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HISTOPATHOLOGY OF STEM GALL OF *ZIZYPHUS MAURITIANA* LAMK. INDUCED BY *ERIOPHYES CERNUUS* MASSEE

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The present investigation deals with histopathology of stem gall of *Zizyphus mauritiana* Lamk. induced by *Eriophyes cernuus* Massee. These galls are irregular, globose, lobed, rugose or tuberculated and hard. Galls represent axillary branches and have appearance of mass of cauliflower - like surface. The entire mass is composed of undifferentiated parenchyma. The cells lining the gall cavities form a nutritive layer. The cells of this zone contain dense cytoplasm and big nuclei. Hypertrophy and hyperplasia of cells play an important role in the development of the gall.

Key Words : *Zizyphus mauritiana, Eriophyes cernuus,* Stem gall.

Plant galls are abnormal, uncontrolled, largely independent growth of the host tissues which arise under the influence of an external stimulus. Insect induced galls are a product of complex interspecific interaction between a pathogen and the plant. Development and anatomy of several insect induced galls on certain plant species have been worked out by many workers. (Kostoff and Kendall, 1929; Lewis and Walton, 1947; Meyer, 1965; Kant and Arya, 1971; Raman *et al.,* 1978; Kant and Sharma, 1981; Ananthakrishanan and Raman, 1988; Kant and Kamawat, 1989; Kant *et al.,* 1994; Ramani *et al.,* 1994).

Galls on the stem of *Zizyphus mauritiana* induced by *Eriophyes cernuus* are widely distributed in India. In Rajasthan, galls are abundant during dry weather. They may however be found almost throughout the year in South India (Mani 1959). Not much information about development and anatomy of this stem gall is available. The present work is therefore concerned with histopathology of stem gall of *Zizyphus mauritiana* caused by *Eriophyes cernuus.*

MATERIALS AND METHODS

Gall and normal plant materials were collected from heavily galled *Zizyphus mauritiana* plants growing in the University Campus and fixed in acetic acid alcohol (Glacial acetic acid, 100% ethanol 1:3). Dehydration, clearing, embedding were done following the tertiary butyl alcohol method as recommended by Johansen (1940). Microtome sections were cut at a thickness of 7-14 μm. and stained with Johansen's safranin and fast green combination.

The galls were examined under the stereoscopic microscope while still attached to the leaf. They were also studied in both fresh and preserved conditions using hand cut sections. Structural drawings were made with camera lucida and photomicrographs were taken.

OBSERVATIONS

Structure of Normal axillary bud : At the tip of the axillary bud a mass of undifferentiated cells form the meristematic region. The meristematic tip is covered with primordia of leaves (Fig. J-K). The cells of the meristematic region resemble each other yet surface cells situated some distance away from the tip appear different from the cells of the tip. These surface cells at this stage make up the protoderm, which through further development form the epidermis. Young leaves and bud axis are covered with long multicellular leaves.

Gall Morphology : Galls are irregular, solitary and also crowded at times. These stem galls represent axillary branches and have the appearance of a mass of cauliflower like surface. They are globose, lobed, rugose or tuberculated and hard. The surface of the gall is irregularly formed by the naked parenchyma. Numerous individual mites feed and pass a part of their life cycle lying within the crevices of the galls. The crevices are directly connected with outside atmosphere (Fig. H).

Gall anatomy : The entire gall mass is composed

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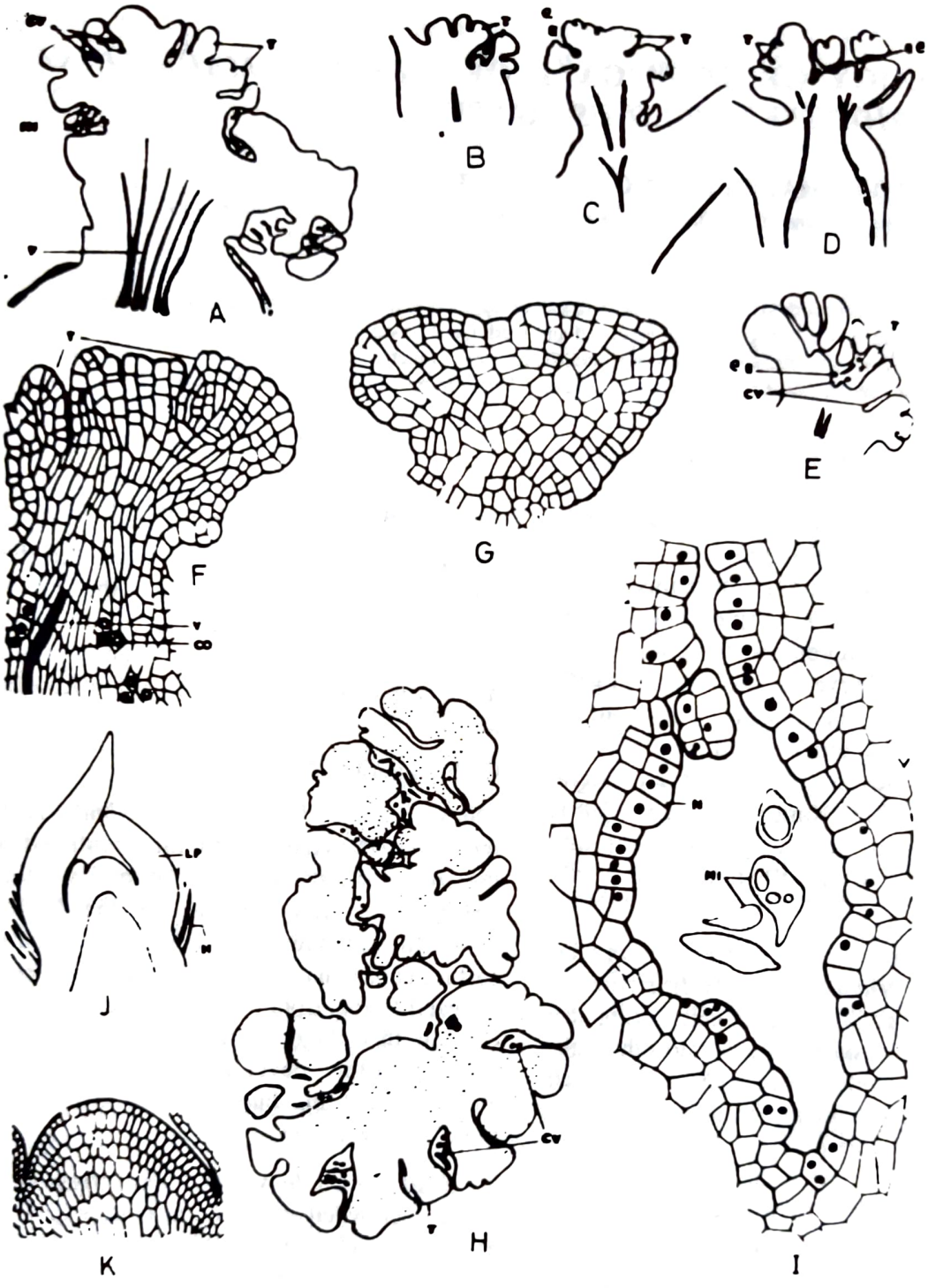

Figure I. A-K Histopathology of stem gall of *Zizyphus mauritiana* Lamk. Induced by *Eriophyes cernuns* Massee.
A. Median longitudinal section (L.S.) of a mature gall x 25. B-E. Median longitudinal section of galls showing comparative stages in development X 25. F. A part of a gall in L.S. showing developing tubercle (Note Calcium oxalate crystals in cells.) X 175. G. A tubercle - Mangified X 400. H. T.S. of a mature gall showing tubercle and crevices with mites. X 25. I . A crevice (magnified) showing nutritive layer and mites X 400. J-K. Median longitudinal section of a normal axillary bud. (Fig. J = X 70; K = x250).
(Abbreviations used for labelling figures in plate. Co = calcium oxalate crystals; D = crushed cells; E = eggs; H = hair; LP = leaf primordia; MI = mites developing; N = nutritive layer; T = tubercle).

of undifferentiated parenchyma except the basal region where vascular strands are present (Fig A). Gall surface is irregular because of unusual growth of naked parenchyma. Due to proliferation of rows of cells in the galls many knot like outgrowth (tubercles) of parenchyma are formed (Fig. G). Large number of crevices are present in between the naked tuberculated parenchyma cells. The crevices are

variable in size and shape. Generally they are irregular and narrow. Numerous individuals of the mite in various stages of their development are lodged in the crevices (Fig. I). In mature galls, many of these cells lying in the basal region contain crystals of calcium oxalate (Fig. F). The cells lying the crevices form a sort of nutritive layer. It's cells are characterized by presence of granular and dense cytoplasm with one or sometimes many conspicuous nuclei. The vascular elements lie scattered in the basal region of the gall and were connected into the xylem and phloem of the main stem.

Gall Development : The gall formation is initiated in the very young buds, which are still in the primordial stage. The mites may attack any axillary bud of the aerial part of the plant. Eggs were laid on very young buds and the abnormal growth is initiated. The stimulated host cells multiply rapidly forming large tubercles (Fig. B - E). Hypertrophy and hyperplasia of the cells play an important role in the development of galls. The axillary bud loses its normal appearance altogether.

The tubercles increase in number. Their growth is accomplished by tangential cell division at/or near the surface. In a tubercle, the cells divide more vigorously on the periphery as compared to those in the inner region. A large number of crevices are formed in the gall because of formation of numerous compact tubercle (Fig. H.). The cecidozoa passes its life cycle in the narrow crevices.

DISCUSSION

The histogenetic events of the gall point to two principle processes that are responsible for gall formation on the host. These are : firstly inhibition of normal course of tissue differentiation in the host and secondly reorganisation and reorientation of host tissues to suit the needs of the parasite. The present investigation reveals that the major tissue reorganisation is brought about by hypertrophy and hyperplasia. The cell proliferation is centered in the parenchyma and vascular tissue of the axillary bud. The stimulated host cells multiply rapidly forming large number of naked parenchyma tubercles.

Similar findings have been observed in several insect induced galls (Kant and Arya, 1971; Raman, 1987a, b; Kant and Ramani, 1988; Kant and Karnawat, 1989; Kant *et al.*, 1994 and Sharma *et al.*, 1995). In *Zizyphus mauritiana* the attack of mite is made on very young axillary buds and due to stimulus of cecidozoa the axillary bud losses its normal development altogether. In this gall the cells lying the gall chamber form a nutritive layer and characteristic nuclear gigantism has also been observed in these cells. The enlargement of nuclei must be correlated with increased metabolic activity. Some workers have associated nuclear hypertrophy with increased in glycosides content. (Westphal, 1977; Raman and Swaminathan, 1978). On the otherhand Meyer (1950) believed it is related to increased RNA and proteogensis. Therefore, it can be suggested that nuclear hypertrophy is in some way related to increased metabolism. The observations enumerated in the paper have open certain interesting aspects of gall development in plants and may prove useful in the experimental part of the problem.

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