

## TRICHOME MORPHOLOGY IN INDIAN *SOLANUM*

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*Twenty six Indian species of the genus Solanum* have been examined for their epidermal surface trichomes occurring along the entire plant body. Based on their structure and organisation the trichomes are grouped into six major types. Variations are observed with respect to their organographic distribution, in frequency and topography. Some of the trichome types have been observed to be species specific and can be used as a subsidiary taxonomic parameter. The study envisages the significance of trichome characteristics as a supplementary factor in elucidating the phylogenetic relationships.

Key words : Trichome Morphology - Glandular E glandular, *Solanum*.

The knowledge of epidermal features using light and electron microscopy including SEM is being significantly utilised for the understanding of systematic problems especially pertaining to finer organisational details. The significance of trichome types has been widely emphasized as one of the important taxonomic tool by various workers (Martin and Juniper, 1970; Heywood, 1971; Metcalfe, 1968; Ramayya, 1969; Theobald *et al.*, 1980; Seithe and Anderson, 1982; Edmonds, 1972). Seithe (1962, 1979) and Roe (1971) have suggested a standard terminology for various trichome types. The genus *Solanum* has a great diversity in trichome types, which could be characteristic of certain sections or species. However, the paucity of information on the structural organisation and pattern of distribution of these bodies along the plant body has limited their applicability only to a selected number of species. A detailed study of these structures may throw significant light on the identification, relationship at inter- and intra-specific level. The present paper deals with the observations on trichome types in some of the Indian *Solanums* and attempts to show their applicability as a parameter for species identification and the interrelationships in *Solanum*.

### MATERIALS AND METHODS

Twenty six species enumerated in Table 1 belonging to the genus *Solanum* (Solanaceae) found in India have been investigated for their epidermal hairs. Trichomes have been studied from the epidermal peels of leaf, stem, and the floral parts including pedicel. Epidermal peels were obtained following the method of Boulos and Beakbane (1971), stained with delafield's hematoxylin and observed under light

microscope after mounting in glycerine. Foliar trichomes were viewed with a scanning electron microscope following critical point drying.

### OBSERVATIONS

The various types of trichomes belonging to twenty six species are chiefly categorised into six major groups as mentioned below. The occurrence and distributional pattern of the various types of trichomes is documented in Table-1.

*Multicellular glands* : Short trichomes usually with stalk and unicellular or multicellular head. The head may consist of 4 cells in one plane with or without a small neck cell or it is composed of 2 or 3 tiers of cells each with 2 or more cells. These are called square gland and storeyed glands respectively (Fig. 1A-C).

*Gland tipped finger trichome* : Multicellular uniseriate finger hairs with a unicellular glandular tip. (Fig. 1D-G).

*Stellate trichome* : Uniseriate or multiseriate, stalked or non-stalked hairs. Mostly rays emerge at the same level. The central hair is always present protruding at right angles. The central hair may be long or short, unicellular or multicellular (Fig. 2H, Fig. 3P).

*Finger trichome* : Simple uniseriate with uni- or multicellular body with or without stalk. (Fig. 2J; Fig. 2K, L, M, N).

*Branchlet trichome* : Uniseriate multicellular dendroid hairs with branches emerging at different levels (Fig. 2I, O, R).

Table 1. Distributional pattern of Hair types on various plant organs.

Sl No.	Name of the species	Stem	Leaf	Pedical	Calyx	Corolla	Androecium	Gynoecium
Section-Melongens								
1.	<i>S. melongena</i> L.	H,J,P	D,E,H,J,K,P	J,P	B,E,H,P	B,E,H	--	--
2.	<i>S. torvum</i> Sw.	B,H,P	B,P	B,H	B,E,J,K,P	B,E,I,J,K,L	--	--
3.	<i>S. indicum</i> L.	D,J,P	D,H,J,K,P	D,P	B,E,G,K,L,P	B,D,E,H,I,J	--	--
4.	<i>S. hispidum</i> Pers.	A,B,H,P	A,B,C,H,P	B,C,H	A,B,H,K	J,K	--	--
5.	<i>S. elaeagnifolium</i> Cav.	H,J,Q	C,H,I,J	B,H,J	E,F,K	K,B,H	--	--
6.	<i>S. marginatum</i> L.	B,H,J	B,H,K,N,Q	B,H,I,K,M	B,K,O	A,K,O	--	--
Section-Oliganthus								
7.	<i>S. surattense</i> Burm	J,K	H,I,J,K,P	J,K	H,P	I,L	--	--
8.	<i>S. macranthum</i> Dun.	P	A,B,H,P	D,H,K,P	N,P	K,P	--	--
9.	<i>S. grandiflorum</i> Ruizelav	F,P	E,P	D,N,P	E,N,P	K,P	--	--
10.	<i>S. trilobatum</i> L.	J,K	A,B,C,J,K	J,K,L	A,C,K,L	H,L	--	--
Section-Acanthonbora								
11.	<i>S. khasianum</i> Clarke	D,J	A,E,H,J	H,J,K	D,E,H,P	D,H,K	--	--
12.	<i>S. viarum</i> Dun.	D,E,J	B,D,E,J,K,L	K	E,K	B	--	--
Section-Anthoresis								
13.	<i>S. galucophyllum</i> Desf.	J,K	J,K	J,K	G,I,J,M,K	J,K	--	--
14.	<i>S. vagum</i> Heyne	A,J,K	A,J,K	A,J,K	I,J,K	J	--	--
Section-Jasminosolanum								
15.	<i>S. jasminoides</i> Paxt.	J,K	A,B,J,K	D,K	I,G	I,K	--	K
16.	<i>S. seaforthianum</i> Andr.	J,K,L,O	A,E,I,K	D,K,L	A,B,D,E	I,K	--	--
Section-Pseudocapsicum								
17.	<i>S. pseudocapsium</i> L.	A,J,K	A,B,J,K	J,K	J,K	J	--	--
18.	<i>S. triquetrum</i> Cav.	J,K	E,J,K	J	J,K	J,K	--	--
Section-Brevantharum								
19.	<i>S. erianthum</i> D.Don	D,E,J,K	D,E,J,K	D,E,J,K	B,J	B,J	--	--
20.	<i>S. mauritianum</i> L.	D,E,H,P	I,H,P	B,C,I	B,J,I,K	I,J,K	--	--
Section-Solanum								
21.	<i>S. nigrum</i> L.	B,C,E,K	B,J,K	A,K	B,C,K	J,K	--	K
Section-Petota								
22.	<i>S. tuberosum</i> L.	J,K	B,J,K,M	D,K	B,J,K	B,K,L	--	--
Section-Cryptocarpum								
23.	<i>S. sisymbriifolium</i> Lamk.	D,E,J,K	C,D,E,H,J,K	D,J	D,E,F,H,J,R	D,E,H,I,K,O,Q,R	--	D,E
Section-Extensum								
24.	<i>S. giganteum</i> Jacq.	E,J,K	E,J,K	J,K,L	E,I,J,K,L	J,K,L	--	--
Section-Lasiocarpa								
25.	<i>S. ferox</i> L.	A,B,K	B,C,J,K	J,K,I	A,B,C,J,K	B,C,I,K	--	--
Section-Archaesolanum								
26.	<i>S. aviculare</i> Forst.	B,E,K	B,C,D,J	D,G,I,J,K	B,C,D,I,K	B,C,I,K	--	--

*Peltate hairs* : Umbrella shaped peltate head with pointed marginal cells (Fig. 1G, Fig. 2Q<sub>1</sub>-Q<sub>3</sub>).

*Topographic variations* : Certain trichome types viz. branchlet hair with uni - or multicellular stalk (L,

O) and finger hair with multicellular stalk (K) are confined to floral parts, whereas the square gland and storeyed glands with or without neck cell (A,B,C) are observed on vegetative parts only (See Table-1).





(Fig. 1. A-G). Glandular trichomes : Type A-G. (A) *S. mecranthum* (B) *S. hispidum* (B<sub>1</sub>), *S. torvum* (B<sub>2</sub>), *S. nigrum* (B<sub>3</sub>), *S. viarum* (B<sub>4</sub>), *S. nigrum* (B<sub>5</sub>), *S. torvum* (B<sub>6</sub>), *S. tuberosum* (B<sub>7</sub>), *S. khasianum* (B<sub>8</sub>). (C) *S. nigrum* (C<sub>1</sub>, C<sub>2</sub>), *S. hispidum* (C<sub>3</sub>), *S. trilobatum* (C<sub>4</sub>). (D) *S. grandiflorum* (D<sub>1</sub>), *S. torvum* (D<sub>2</sub>), *S. jasminoides* (D<sub>3</sub>), *S. khasianum* (D<sub>4</sub>). (E) *S. macranthum* (E<sub>1</sub>), *S. nigrum* (E<sub>2</sub>), *S. grandiflorum* (E<sub>3</sub>, E<sub>4</sub>), *S. viarum* (E<sub>5</sub>, E<sub>6</sub>), *S. khasianum* (E<sub>7</sub>), *S. sisymbriifolium* (E<sub>8</sub>), *S. torvum* (E<sub>9</sub>). (F) *S. grandiflorum* (F<sub>1</sub>, F<sub>2</sub>), *S. torvum* (F<sub>3</sub>). (G) *S. aviculare* (G<sub>1</sub>), *S. glaucum*.

**DISCUSSION**

*Trichome types and organisation* : A systematic account of hair morphology in *Solanum* has earlier been given by Seithe (1979) Seithe and Anderson (1982) in section *Basarthus*, and Edmonds (1982) in section *Solanum*. These workers stressed the significance of trichomes as a taxonomic character. Besides, some scattered efforts have also been exercised by some other workers (Ahmad, 1964 a,b; Rogers & Ogg, 1981; Ogg *et al.*, 1981) in this direction to support the observation that the presence of short



(Fig. 2. H-J). Eglanular trichomes : Types H-J. (H) *S. indicum* (H<sub>1</sub>), *S. torvum* (H<sub>2</sub>), *S. trilobatum* (H<sub>3</sub>). (I) *S. surattense* (I<sub>1</sub>, I<sub>2</sub>, I<sub>3</sub>, I<sub>4</sub>), *S. torvum* (I<sub>5</sub>, I<sub>6</sub>), *S. glaucum* (I<sub>7</sub>), *S. indicum* (I<sub>8</sub>), *S. hispidum* (I<sub>9</sub>), *S. erianthum* (I<sub>10</sub>), *S. khasianum* (I<sub>11</sub>). (J) *S. nigrum* (J<sub>1</sub>), *S. jasminoides* (J<sub>2</sub>), *S. khasianum*. (J<sub>3</sub>), *S. ferox* (J<sub>4</sub>), *S. pseudocapsicum* (J<sub>5</sub>).

glands is a common feature met within the species of *Solanum*. However, the present study is a systematic attempt to furnish the information on trichomes on Indian species. A comparison of the observations recorded by earlier workers with that of the present one reveals the occurrence of some additional types, together with certain minor variations in the structural organisation.

Seithe (1979) characterized *S. sisymbriifolium* by the presence of stellate hairs with a glandular central hair and Ahmad (1964 a) specified this species by the presence of gland tipped finger trichome. However, the present author could not find the type described by Seithe (1979) in this species, whereas the type



(Fig. 3 K-R) Glandular trichomes Types K-R.  
 (K) *S. nigrum* (K<sub>1</sub>, K<sub>2</sub>, K<sub>3</sub>), *S. erianthum* (K<sub>4</sub>, K<sub>5</sub>), *S. grandiflorum* (K<sub>6</sub>), *S. melongena* (K<sub>7</sub>), *S. viarum* (K<sub>8</sub>), *S. khasianum* (K<sub>9</sub>), *S. tuberosum* (K<sub>10</sub>, K<sub>11</sub>), *S. indicum* (K<sub>12</sub>), *S. trilobatum* (K<sub>13</sub>), *S. torvum* (K<sub>14</sub>), *S. jasminoides* (K<sub>15</sub>), *S. seaforthianum* (K<sub>16</sub>, K<sub>17</sub>). (L) *S. viarum* (L). (M) *S. indicum* (M<sub>1</sub>), *S. trilobatum* (M<sub>2</sub>), *S. torvum* (M<sub>3</sub>). (N) *S. macranthum* (N). (O) *S. macranthum* (O<sub>1</sub>), *S. surymbrifolium* (O<sub>2</sub>, O<sub>3</sub>). (P) *S. krandiflorum* (P), *S. mauritanum* (P). (Q) *S. elaeagnifolium* (Q<sub>1</sub>, Q<sub>2</sub>, Q<sub>3</sub>). (R) *S. surymbrifolium* (R).

reported by Ahmad (1964 a) is also commonly met within the other species investigated in this study. Ahmad (1964 a) recorded only stellate hairs in *S. melongena* whereas I have observed the additional types such as the square glands, finger trichome alongwith branchlet trichome, though their frequency is less. Likewise, a good number of additional types compared to that of Ahmad (1964 a) i.e. nonstalked stellate, stalked stellate, stalked branchlet trichomes, both uni- and multicellular finger trichomes square and storeyed glands are observed. However, I have not come across the short glandular trichomes in *S. surattense* (Ahmad, 1964 b). The variation in the

observations may either be due to the different source of collection of the material or represent an omission by earlier workers owing to their occurrence in low frequency or the difference in the technical procedure adopted.

Further, there are certain topographic variations in hair types in the same species as recorded here. These variations mainly represent the various ontogenic stages as mentioned by Seithe (1979).

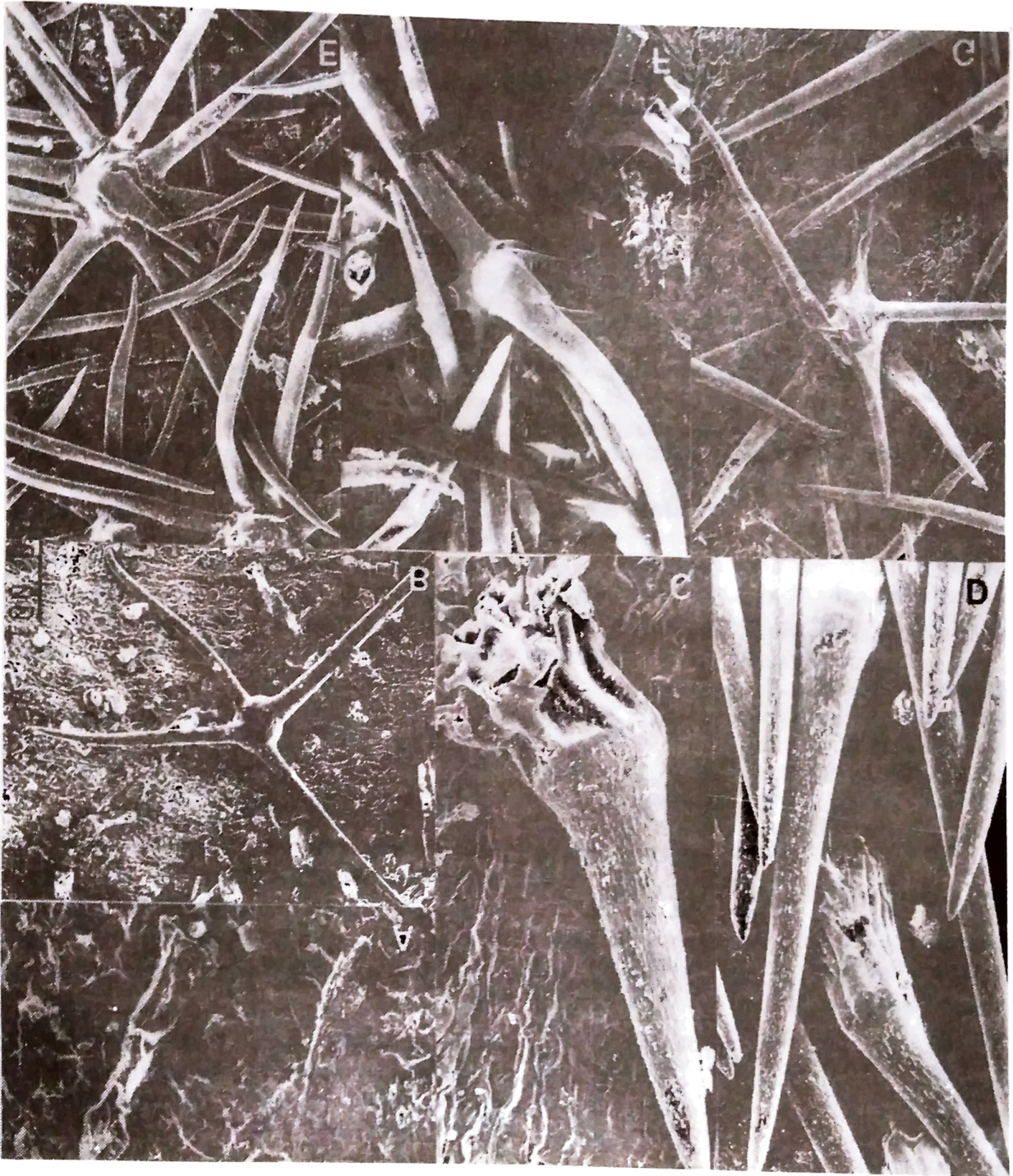
*Evolutionary trends in trichome types*: Based on ontogeny and development of trichomes, Seithe (1979) has suggested that the species with simpler gland tipped hair are more primitive than with multicellular branched or stellate forms. Assuming Seithe's proposal in view of the present observation, the following evolutionary trend in hair types is proposed. This has facilitated the classification and arrangement of hairs as depicted in Figs 1-3. The proposed evolutionary trends are:

- (i) Glandular to non glandular
- (ii) Non stalked to stalked
- (iii) Stalk unbranched to branched
- (iv) Stalk uniseriate to multiseriate
- (v) Few to many branches
- (vi) Hairs without neck cell to hairs with neck cell.

*Trichomes in species identification and relationships*: As it is evident from the present observations, the basic trichome types may be common in some of the species, whereas a particular species though representing a particular class may have the specific organization of hairs so far the number and pattern of cells, cell size and overall trichome body is concerned. Thus many of the hair types when taken into account of their category, structural organization and topographic distributional pattern may be characteristic of the species. This can help in identification of the species and may also act as a marker for genetic experiments in biosystematic approaches.

Based on the observations pertaining to the various species investigated, the specificity of hairs is revealed to a certain extent in various species namely their sectional assignments in the genus. Within the section *Melongena*, the specific types revealed are: unicellular finger hair with unicellular or multicellular stalk (*S. torvum*); glandular peltate hair (*S. indicum*), an abundance of square glands, stellate hair with multicellular stalk (*S. hispidum*).





(Fig. 4. A-G). Types are written in parenthesis.

(A) *S. sisymbriifolium* (D) (B) *S. sisymbriifolium* (H) (C) *S. macranthum* (M) (D) *S. grandiflorum* (N) (E) *S. torvum* (P) (F) *S. grandiflorum* (P) (G) *S. hispidum* (P).

Similarly within the section Anthoresis: the presence of peltate glandular hair with multicellular stalk (*S. glaucophyllum*) and absence in *S. vagum* section Oliganthes : square glands, storeyed gland with neck

cell and multicellular stalk (*S. macranthum*); unicellular finger hair with one celled stalk (*S. surattense*); storeyed gland with neck cell and unicellular stalk in *S. trilobatum*; section Psilocarpa; square gland with



multicellular stalk unicellular finger hair in *S. viarum*; sessile and stalked stellate hairs in *S. khasianum*; section Pseudocapsicum storeyed gland both with uni- or multi - celled stalk in *S. pseudocapsicum*; square gland with multicellular stalk in *S. triquatum*; section Brevantherum: abundance of unicellular finger hair in *S. erianthum* where as restricted to floral parts only in *S. mauritianum*.

Thus, trichome types could be used to categorise the species into two major groups on the basis of glandular/glandular nature of the hairs, as distinguished here, or stellate/branchlet types as proposed by Seithe (1979). Further, relationships can be envisaged on the distribution and organizational pattern of other trichome types. Although the genus *Solanum* comprises about 1700 species out of which only a small number have been listed here, yet the variations in form, structure and organization of trichome types in *Solanum* suggests their possible use in depicting taxonomic relationship. Evidence of affinity can be implied by comparing the trichomes of various species.

The present study is based mainly on mature plant organs, giving sufficient information on trichome types and their organization. However, a more systematic approach should also include the various developmental stages, right from the seedling stage for the sake of better comparison. Considering hair character as a parameter Seithe (1979) has divided the genus *Solanum* into two large parts, *Solanum* and *Stellatipilum* representing branchlet or stellate hair types, respectively. Further, Seithe and Anderson (1982) established the relationship of the species of the section Basarthrum on the basis of trichome types. Bitter (1917) classified the whole genus into several sections using trichome characters. It is my belief that an extensive study of trichome types, their ontogenic development and topographic variation in various species of the genus *Solanum* will significantly add to our knowledge regarding their applicability as a parameter for species identification and taxonomic relationships.

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