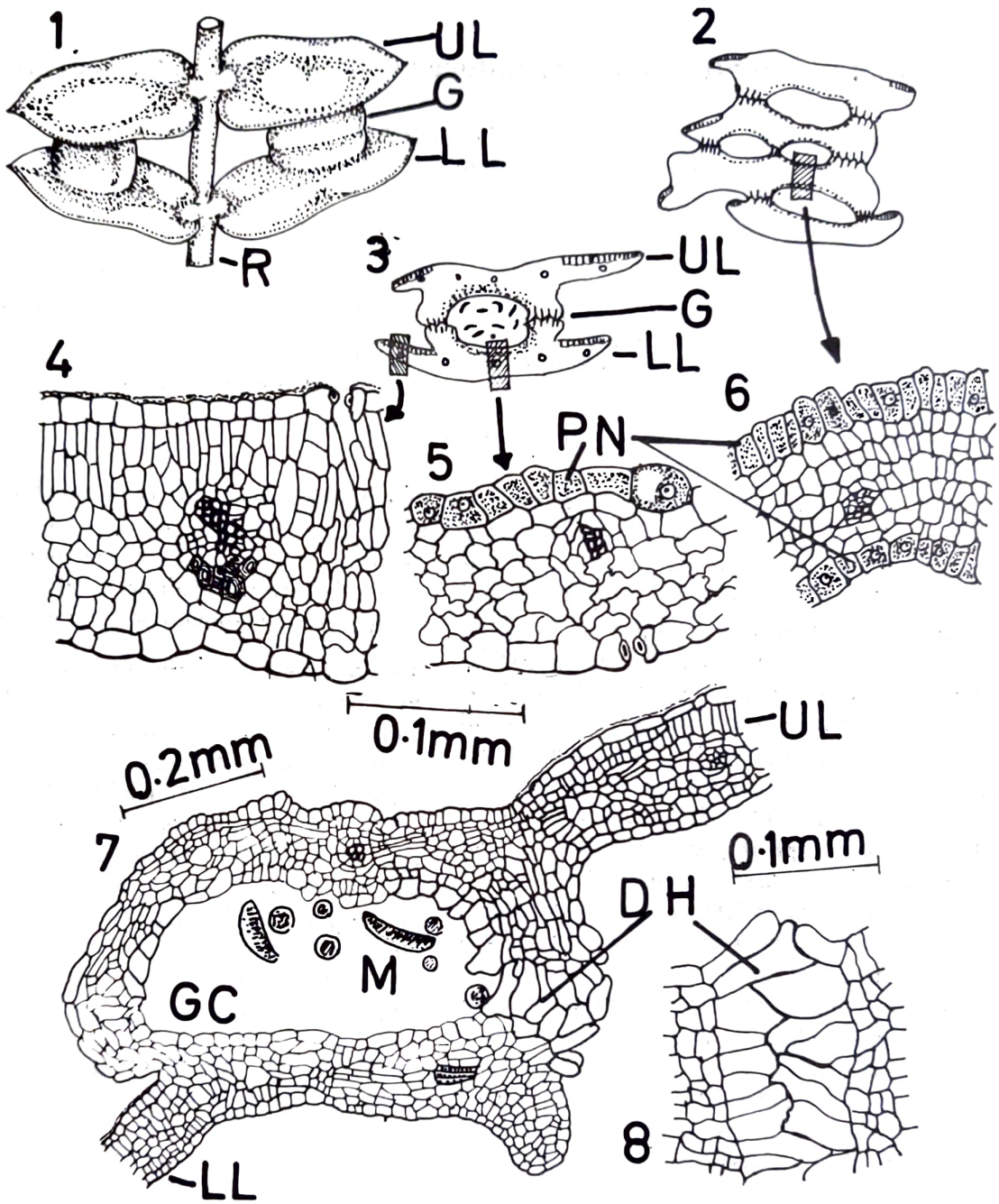
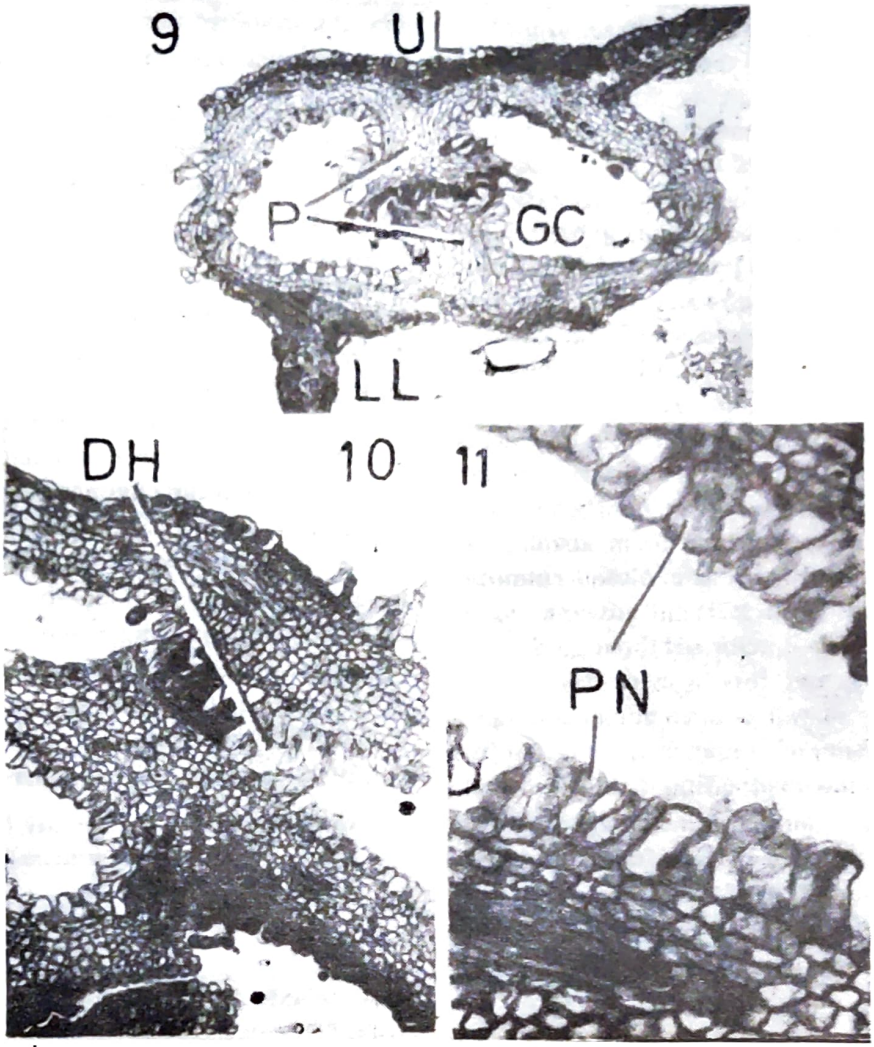



Fig 1-8. *Dichrostachys cinerea*

1. Part of compound leaf with galls in between consecutive leaflets;
2. Section through four leaflets with gall in between;
3. Section through a gall and a pair of leaflets;
4. T.S. of lamina showing palisade-spongy mesophyll organisation and a vascular bundle;
5. A sector of the gall region marked in Fig.3;
6. A sector of the gall region marked in Fig.2 showing two layers of nutritive cells;
7. Section through a gall in between a pair of leaflets;
8. Juxtaposed dovetailing hairs of the gall.

(DH - Dovetailing hairs; G- Gall; GC - Gall cavity; LL - Lower leaflet; M - Mites; PN - Palisade-like nutritive cells; R - Rachis; UL Upper leaflet).




Figs. 9-11 *Dichrostachys cinerea*

9. T.S. of a two chambered gall

10. A portion of the gall showing the interlocking system of trichomes

11. A portion of the gall showing the palisade-like nutritive cells.

(D.H. - Dovetailing hairs; G.C. - Gall chamber; L.L. - Lower leaflet; P.- Partition between two adjacent galls; P.N. - Palisade-like nutritive cells; U.L. - Upper leaflet.)

phyll tissues. A circular meristematic zone arises around the site of infestation on both the opposed surfaces of the leaflets which give rise to short epidermal hairs. These protruberant epidermal hairs from the two opposite zones establish a mutually interlocking system of union enclosing a central cavity surrounded by the cylinder of dovetailing hairs (Fig.8,10). The mite lays eggs, and the mature gall cavity is filled with hundreds of mites and eggs. The feeding activity of such large population of mites causes the palisadelike lining layer of cells to collapse into a dark zone bordering the gall cavity (Fig.9).

While the galled portion of the leaflet possesses undifferentiated compact layers of parenchyma cells, the remaining lateral basal and terminal portions exhibit normal structural organisation characteristic of the unaffected leaflets (Fig.4-7). Thus, the cecidogenetic field is very limited and circumscribed. There is no special mode of dehiscence of the mature gall. Drying and shrivelling lead to break of the gall and subsequent escape of the mites.

DISCUSSION Development of dense epidermal hairs is one of the striking features of the mite induced plant galls.

These hairs are often said to be nutritive in the sense that they provide the nutrient sap to the mites as their food. They also provide a safe dwelling place for the mites and a conducive microclimate for breeding (Jeppson *et al.* 1975). Further, the lining layer of the gall cavity in most of the mite galls can be distinguished cytologically as a distinctive layer. Hypertrophied cells with dilated nuclei and dense cytoplasm occur quite frequently in those mite galls where the characteristic trichomes do not appear in abundance. The gall on *D. cinerea* is somewhat unusual for the mites and it involves certain peculiar morphogenetic phenomena. In this gall we come across both epidermal trichomes as well as the lining layer of cytologically distinctive cells around the gall cavity. However, the epidermal outgrowths in this case are not evidently nutritive. They appear in a perfect cylindrical form around the region of mite attack and form a safe, closed chamber which protects the mites from external adverse conditions. The nutritive function is achieved through the cells lining the gall chamber and this is evidenced by the hypertrophy of the cells as well as their nuclei and dense cytoplasm. Thus, a division of labour is observed in this particular gall with some protruding epidermal cells forming a protective wall around the gall cavity While the other epidermal cells inside the gall perform a nutritive function. The nutritive function of the lining layer of the gall cavity in mite induced galls has been proved beyond any dispute by several investigators through histochemical and ultrastructural studies (Westphal, 1972).

Fusion of organs or a part of tissues of the organs is of frequent occurrence both in the insect and mite galls. Especially in the case of folded lamina, the juxtaposed tissues of the leaf become grafted during the formation of gall. In *D. cinerea* two cylindrical zones of trichomes appear on juxtaposed surfaces of two consecutive leaflets in such a way that the two zones meet with each other and form a dovetailing of their trichomes. The wall of the gall is formed not merely by a dovetailing of the trichomes, but these appear to become cemented together. The *modus operandi* of the cementing processs and the nature of the stimulus involved remain to be understood, and warrant histochemical and ultrastructural investigations.

The process of origin and spreading of the cecidogenetic stimulus in mite and insect galls has been studied in much detail by many investigators (Kostoff & Kendall, 1929; Sterling, 1952; Mani 1964). The stimulus, whatever be its nature, originates from the point of attack on the host tissue by the pathogen and spreads in graded concentrations along specific cecidogenetic field (Mani, 1964). In the graded diffusion of the stimulus, the region of optimum concentration of the stimulatory factor is marked by a meristematic zone wherein higher rate of mitotic activity, increased level of nucleic acids and other molecular and subcellular changes occur (Sterling, 1952; Mani 1964). In *D. cinerea* during early cecidogenesis, a circular meristematic zone is established around the point of infestation on the leaflets and this zone gives rise to the cylinder of interlocking sytem of trichomes. The very high degree of specificity of different morphological categories of galls of insects and mites can be explained mostly on the basis of the concentration gradients of the cecidogenetic stimulus and behavioural aspects of the pathogens.

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## REFERENCES

JAYARAMAN, P 1980. Ontogenetic studies on Plant Galls induced by mites and insects. Ph.D. thesis, Madras Univerrity, Madras.

JEPPSON, L. R., KEIFER, H.H. and BAKER, E.W. 1975. Mites injurious to Economic plants. University of California Press, Berkeley.

KOSTOFF, D. and KENDALL, J. 1929. Studies in the structure and development of certain cynipid galls. Biol. Bull., 56: 402-458.

MANI, M S 1964 Ecology of Plant Galls. Junk The Hague.

MANI, M.S. 1973. Plant Galls of India. MacMillan New Delhi.

STERLING, C. 1952. Ontogeny of the *Phylloxera* gall of grape leaf. Amer. J. Bot.,39 : 6-15

WESTPHAL, E. 1972. Observations sur la development et l'ultrastructure de e'rinoses: I Erinose provoquae par l'*Eriophyes biosoma* Nal. sur le *Tilia intermedia* D.C. Marcellia 38 :197-209.