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Eriophytid mite interaction on leaves of Pongamia pinnata-a histological study

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Abstract
Galls are irregular growth of cells formed as a result of stimulation from Insects Eriophytid mite Aceria pongamiae on leaves of Pongamia pinnata. In the present study different stages of leaf galls were cut and their internal study was carried out. Pouched Galls were found both on adaxial and abaxial surfaces of the leaves which represented neoplastic growth. In this study different day-old leaf galls were cut and undifferentiated mesophyll tissue was seen which was absent in results of anatomical study of non-galled leaves.

Keywords: abaxial, adaxial, galls, morphogenesis,neoplastic

Introduction
Galls are neoplastic outgrowth formed as a result of interaction between inducers such as insect, mites,nematodes,bacteria and fungi and the host. (Harris et al. 2003, Raman A 2003). Galls on the leaves of Pongamia pinnata were found singlely or in clusters on the adaxial and abaxial surfaces of the leaf. The pouched galls were variable in size, as their length varied from 1mm to 1.5cm. Gall morphogenesis include cell proliferation, differentiation and hypertrophy. The histopathological changes in Pongamia pinnata can be closely related with the galling life style of Aceria pongamiae as during mite infestation physiology and growth of plant is affected. The present study sheds light on anatomical alteration of Pongamia pinnata and development of abnormal pouch like outgrowths on the adaxial and abaxial surfaces of the foliage.

Materials and Methods
Collection of gall samples
During the course of present study galled and ungalled leaves were collected randomly from different branches of naturally growing trees of Pongamia pinnata University of Kota Rajasthan India during the month of November and December. Samples were washed carefully to remove dust, dried and preserved in 70%alcohol. Subsequent dehydration, clearing and embedding was done following the tertiary butyl alcohol method (Johansen, 1940). sections were cut and after staining with safranin and fast green. Histopathological study was carried out. Free hand cut sections were stained and galls were examined using a binocular microscope.

Result and Discussion
The healthy ungalled leaves of the plant were characteristically dark green on the adaxial surface as compared to the abaxial surface. Both the surfaces had a mosaic pattern of green patches and were devoid of trichomes. In mature galls the mesophyll cells adjacent to the adaxial epidermis became sclerenchymatous to form mechanical zone. the inner-gall chamber lined with inner-gall tissue and the outer gall is composed of cortical parenchyma cells (Fig. 1a). During gall development hypertrophy and hyperplasia are induced in the entire cortex. Cell proliferation of the cortex adds significantly to the width of the gall. The cells around gall chamber constitute the nutritive region. These cells were larger in size and

rich in cytoplasm because they provided nutrition to cecidozoa. an initial uplifting of tissues occurred on the adaxial leaf surface, which assumed the form of a small tubercle (the gall being an actual extension of upper epidermal cells). Due to the uncontrolled cell multiplication occurred at the abaxial surface, the chloroplast got reduced and simultaneously, an upward pushing of abaxial epidermis was observed (Fig. 1). increase in the growth of uniseriated erineal hairs was observed. interior of the gall contained a circular or oval cavity which opened outside by a minute ostiole formed on the abaxial surface of leaf.The nutritive parenchyma cells are transformed into nutritive cells as the larva grazes and show increased lipid and protein concentrations as well as an increase in amylase activity which gets reflected by reduced concentrations of starch in the gall. As the gall reaches maturation, cell proliferation ceases, most of the gall tissues lignify, besides this the larva matures and finally adult is formed. Eventually the gall desiccates and adult comes out. The growth stage consists mainly of cell expansion, leading to gall growth and inner-chamber growth. The larva grazes on the inner-gall tissue throughout development and as the larva increases in size, the cell layers of inner-gall tissue decrease

Each leaf gall is a highly complex, irregular massive structure, and the formation of which often leads to complete destruction of leaves, especially during heavy mite infestation, and thereby adversely affecting the physiology and growth of the host plant. In un galled leaves The mesophyll was found to comprise ground tissue (palisade and spongy parenchyma). The palisade parenchymatous tissue was found to comprise two layers of compactly arranged columnar cells and the spongy parenchymatous tissue was formed of loosely arranged 4–5 layers of large round and oval shaped cells with small intercellular space. The spongy tissue contained comparatively lesser number of chloroplasts than that of the palisade tissue (fig 2) Results of histological reprogramming assessment of leaf galls carried out during the present study clearly revealed the anatomical and morphological characterization of different developmental stages of galls and also the patterns of gall organogenesis. vascular elements were arranged as broken rings and were encircled with compactly arranged parenchyma cells (Fig. 2) Formation of multicellular erineal hairs occurred from the inner layer of compactly arranged parenchyma cells, and which protruded into the gall cavity (Fig. 3). The morphogenesis pattern of gall development presented various levels of manipulation induced by A.pongamiae, indicating that the gall actually represents a limited neoplastic growth. Anatomical characterization of galled and ungalled leaves revealed distinct variations from that of the control leaves [mathur2002, patani2000]. The galled leaves did not show any differentiation between ground tissues, and only a homogenous mass of dedifferentiated mesophyll tissues could be observed in the galled leaves. But, a perfect distribution pattern of ground tissues and vascular bundles was observed in the non-galled leaves. Gall-inducing insects have profound effects on their hosts. These insects live within the plant tissues and induce tumor-like growths that provide them with food, shelter, and protection from natural enemies (Raman et al. 2005). Gall-forming insects are also known to manipulate their host plants and induce changes in source-sink relationships in a way that is beneficial to larval development. Since insects derive their nutrition from gall tissue, the gall becomes a sink for different nutrients and energy that is vital for the insect's growth (Raman 2003; Raman and Abrahamson. 1995).

Fig. 1: pongamia pinnata leaf gall.

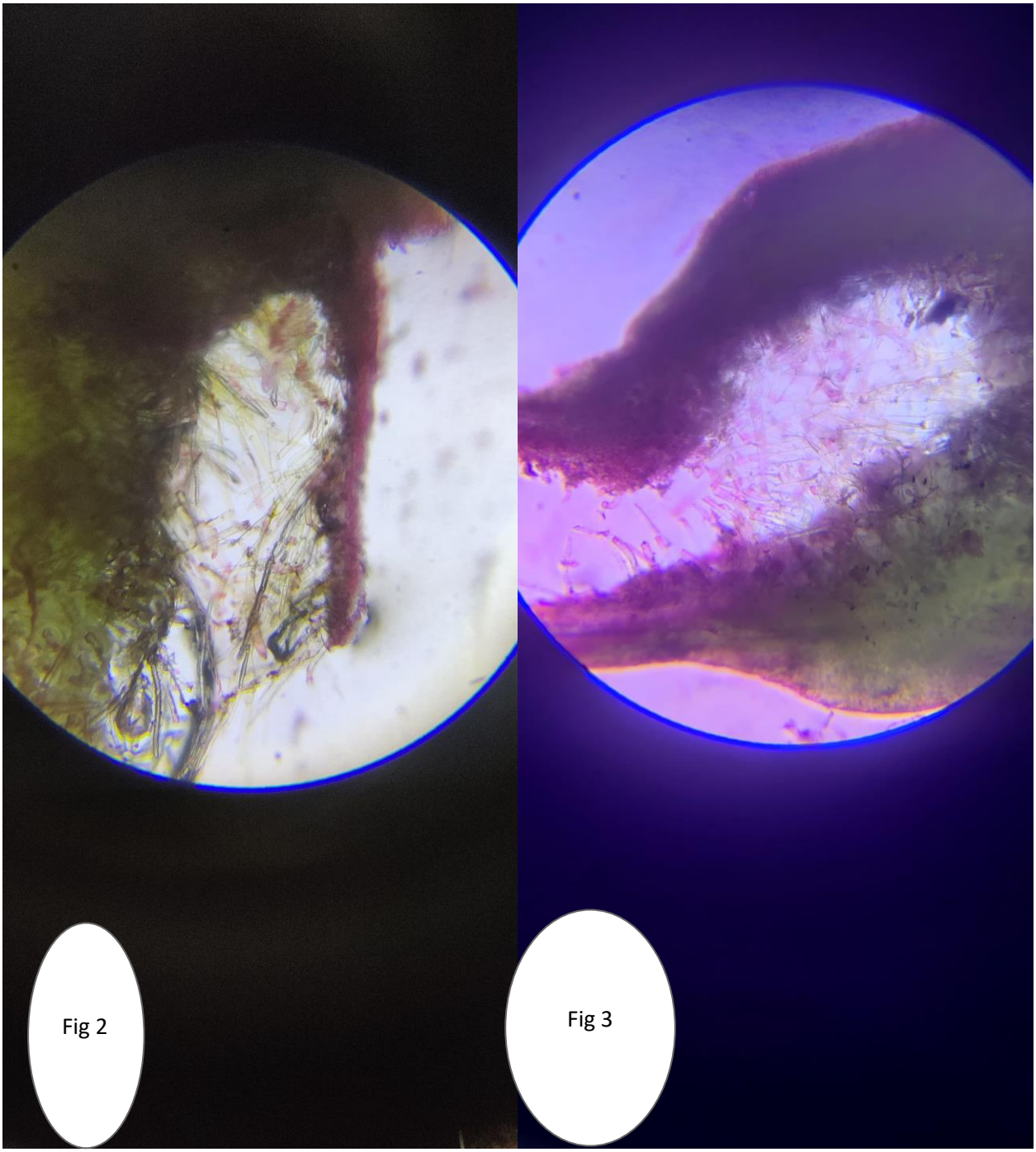

Fig 2and 3: Transverse sections of galls showing Erineal hair, larvae and parenchymatous tissue.

Conclusion

Considering the economic utility of the plant and the highly complex and intricate host-plant mite interaction between the gall mite, A. pongamiae and its host P. pinnata (L.) the present study was selected to analyze the sequences and processes involved in gall formation, through extensive studies on gall morphology,From the host parasite interaction study it can be concluded that Galls are a kind of house for insect family. It is place were insect and larvae get food, nutrition and shelter. Once gall formation is initiated, many galls will continue to form even if the insect dies.The old leaves remain unaffected and rest of the tree remains healthy.

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