STRUCTURE, DISTRIBUTION AND DEVELOPMENT OF CAVITATED TRICHOMES IN *INDIGOFERA* L. (FABACEAE)

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Abstract

Cavitated trichomes are for the first time recorded in seven of the 28 taxa of the *Indigofera* studied. Their structure, organographic distribution and ontogeny are dealt in detail. Structurally they belong to multiseriate hollow-discoid hair type and ontogenetically to third pattern, proposed by Leelavathi *et al.* for multiseriate trichomes. Further their taxonomic, phylogenetic and functional significance are also discussed.

Introduction

Though cavitated trichomes have been described in several diversified angiospermous taxa (De Bary, 1884; Solereder, 1908; Carlquist, 1959; Prabhakar & Ramayya, 1975; Leelavathi & Ramayya, 1982, 1983a, 1983b), there seems to be so far no report on their occurrence in Papilionoideae except in *Centrolobium robustum* and *C. tomentosum* (Solereder, 1908). Therefore, presently an attempt is made to elucidate its detailed structure, organographic distribution and ontogeny in *Indigofera*.

Material and Methods

Young and mature plant parts of 23 taxa were collected from plants growing in varied localities of India, while herbarium specimens of *I. angulosa*, *I. hirsuta*, *I. nummularifolia*, *I. pedicellata* and *I. vestita* were obtained from Botanical survey of India, Coimbatore and Poona (Table 1). Varied micropreparations, viz., epidermal peels, whole mounts of cleared organs and scrapings of trichomes which were stained with aniline blue and mounted in glycerine (Ramayya & Rajagopal, 1968), were used to study the mature structure and organographic distribution of trichomes, whereas for ontogenetic studies longitudinal and transverse sections of shoot and floral apices were prepared following the usual paraffin method (Johansen, 1940). Terms used are after Ramayya (1962) and Vijay Kumar (1983).

Observations

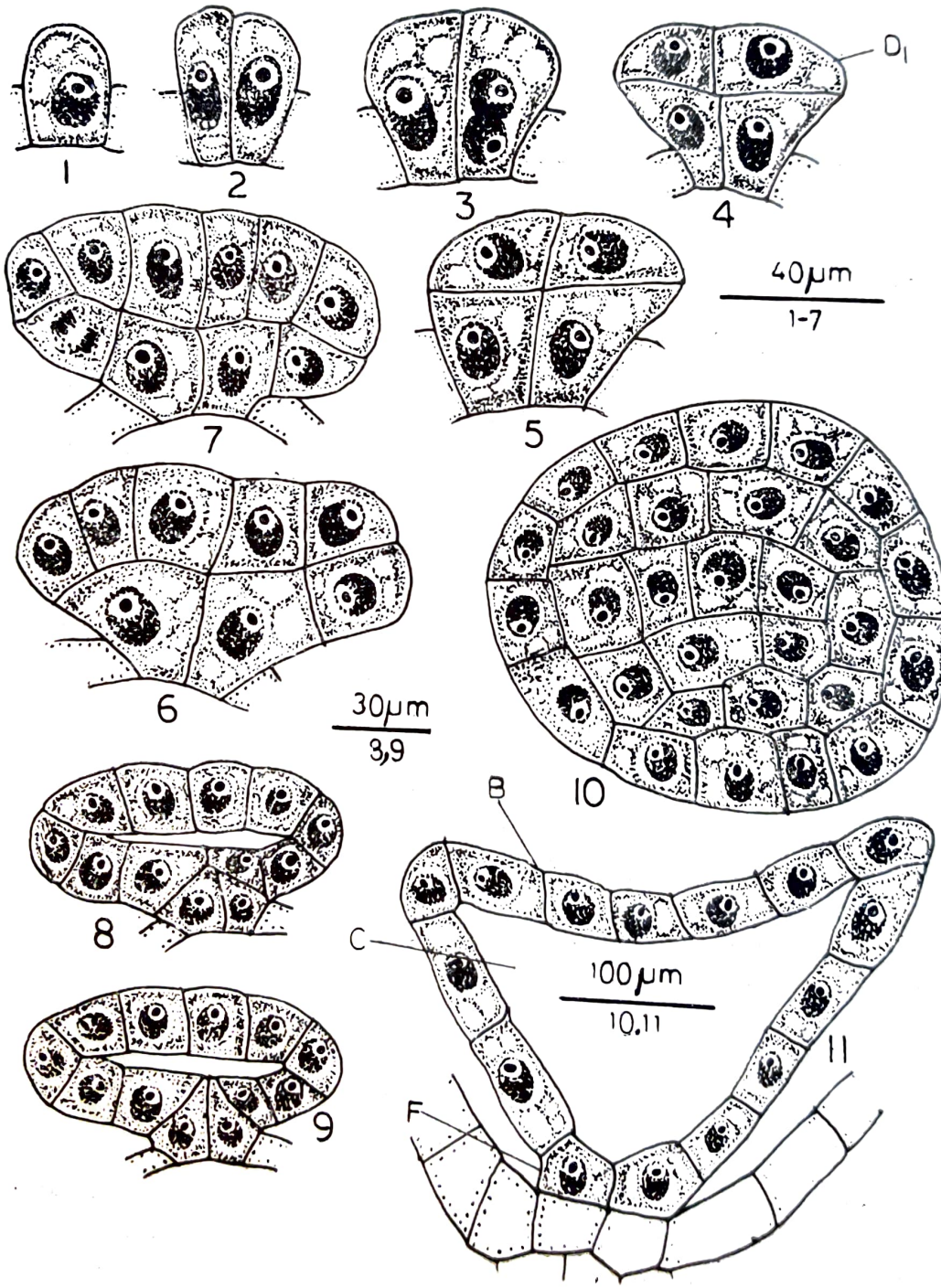
The structure, organographic distribution and ontogeny of the multiseriate hollow-discoid hair is as follows :

Structure—Foot : Multicellular; cells juxtaposed, flushed with epidermis; contents scanty; walls thin. *Body* : Multiseriate, disc-like, circular or oval-shaped in surface view; parallel to the epidermis; cavitated in the center; cavity empty, enclosed by a single layer of cells, 8 to 10-celled in diameter; cells slightly broader than long or vice versa; contents dense, persistent; walls thin; surface smooth (Figs. 10, 11).

Organographic distribution—Of the 28 taxa investigated, the multiseriate hollow-discoid hair occurs only in seven taxa on different plant parts but absent in the remainder (Table 1). From the Table it is evident that, in all the seven taxa they are distributed uniformly on abaxial of leaflet, stipule, sepal, standard petal, keel petal and all over on petiole, stem, peduncle, pedicel and ovary, while absent on other surfaces.

Development—The ontogeny was found to be similar in all, but detailed below as observed in *I. trifoliata*.

The trichome originates from a single protodermal initial which is distinctive due to its protruded rounded apex, large nucleus and dense cytoplasm (Fig. 1). At the outset



Figs. 1-9, 11. *Indigofera trifoliata* L. Developmental stages of multiseriate hollow-discoid hair in sectional view; **10.** Mature trichome in surface view.

Table 1—List of the taxa investigated along with organographic distribution of multiseriate hollow-discoid hairs in *Indigofera* L.

Sl. No.	Name of the taxa	Place of collection	A	B
1.	*I. angulosa* Edgew.	B. S. I. (Poona)	—	—
2.	*I. aspalathoides* Vahl	Vizag	—	—
3.	*I. astragalina* DC.	Hyderabad	—	—
4.	*I. barberi* Gamble*	Tirupathi	+	—
5.	*I. cassiodes* Rottl.	Vicarabad	—	—
6.	*I. colutea* (Burm. f.) Lamk.	Bellary	—	—
7.	*I. cordifolia* Heyne	Hyderabad	—	—
8.	*I. dalzellii* T. Cooke	Poona	—	—
9.	*I. glabra* L.	Vizag	—	—
10.	*I. glandulosa* Willd. var. *glandulosa*	Hyderabad	+	—
11.	*I. glandulosa* Willd. var. *sykesii* ex. Vij. Kum. & Ram.**	Poona	+	—
12.	*I. hisrsuta* L.	B. S. I. (Coimbatore)	—	—
13.	*I. hochstetteri* Baker	Poona	—	—
14.	*I. linifolia* Retz.	Hyderabad	—	—
15.	*I. linnaei* Ali.	Hyderabad	—	—
16.	*I. mysorensis* Rottl.	Tirupathi	—	—
17.	*I. nummularifolia* (L.) Livera	B. S. I. (Coimbatore)	—	—
18.	*I. oblongifolia* Forsk.	Karimnagar	—	—
19.	*I. parviflora* Heyne	Poona	—	—
20.	*I. pedicellata* W. & A.*	B. S. I. (Coimbatore)	+	—
21.	*I. prostrata* Willd.	Poona	+	—
22.	*I. spicata* Forsk.	Vicarabad	—	—
23.	*I. tenuifolia* Rottl.	Belgaum	—	—
24.	*I. tinctoria* L.	Hyderabad	—	—
25.	*I. trifoliata* L.	Hyderabad	+	—
26.	*I. uniflora* Buch.-Ham.	Belgaum	—	—
27.	*I. vestita* Baker**	B. S. I. (Coimbatore)	+	—
28.	*I. wightii* Grah.	Vicarabad	—	—

A—Abaxial leaflet stipule, sepal, standard petal, keel petal and allover on petiole, stem, peduncle, pedicel, ovary; B—Adaxial and margin of leaflet, stipule, sepal, standard petal, keel petal and allover on bract, wing petal, androecium, style and stigma; *-Stipule not studied; **-Stipule and petal not studied; +, Present; —, Absent.

the initial undergoes two successive anticlinal divisions, the later being right angle to the former, leading to the formation of four juxtaposed cells (Figs. 2, 3). In longisections the tetrad is easily distinguishable from the dyad due to its large size and four nuclei in thick sections (Fig. 3). The tetrad stage acts as "basal meristem", laying foundation to development of multiseriate trichome. The tetrad now divides periclinally giving rise to a tier of D_1 cells (Fig. 4). The cells of the D_1 and the basal meristem slightly expand parallel to the surface of the organ producing a wedge-shaped structure, seeming distinct from the preceeding stage (Fig. 5). Subsequently only anticlinal and oblique divisions occur in the cells of D_1 and basal meristem, producing a discoid body which is two tierd, each being 6 to 8-cells in diameter (Figs. 6-9). Simultaneously cavitation occurs in between the cells of the two tiered body, schizogenously and centrifugally, leading to the formation of a large empty cavity surrounded by a single layer of cells at maturity (Figs. 8, 9, 11). The part of the trichome embedded in the epidermis constitute the foot (Fig. 11). The trichome matures by slight enlargement of the cells and depletion of cytoplasmic contents.

Discussion

Cavitated trichomes though reported in Caesalpinioideae and Mimosoideae (Leelavathi & Ramayya, 1982, 1983a; Leelavathi *et al.*, 1984b), are unknown in Papilionoideae (Leelavathi & Ramayya, 1983b), except in *Centrolobium* (Solereder, 1908). Present finding is interesting in that, they are reported in seven among the 28 taxa of *Indigofera* investigated (Table 1).

The multiseriate hollw-discoid hairs develop from a single protodermal initial, hence are trichomic in origin. The cavity occurs throughout the body of the trichome (Fig. 11) as earlier reported in *Centrolobium* (Solereder, 1908) and *Bauhinia* (Leelavathi *et al.*, 1984b).

The initials of glandular trichomes are usually clavate and round-tipped, while those of the non-glandular ones are acute (Uphof, 1962). This is presently confirmed since the trichomes studied are glandular and their initials are round-tipped (Fig. 1).

The multiseriate trichomes develop through three patterns of ontogeny (Leelavathi *et al.*, 1984a), viz., I. First division of the trichome initial periclinal, II. First division of the trichome initials anticlinal and subsequent ones periclinal, III. First two or more divisions of the trichome initials anticlinal. Earlier, cavitated trichomes were observed to develop through two patterns of ontogeny, viz., the hollow-stalked glands of *Holocarpha* developing through IInd pattern (Carlquist, 1959), while hollow-capitate hairs of Portulacaceae (Prabhakar & Ramayya 1975), hollow cylindrical and naviculate hairs of *Bauhinia* (Leelavathi *et al.*, 1984b) through IIIrd pattern of ontogeny. Since the initials of the multiseriate hollow-discoid hairs presently studied divide more than once anticlinally before occurrence of any periclinal divisions (Figs. 1-3), they belong to the IIIrd pattern of ontogeny.

The cavity may be formed either lysigenously (Carlquist, 1959; Leelavathi *et al.*, 1984 b) or schizogenously (Prabhakar & Ramayya, 1975). In *Indigofera*, however, the cavity is formed schizogenously (Figs. 8, 9, 11).

Cavitated trichomes occur widely in unrelated taxa and hence, phylogenetically insignificant (Leelavathi *et al.*, 1984b). However, their occurrence in seven of the 28 taxa of *Indigofera* investigated are taxonomically significant (Table 1). Further, the biological significance of their occurrence in the above seven terrestrial plants rules out their use

in buoyance, but whatelse role do they play in the biology of the plants concerned is presently difficult to surmise.

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