

MORBID ANATOMY OF MITE INDUCED LEAF GALLS OF COTTON

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The present investigation is concerned with the morbid anatomy of Cotton (*Gossypium herbaceum*) leaf galls induced by mite (*Eriophyes gossypii*). These galls are found singly or in clusters on the adaxial surface of the leaf. Structure of gall tissue differs from that of normal tissues in several features. The mesophyll of the gall tissue is not differentiated in the components as in the normal mesophyll. Gall chamber and nutritive tissue is formed by the abaxial epidermal and hypodermal cells. Gall development is initiated with the attack of the mite on the abaxial surface of a very young leaf. Several cells of the abaxial epidermis develop into characteristic multicellular hair.

Key Words: *Gossypium herbaceum*; *Eriophyes gossypii*;

The galls are the pathologically developed structures, resulted by inter-specific interaction and mutual adaptation between plant and gall inducing agent. They arise mostly by hypertrophy and hyperplasia under the influence of cecidozoa. A large number of workers have described the morphology of different galls (Malpighi, 1687; Cook, 1923; Kostoff, 1930; Mani, 1973; and Kant and S.L. Sharma, 1981) Studies on anatomy and development of galls on certain plant species were also carried out by several workers (Taylor, 1949; Plumb, 1953; and Kant and Arya, 1971).

Different parts of the plant *Gossypium herbaceum* Linn. are attacked by certain insects to produce galls. The stem galls are produced by *Alcidodes* sp. and *Pempherulus affinis*, The fruit and leaf galls are induced by *Eriophyes gossypii* Banks. The leaf galls are common in the months of January and February. In heavily infected plants practically all the leaves are galled formed during this period.

MATERIALS AND METHODS

Galls and normal counter parts were collected from Jaipur and adjoining areas in the months of January to March. Galls at various stages of their development were taken and fixed in F.A.A. (Formalin-acetic-alcohol) and A.A. (Aceto Alcohol). Dehydration, clearing and embedding were done following the tertiary butyl alcohol method (Johanson, 1940). Microtome sections were cut at a thickness of 7-10 microns and stained with Safranin-Fast green combination. Galls were studied in both fresh and pre-

served conditions using hand cut sections. Structural drawings were made with camera lucida and photomicrographs were taken.

OBSERVATIONS

Structure of normal leaf: The leaf shows typical dicotyledonous anatomy. The leaf tissues are bounded

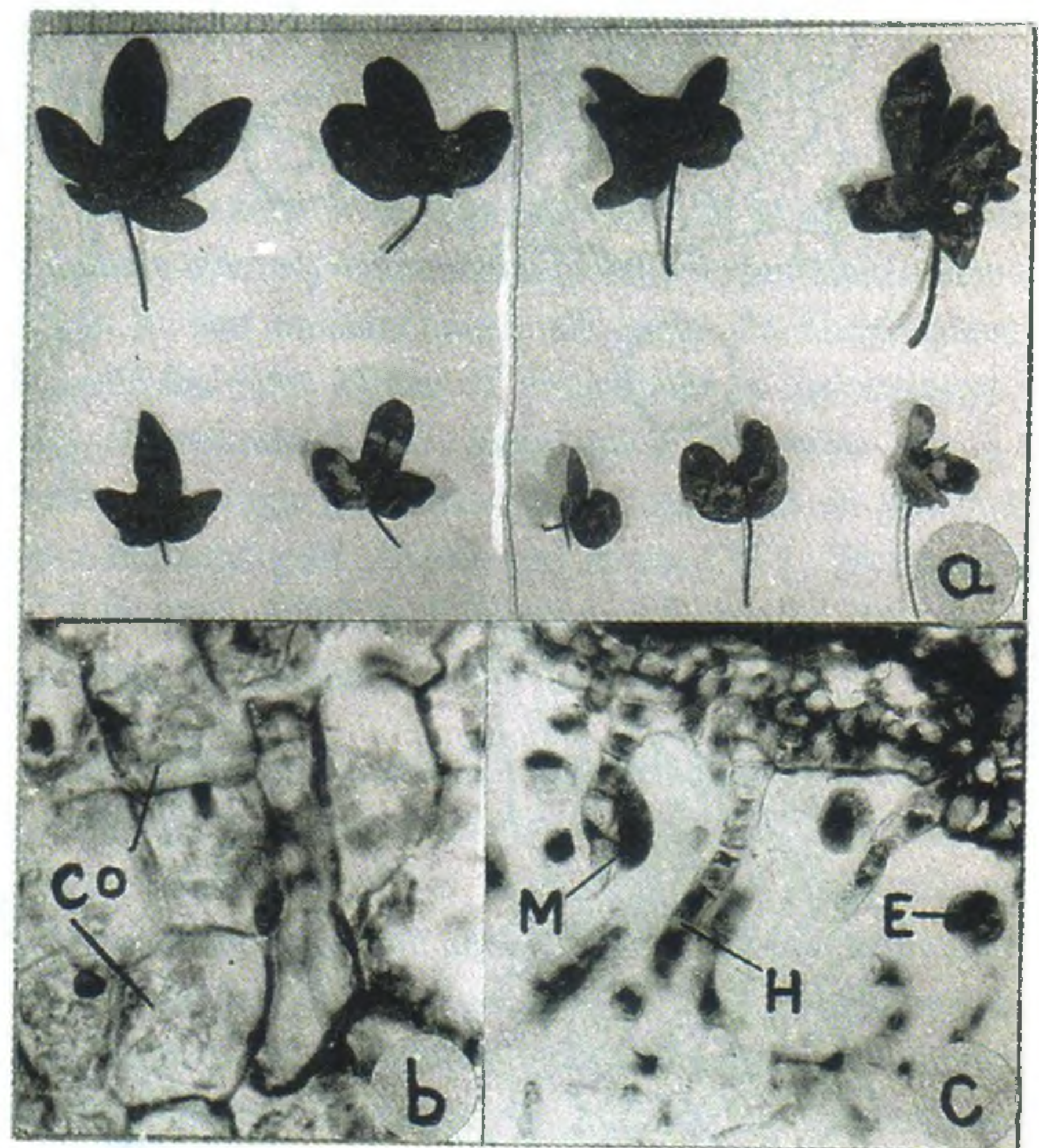


Figure 1 a-c Leaf galls of *Gossypium herbaceum* Linn. Fig.1a Galled leaves, x $\frac{1}{2}$. 1b. Galled parenchyma showing calcium oxalate crystals x 1600. 1c. various stages of mite lodged in between the hair. x 500.

Abbreviations: Co, Calcium oxalate crystals; M, mite H, hair; E, egg.

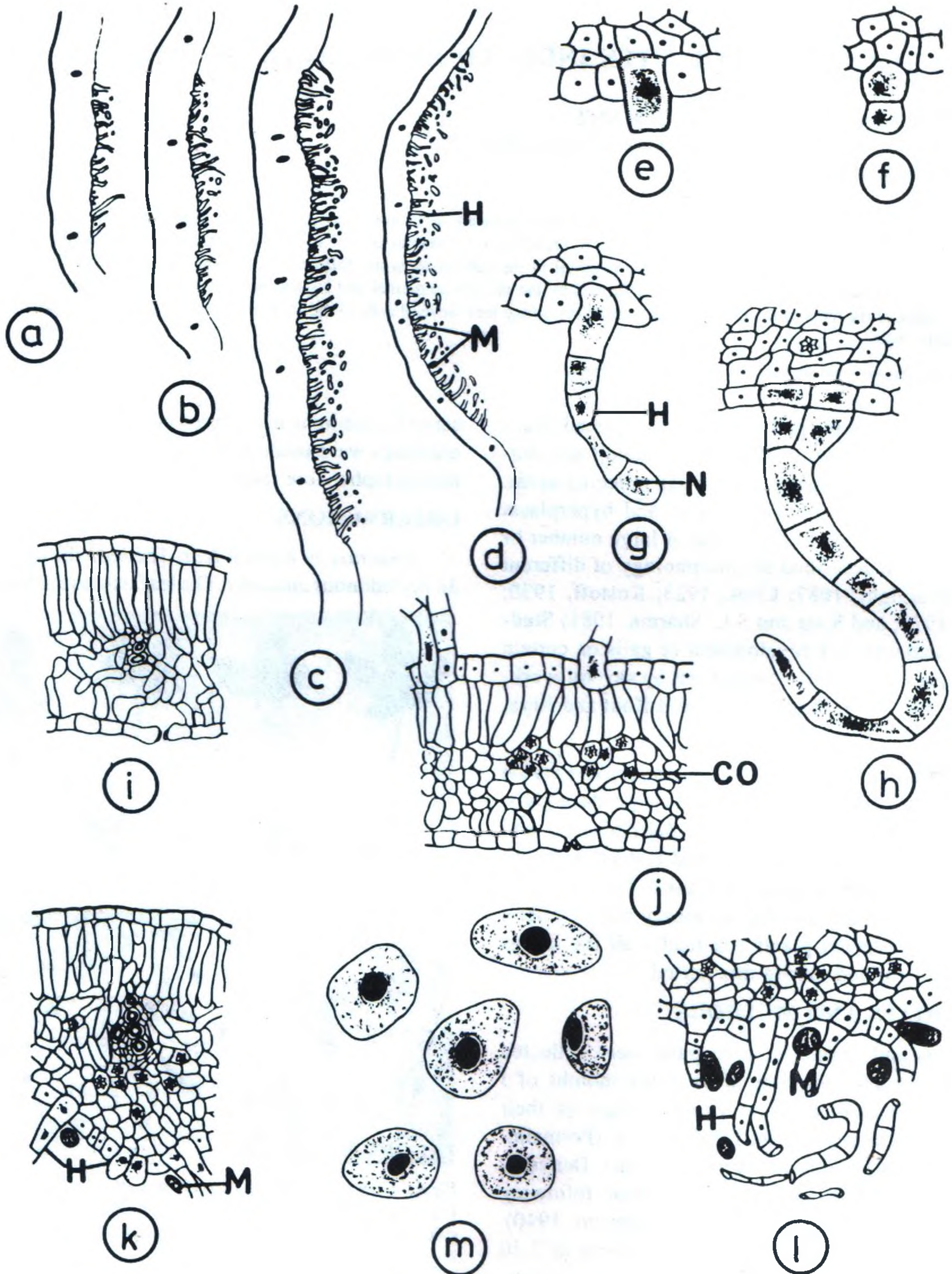


Figure 2 a-m leaf galls of *Gossypium herbaceum* Linn. Fig. a-d Median longitudinal sections of galls showing comparative stages of development. (a-c x 80 and d x 15). e-h Different stages of development of multicellular hair. x 345. i. Cross section of a normal leaf. x 225. j. A portion of mature gall formed on abaxial side of leaf in CS x 225. k. A portion of mature gall formed on adaxial side of leaf in CS x 225. l. Mites in various stages of development in the nutritive region. x 225. m. Representative sample of nuclei from nutritive zone. x 900. Abbreviations : H, Hair; M, mite; N, Nucleus; Co, Calcium oxalate crystals.

on both the sides by single layered epidermis. Stomata are present only on the lower side of leaf. Mesophyll is more or less equally divided into palisade and spongy parenchyma regions. The vascular bundles are embedded in the parenchyma tissue (Fig. 21.)

Gail morphology: The galls are formed generally on the adaxial surface of the leaf either singly or in clusters (Fig. 1a). Rarely galls are formed on both the sides. These are irregular silky white outgrowths. Galls are variable in size ranging from 1.5 to 10.0 mm in diameter. The young galls have white silky hairy covering on the underside of the gall which changes to brown with the advancement in age.

Gall anatomy : The epidermis of the gall on the adaxial side is continuous with the unaffected part of the leaf epidermis. The epidermis on abaxial surface is well defined in early growth. Later on nutritive tissue and multicellular hairs are formed from this layer. The mesophyll tissue of the gall differ with that of normal in several respects. It is not differentiated in to palisade and spongy parenchyma unlike normal leaves. The palisade cells are shorter and compact. The paranchyma cells are arranged compactly without large intercellular spaces. These cells are large, thin walled with dense cytoplasm (Fig. 2j). The vascular bundles are more numerous, the mesophyll cells situated in the inner side of the gall take part in the formation of nutritive zone. The cells of this region have thin walls and possess granular cytoplasm and large nuclei. Calcium oxalate crystals are observed in several cells of mesophyll (Fig. 1b, Fig. 2j).

In mature leaf gall a thick forest of multicellular hair is formed in the gall chamber in the gall chamber. Mites in their various stages of development are lodged in between the hair (Fig. 1c, Fig. 21). In young galls the hair are white but turn dirty white to light brown with the maturity of gall. Hair are cylindrical with variously curved tips. The base of the hair lies in the nutritive tissue of the gall. Average length of hair is 325.40 micrones. The number of cells in a hair is variable ranging from two to eight or sometimes up to twelve (fig. 2h). Hard thick walled spiny trichomes are also observed in the gall cavity.

Gall development: Stages of gall development are shown in Fig.2a to d. Gall formation is initiated by the attack of the mite on the leaf. Mite usually attack 2nd and/or 3rd leaf from growing tips of the

branches. Mite generally attacks the abaxial surface of the leaf. New attacks are continuous on the young leaves. As a result large number of galls appear at various stages of their development.

There is a marked change in the normal histological pattern. Rapid cell divisions in both periclinal and anticlinal planes take place adjoining the areas of mite attack. Both hypertrophy and hyperplasia of cells occur in the affected area causing increase of mesophyll tissue of the developing gall. A slight arch is formed due to anticlinal divisions and tangential elongation of the tissues on outer side of the galled region of the leaf (Fig. 2d).

The nutritive tissue increases in the mature gall. The cells of this zone multiply rapidly to form irregular fleshy outgrowth in the gall. The cells of this zone are characterised by their large size, crowded nature and dense cytoplasm with big nuclei. The whole mesophyll tissue of the gall show hyperplasia and hypertrophy and lacks differentiation of normal tissue.

DISCUSSION

The present investigation reveals that both the processes namely hypertrophy and hyperplasia contribute to the development of galls. In *Gossypium* leaf gall the first effect of cecidozoa is the enlargement of epidermal cells adjacent to the mite attack. Similar findings have also been reported in several insect induced galls (Kant and Arya, 1971; Westphal, 1977; Raman, 1987, a, b, Kant and Ramani, 1988 and Kant and Karnawat, 1989).

Generally galls exhibit highly enlarged cells in the nutritive region which is a characteristic feature of mite induced galls. Similarly in *Gossypium herbaceum* leaf gall the cells of the nutritive zone are highly enlarged with large nuclei. The enlargement of nuclei must be corelated with increased metabolic activity. Nuclear hypertrophy is also an interesting feature of mite induced galls and has been described by a number of workers (Taylor, 1949, Sterling, 1952; and Kant and Arya, 1971). Some workers have associated nuclear hypertrophy with increased in glucides, while Mayer (1950) believes that it is related to increased RNA and proteogenesis. Nuclear hypertrophy is also an interesting feature of mite induced galls and this must be corelated with increased metabolic activity.

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