

MORPHOANATOMICAL STUDIES OF TRICHOMES IN FAMILY MORACEAE BY LIGHT AND SCANNING ELECTRON MICROSCOPY

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Abstract

Foliar trichome morphology and structure of 14 species belonging to family Moraceae have been studied using light and scanning electron microscopy. The present study is based on fresh samples collected from Botanic Garden GC University Lahore. Simple, unbranched, glandular and nonglandular trichomes have been observed on both abaxial and adaxial surfaces of leaves. Glandular trichomes were examined in *Artocarpus integrifolia* Auct., *Morus nigra* Linn., *Ficus benghalensis* var. *benghalensis* Linn., *Ficus benjamina* Linn., *Ficus petiolaris* Kunth, *Ficus nerifolia* Sm., *Ficus lyrata* Warb., *Ficus infectoria* auct. non Willd. and *Ficus glomerata* Roxb.. However, nonglandular trichomes were observed only in *Ficus religiosa* Linn. In *Morus alba* Linn. and *Ficus benghalensis* var. *Krishnae* Linn., glandular and nonglandular trichomes were densely present on both abaxial and adaxial surfaces. *Morus nigra* was discrete in having glandular multicellular trichomes with tubercules as a prominent feature. The trichomes were mostly unicellular, cylindrical and conical in shape and infrequently multicellular. The findings of present study could be a useful systematic marker in the identification of species and varieties of family Moraceae.

Key words: *Ficus*, Glandular, Moraceae, *Morus*, Nonglandular

Introduction

Plant trichomes are actually epidermal protuberances, which are highly variable in structure, shape, cytology and function (Uphof, 1962). More than 300 types of trichomes are described (Wagner, 1991). Many Scientists have worked on the hair characters and used them for the identification and classification of plants belonging to various families (Metcalf & Chalk, 1950).

Trichomes of Moraceae are unicellular and multicellular, sessile and pedunculated, non-secretory (non-glandular) and secretory (glandular), scales and absorbent hairs (Esau, 1974). Metabolic secretions of plants such as resins, oils, nectar and digestive juices secreted by special kind of secretory trichomes depends basically on species and need of plants. The trichomes are usually unicellular or multicellular with different size and shape of head seen on the upper surface of leaves. The head is attached to the plant surface in sessile trichomes, while in pedunculated trichomes head connected to plant surface by means of a peduncle which might be unicellular or multicellular and differ in size (Fahn, 1979; Castro and Machado, 2012).

Trichomes presence and absence is one of important characteristics for the identification of taxa and trichome bearing species are easily distinguished

from the rest. In addition to taxonomic uses, trichomes have numerous ecological and physiological roles in a plant that help it to better establish itself in its habitat. Different investigations (Wagner, 1991; Ascensao *et al.*, 1998; Werker, 2000; Talebi *et al.*, 2012) confirm that the main functions of glandular and non-glandular trichomes in plants are the reduction of the heat load, the increase of freezing tolerance, aid in seed dispersal, enhancement of water absorption and protection of the structures of plants against the harmful effects of UV radiation. They function as taxonomic characteristics, serve as an insect repulsion and offered a means of protection against herbivores and pathogens. Therefore, the aim of the present study is to identify the trichome morphology of family Moraceae by light and scanning electron microscopy.

Materials and Methods

The present study is based upon fresh samples (leaves) obtained from Botanic Garden, GC University Lahore. After collection the leaves were washed to remove the debris and air dried, and subjected to section cutting with the help of sharp blade for separation of trichomes. The sections were then placed in lactic acid (10-20 minutes) for separation of epidermis and different grades of

methanol (30-90 %) for 3 minutes for dehydration. The epidermis containing trichomes were also stained with fast green and placed onto a slide. The Johansen's method (1940) of maceration was employed to separate the trichomes in some samples. Prepared slides were studied under light microscope (Labomed CxL) using different magnifications. For scanning microscopic studies fresh samples containing trichomes were mounted on metallic stubs using double adhesive tape and examined on Scanning Electron Microscope of JEOL (JSM-6480LV).

Results

A total of 14 species of Moraceae family were examined for trichome morphology belonging to three different genera i.e. *Ficus* (11 species), *Morus* (2 species) and *Artocarpus* (1 species). The trichomes of studied species showed a greater variations ranging from glandular to nonglandular, unicellular to multicellular and branched to unbranched (Table 1). In *Ficus benghalensis* var. *benghalensis* glandular, dense, unicellular uniseriate, unbranched trichomes were observed (Plate 1A and Plate 3S). Glandular, fewer, unbranched, unicellular and multiseriate trichomes with tubercules were seen on abaxial surface of *Ficus glomerata* (Plate 1B and Plate 3T). In *Morus alba* both types of trichomes glandular and non-glandular were seen which were cystolith, unicellular, uniseriate, unbranched and long upto 220 μm (Plate 1C & Plate 3P). However, in *M. nigra* only glandular, unbranched, multicellular, multiseriate trichomes with tubercules were examined on both surfaces of leaf which were long upto 225 μm (Plate 1D & Plate 3Q).

The *F. carica* have dense, glandular, unbranched, unicellular and uniseriate trichomes which were 380 μm in length (Plate 1E & Plate 3U). The leaves of *Ficus benjamina* have fewer trichomes which were glandular, multicellular, uniseriate and unbranched trichomes (Plate 1F). Whereas, in *F. elastica* glandular, multicellular, uniseriate trichomes were seen (Plate 1G). In *F. lyrata* glandular, multicellular, multiseriate and unbranched trichomes were present (Plate 1H). In *F. religiosa* non glandular trichomes were present sparsely on adaxial surface

only (late 2I). In *F. nerifolia* glandular, uniseriate and unbranched trichomes were seen sparsely (Plate 2J). In *F. benghalensis* var. *Krishnae* dense glandular, unbranched and unicellular trichomes were observed (Plate 2K).

Glandular, unicellular and uniseriate trichomes were examined moderately on both surfaces of leaves of *F. infectoria* (Plate 2L and Plate 3V) which were 420 μm long. In *F. petiolaris* glandular and unicellular trichomes were seen on both surfaces of leaves (Plate 2M and Plate 3R). Whereas, the trichomes of *Artocarpus integrifolia* were glandular, multicellular and uniseriate (Plate 2R).

Discussion

Trichomes vary from unicellular to multicellular, branched to unbranched, glandular to non-glandular and uniseriate to multiseriate. *Ficus* species contained unicellular, glandular to non-glandular trichomes. In *F. religiosa* non glandular trichome were observed by Shakir and Baji (2016). Glandular trichomes in *F. lyrata* were observed by Sonibare *et al.* (2005). *Artocarpus* species contained peltate and capitate trichomes and in *Morus* species both glandular and non-glandular trichomes were seen. The similar kind of work in other taxa of the family Moraceae has also been carried out by Azizian (2002). The leaves of *F. benjamina* are smooth and contained sunken trichomes on abaxial and adaxial surfaces. The leaves of *F. bengalensis* var. *Krishnae* are rough and have glandular and non-glandular trichomes on both surfaces. In *Artocarpus integrifolia* glandular and unbranched trichomes.

Glandular and unicellular trichomes are common in the family Moraceae as in most of the taxa of present investigations. However, the non-glandular trichomes are examined in only three species viz. *Ficus bengalensis* var. *Krishnae*, *Morus alba*, *Ficus religiosa*. Another type of trichome i.e. cystolith with swollen base and sharp pointed apex has also been observed in *Morus alba* (Fig 17) which is a characteristic feature of the family Moraceae (Azizian, 2002).

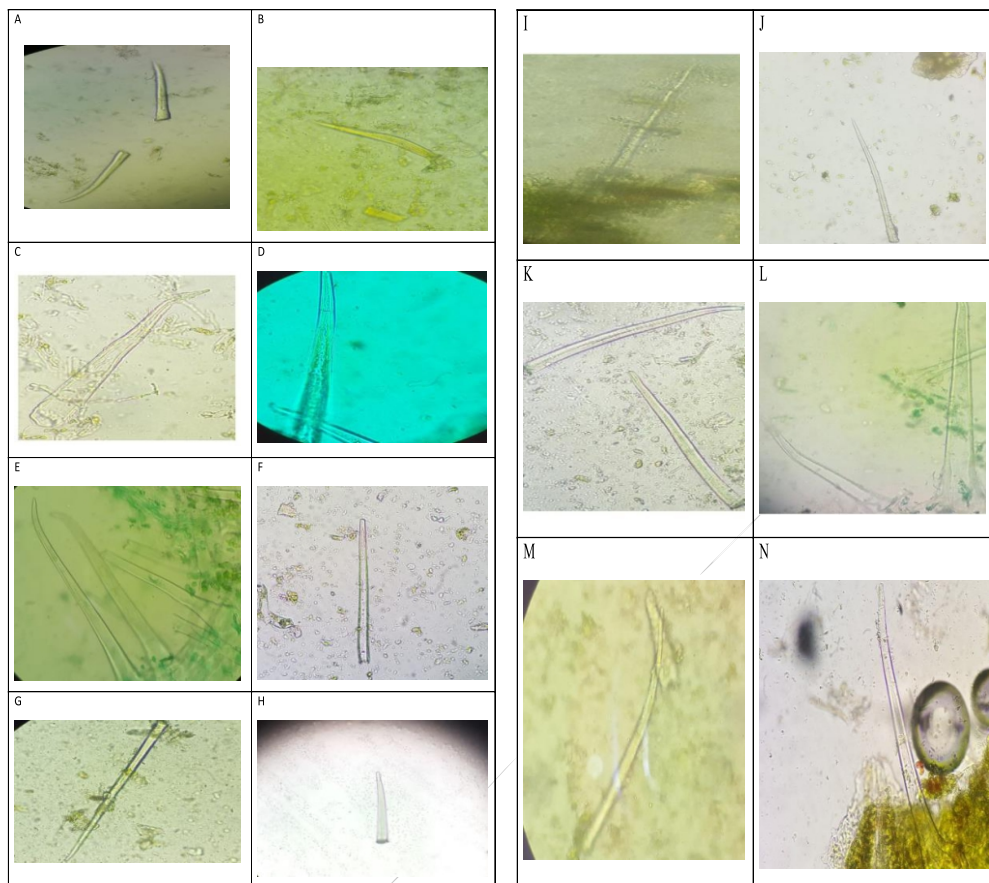


Plate 1

Plate 2

Plate 1: LM Micrograph of A: *Ficus bengalensis* var. *bengalensis*, B: *Ficus glomerata*, C: *Morus alba*, D: *Morus nigra*, E: *Ficus carica*, F: *Ficus benjamina*, G: *Ficus elastic*, H: *Ficus lyrata*

Plate 2: LM Micrograph of I: *Ficus religiosa*, J: *Ficus nerifolia*, K: *Ficus bengalensis* var. *krisnae*, L: *Ficus infectoria*, M: *Ficus petiolaris*, N: *Artocarpus integrifolia*

Conclusion

In the present study three types of trichomes are recognized based on their density on leaves i.e. Sparse and fewer which were usually glandular and unicellular and observed in eight different species, Moderately distributed which may be further divided into short and long on the basis of their length, Dense

which varies from glandular to non-glandular. The trichomes of the family Moraceae in three genera of the present study showed greater variations in their size, density, number of cells and shape, therefore the current data may be valuable for delamination of the species.

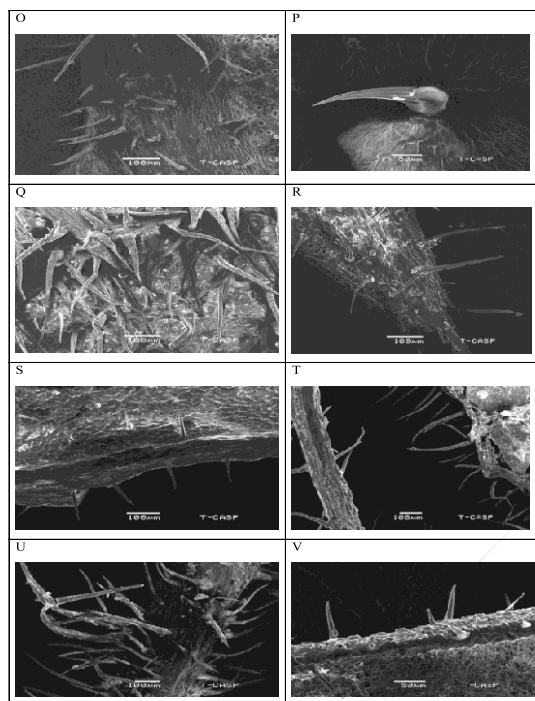


Plate 3: SEM micrograph of O: *Ficus elastica*, P: *Morus alba*, Q: *Morus nigra*, R: *Ficus petiolaris*, S: *Ficus benghalensis* var. *benghalensis*, T: *Ficus glomerata*, U: *Ficus carica*, V: *Ficus infectoria*

Table 1: Morphographic characters of Trichomes of family Moraceae

Sr.no	Species name	Density	Type	No of cells
1	<i>Artocarpus integrifolia</i>	Fewer	Glandular	Multicellular
2	<i>Morus alba</i>	Dense	Non glandular & glandular	Unicellular
3	<i>Morus nigra</i>	Dense	Glandular	Multicellular
4	<i>Ficus elastica</i>	Fewer	Glandular	Multicellular
5	<i>Ficus religiosa</i>	Sparse	Non glandular	Unicellular
6	<i>Ficus benjamina</i>	Fewer	Glandular	Multicellular
7	<i>Ficus petiolaris</i>	Moderate	Glandular	Unicellular
8	<i>Ficus benghalensis</i> var. <i>Krishnae</i>	Dense	Glandular & non glandular	Unicellular
9	<i>Ficus glomerata</i>	Fewer	Glandular	Unicellular
10	<i>Ficus nerifolia</i>	Sparse	Glandular	Unicellular
11	<i>Ficus lyrata</i>	Sparse	Glandular	Multicellular
12	<i>Ficus infectoria</i>	Moderate	Glandular	Unicellular
13	<i>Ficus carica</i>	Dense	Glandular	Unicellular
14	<i>Ficus bengalensis</i> var. <i>bengalensis</i>	Dense	Glandular	Unicellular

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