



Research Article

Study of Leaf Epidermal Characters of Some Species of the Genus *Desmodium* Desv. (Papilionoideae-Leguminosae) of Chitradurga, Karnataka, India

Rachitha CJ^{1*} and Krishnaswamy K²

¹Department of Botany, Kuvempu University, Shivamogga, Karnataka, India

²Department of Botany, Sahyadri Science College, Shivamogga, Karnataka, India

*Corresponding Author's E-mail: rachithacj1992@gmail.com

Abstract

The epidermal study of three species of *Desmodium* Desv viz *Desmodium dichotomum* (Willd.) DC. Synonym of *Bouffordia dichotoma* (Willd.) H. Ohashi and K. Ohashi, *Desmodium scorpiurus* (Sw.) Desv. *Desmodium triflorum* (L.) DC. Synonym of *Grona triflora* (L.) H. Ohashi and K. Ohashi found in Hosadurga and Holalkere taluks of Chitradurga, the epidermal characters including the properties of epidermal cells (shape, size and frequency), stomatal properties of both adaxial and abaxial (type of stomata complex, length, width, frequency and index), type and length of trichome were investigated. All the three species are amphistomatic and shows different types of stomata such as anisocytic, diacytic, paracytic, hemiparacytic and tetracytic were documented. Trichomes were present in adaxial and abaxial surface of all species of *Desmodium* but absent in abaxial surface of *D. triflorum* and reported unicellular eglandular unbranched trichomes of long and short. In the present study of leaf epidermis of all three species of *Desmodium* revealed inter specific relationship among species, which could be used as taxonomic tool in identification of species.

Keywords: *Desmodium* Desv, Epidermal Characteristics, Chitradurga, Stomata, Trichome

INTRODUCTION

The genus *Desmodium* Desv was commonly known as Tick clover or beggar weed contains about 280 species about 49 species were recorded in Flora of British India and is native to tropics and subtropics. Mostly herbs, subshrubs, shrubs and rarely climbers or trees, leaves pinnately 3-foliolate or 1-foliolate by reduction of laterals leaflets, stipulate. Flowers usually smaller in racemes or panicles, axillary or terminal, rarely solitary or binate in leaf axils.

Bracts persistent or early deciduous; bracteoles present or absent, calyx campanulate, 4 or 5-lobed, bivariate upper 2 lobes connate for all or most of length entire or 2 toothed at apex, lower lobes free longest. Corolla white, green-white pink, purple or violet; standard elliptic or obovate to nearly orbicular; wings, ovary sessile 2 many, legumes usually stipulate or sometimes sessile, well exerted from the calyx, compressed, usually indehiscient,

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transversely segmented, upper (adaxial) suture slightly constricted or straight, lower (abaxial) one constricted; one seeded, membranous or lathery almost flat or more rarely inflated. Seeds along reniform or sub quadrangular, compressed; aril not developed (Essiett, et al., 2012).

In the current study three species of *Desmodium* viz., *Desmodium* Desv viz *Desmodium dichotomum* (Willd.) DC. synonym of *Bouffordia dichotoma* (willd.) H. Ohashi and K. Ohashi, *Desmodium scorpiurus* (Sw.) Desv. *Desmodium triflorum* (L.) DC. Synonym of *Grona triflora* (L.) H. ohashi and K. Ohashi were identified in the study area and selected for epidermal studies (Gamble, et al., 1918).

Foliar epidermis provides valuable taxonomic information in distinguishing various taxa. Taxonomic significance of epidermal features has been discussed by various workers. Microscopic features of leaf epidermis for taxonomic study includes trichomes, epidermal cells, stomata and subsidiary cells. All these epidermal characters help in identification, rearrangement and delimitation of taxa on every level (Hooker, et al., 1878). The object of current study was to provide micromorphological data of *Desmodium* species in study area and also providing information for easy identification and deduce phylogenetic relationship on the basis of micromorphology (Leelavathi, et al., 1983).

MATERIALS AND METHODS

Fresh samples of *Desmodium* were collected from different localities of Hosadurga and Holalkere taluks of Chitradurga of Karnataka state of India,

during the period of July 2018 to December 2020 and identified using local floras and Plants of world online and mentioned accepted name. To study the epidermal characters, fresh leaf samples were collected from five different regions of the study area; each leaf was painted with fingernail polish on both the adaxial and abaxial surfaces and allowed to dry. After drying, short clear cellophane tape was firmly pressed over the dried nail polish on the surface according to the method of Mbagwu. The slides were observed by using light microscope, stomata were studied in 450x and trichome in 150x. The characters determined were stomata complex features (stomata type, size and frequency); Epidermal cell features (shape, size and frequency) and trichome features (type and frequency). Photographs of lamina epidermis (Adaxial and Abaxial) characters were taken using a microscope equipped with a digital camera. The Stomata Index (SI) was calculated using the formula of SI= (S/(S+E)) × 100, where S=No. of stomata in 1 sq mm and E=No. of epidermal cells in an area of 1 sq mm. The stomata, guard cell, stomatal pore, subsidiary cell, and epidermal cell length, width and trichome length were estimated by stage and ocular micrometry and mean value of 10 different views in 100x, 450x were presented in standard mean error. Terminology and classification for the epidermal cells, stomata and trichome are made after Metcalfe CR and Chalk L (Mbagwu, et al., 2007).

RESULTS

Epidermal characters of three species of the Genus *Desmodium* Desv was documented in the **Tables 1 and 2** and **Figures 1 and 2**.

Table 1. Epidermal characters of three species of *Desmodium* (all the measurements are in micro meter and are replica of 10 and also mentioned with standard error) and all measurements are in micrometer (µm).

SI no	Plant name	<i>Desmodium dichotomum</i>		<i>Desmodium scorpiurus</i>		<i>Desmodium triflorum</i>	
		Adaxial	Abaxial	Adaxial	Abaxial	Adaxial	Abaxial
1	Epidermal cell length (Mean ± SE) µm	83.2 ± 5	29.5 ± 2.29	43.6 ± 1.7	54.9 ± 2.4	70.0 ± 4.2	49.8 ± 1.9
2	Epidermal cell width (Mean ± SE) µm	40.5 ± 1.6	17.3 ± 0.65	30.6 ± 1.6	27.8 ± 1.7	29.9 ± 2.7	32.4 ± 2.4
3	Guard cell length (Mean ± SE) µm	26.1 ± 1.8	11.6 ± 0.63	19.6 ± 2.5	20.1 ± 0.7	24.1 ± 1.3	25 ± 1.7
4	Guard cell width (Mean ± SE) µm	5.5 ± 0.6	1.7 ± 0.12	4.5 ± 0.5	3.8 ± 0.2	3.4 ± 0.3	3.01 ± 0.4
5	Pore length (Mean ± SE) µm	19.7 ± 0.9	7.2 ± 0.28	9.5 ± 1.1	12.9 ± 0.7	14.3 ± 0.8	16.7 ± 0.9
6	Pore width (Mean ± SE) µm	5.5 ± 0.3	2.4 ± 0.25	2.1 ± 0.5	5 ± 0.4	2.9 ± 0.2	2.7 ± 0.3
7	Stomata length (Mean ± SE) µm	32.4 ± 1.4	14.8 ± 0.44	30.4 ± 1	27.3 ± 1.6	26.5 ± 0.9	28.7 ± 1.4
8	Stomata width (Mean ± SE) µm	13.91 ± 0.4	6.02 ± 0.26	10.7 ± 0.9	13 ± 0.8	11.9 ± 0.5	12.3 ± 0.8
9	Subsidiary length (Mean ± SE) µm	66.8 ± 3.7	25.9 ± 2.1	27.6 ± 3.5	44.3 ± 2.5	66.6 ± 4.5	57.5 ± 4.7
10	Subsidiary width (Mean ± SE)	24.3 ± 2.3	12.1 ± 0.98	9.4 ± 1.6	20.9 ± 1.9	25.6 ± 2.6	37.4 ± 2.8

	μm						
11	Trichome length (Mean \pm SE) μm	495.2 \pm 153.6	488.5 \pm 62.3	65.9 \pm 11.1	393.2 \pm 77.7	AB	59.3 \pm 3.1
12	Stomatal Index (SI)	23.6	64.06	16.65	56.62	31.9	40.6
13	SCF	3-8	12-25	6-15	16-28	13-19	3-8
14	ECF	14-20	07-13	44-71	12-21	21-53	14-20
15	TCF	3-5	23-39	29-49	19-32	AB	3-5
16	No of trichome per sq mm	4	31	35	26	AB	32
S.I: Stomatal Index; SCF: Stomatal Cell Frequency; ECF: Epidermal Cell Frequency; TCF: Trichome Cell Frequency							

Table 2. Epidermal characters of three species of *Desmodium*.

Sl no	Plant name	<i>Desmodium dichotomum</i>		<i>Desmodium scorpiurus</i>		<i>Desmodium triflorum</i>	
		Surface	Adaxial	Abaxial	Adaxial	Abaxial	Adaxial
1	Epidermal cell shape	Regular, polygonal, rectangular	Irregular	Irregular, pentagonal, hexagonal, polygonal	Irregular, polygonal	Irregular, polygonal	Irregular, polygonal
2	Epidermal cell wall	Sinuous, wavy, curved	Slightly wavy, curved	Straight	Sinuous, wavy, curved	Sinuous, wavy, curved	Sinuous, wavy, curved
3	Stomata	Present	Present	Present	Present	Present	Present
4	Type of stomata	Anisocytic, hemiparacytic	Paracytic, tetracytic	Anisocytic, hemiparacytic paracytic,	Anisocytic, hemiparacytic paracytic, tetracytic	Anisocytic, hemicytic paracytic, tetracytic diacytic	Anisocytic, hemicytic paracytic, tetracytic diacytic
5	Trichome	Present	Present	Present	Present	Absent	Present
6	Trichome type and size	Uniseriate, long, unbranched, eglandular, unicellular, falcate	Uniseriate long, unbranched, eglandular, unicellular	Uniseriate short and long, unbranched, eglandular, unicellular, straight and falcate.	Uniseriate short and long, unbranched, eglandular, unicellular, straight and falcate.	Absent	Uniseriate short, unbranched, eglandular, unicellular, clavate cylindrical.

Figure 1. A-D. *Triflorum* adaxial surface, B-D. *triflorum* abaxial surface, C-D. *scorpiurus* adaxial surface, D-D. *Scorpiurus* abaxial surface, E-D. *dichotomum* abaxial surface, F-D. *dichotomum* adaxial surface. G, J-Paracytic stomata, H-Hemiparacytic stomata, I-Anisocytic stomata.

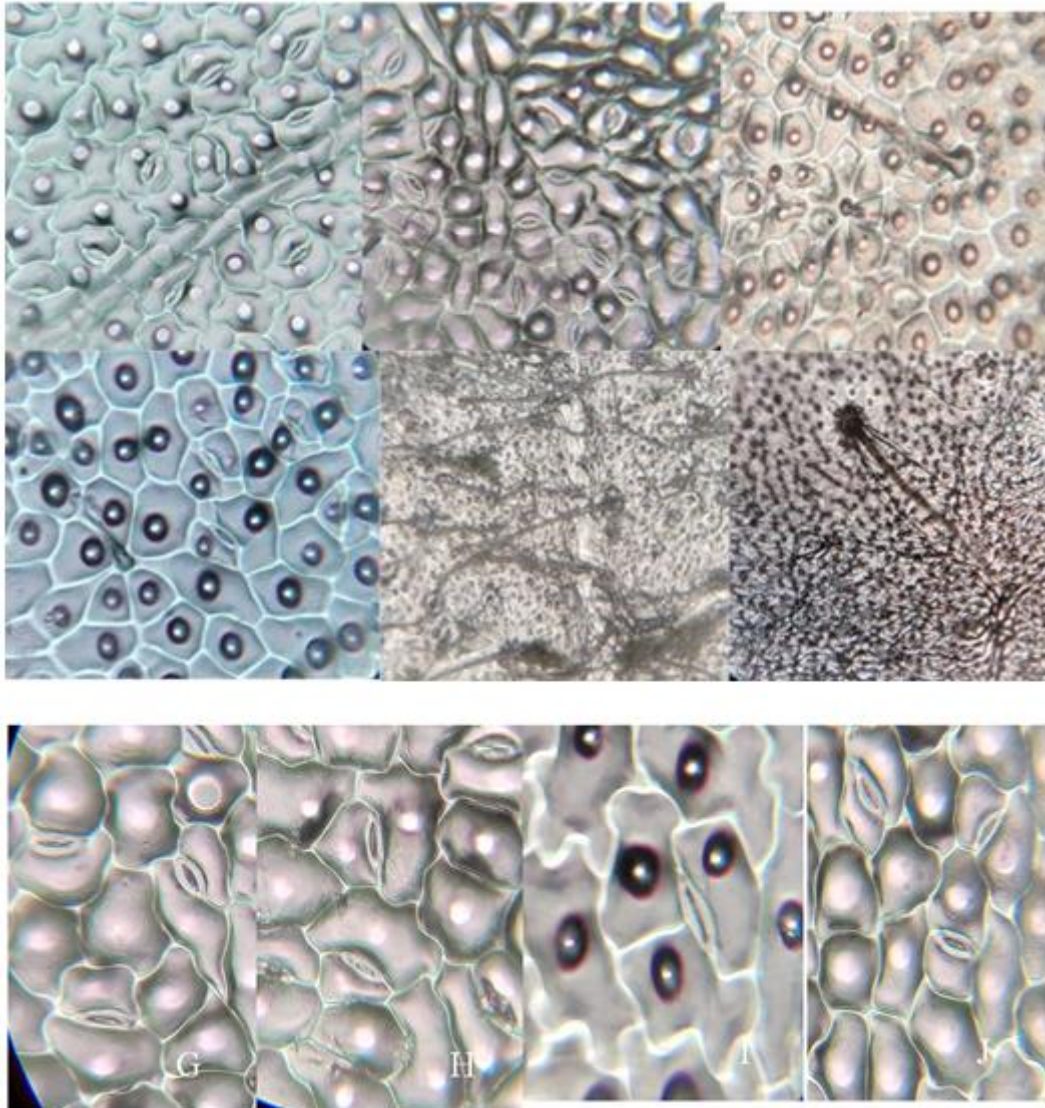
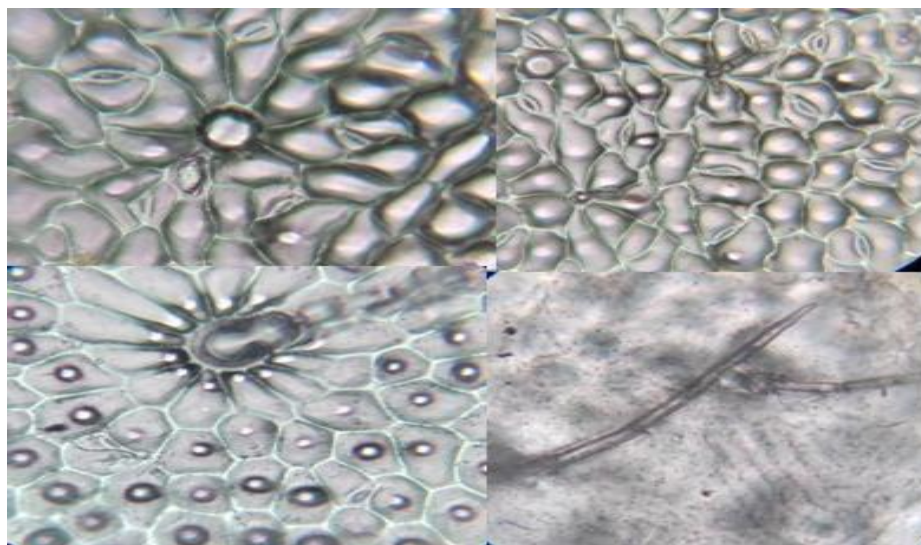


Figure 2. Trichome: A-Diacytic stomata, B-Peltate trichome, C-Trichome base, D-Long trichome.



Epidermal cell

In the studied three species of *Desmodium*,

epidermal cell shape is regular in adaxial surface of *Desmodium dichotomum* and *Desmodium scorpiurus*, where as irregular in abaxial surface of

Desmodium triflorum and *D. scorpiurus* and in both adaxial and abaxial surface of *D. triflorum*, all the three species in both the surface showed polygonal cell, along with it rectangular cells are also observed in adaxial surface of *D. dichotomum*, whereas in adaxial surface of *D. scorpiurus* possess pentagonal and hexagonal cells were also observed (Metcalf, et al., 1979). Epidermal cell wall is sinous, wavy and curved in all the species of its both the surface except in adaxial surface of *D. scorpiurus*, which is straight (Salisbury, et al., 1927). The epidermal cell length is varied in the Genus *Desmodium*, where the larger epidermal cell is observed in adaxial surface of *D. dichotomum* (length 83.2 ± 5 , width 40.5 ± 1.6) and smallest epidermal cell is found in abaxial surface of *D. dichotomum* (length 29.5 ± 2.29 , width 17.3 ± 0.65), which is mentioned in Table 1. Both larger and smaller epidermal cell is found in the same plant (Shah, et al., 1971).

Stomata

All the three species of *Desmodium* is Amphistomatic. Different types of stomata is observed, anisocytic and hemiparacytic stomata is found in all the species of *Desmodium* except in adaxial surface of *D. dichotomum*, tetracytic is not found in adaxial surface of *D. dichotomum* and *D. scorpiurus*, diacytic is found in only *D. triflorum* in both the surface of leaf. The size of the stomata measures differentially, largest stomata is observed in adaxial surfaces of *D. dichotomum* its length is measures about 32.4 ± 1.4 and width is 13.91 ± 0.4 , smaller stomata is observed in abaxial surface of *D. dichotomum* with length measures about 14.8 ± 0.44 and width is 6.02 ± 0.26 . The highest guard cell length is found in adaxial surface of *D. dichotomum* (26.1 ± 1.8) and lowest guard cell length is observed in abaxial surface of *D. dichotomum* (11.6 ± 0.63), highest guard cell width is seen in adaxial surface of *D. scorpiurus* (4.5 ± 0.5), whereas lowest guard cell width in adaxial surface of *D. dichotomum* (0.7 ± 0.12). highest pore length in adaxial surface of *D. dichotomum* (19.7 ± 0.9) and lowest pore length is in abaxial surface of *D. dichotomum* (7.2 ± 0.28), highest pore width in adaxial surface of *D. dichotomum* (5.5 ± 0.3) and lowest pore width in adaxial surface of *D. dichotomum* (2.1 ± 0.5), the highest subsidiary cell length is found in abaxial surface of *D. dichotomum*

(66.8 ± 3.7) and lowest subsidiary cell length is observed in abaxial surface of *D. dichotomum* (25.9 ± 2.1), highest subsidiary cell width is seen in abaxial surface of *D. triflorum* (37.4 ± 2.8), whereas lowest subsidiary cell width in adaxial surface of *D. scorpiurus* (9.4 ± 1.6). Highest Stomatal Index (SI) per unit area is found in abaxial surface of *D. dichotomum* (64.06%) and lowest stomatal index is found in adaxial surface of *D. scorpiurus* (16.65%). In all *Desmodium* species shows the stomatal types are quite differential this result correlates with Shah and Gopal they state that in Papilionoideae different stomata types follow a similar pattern of development (Shokefun, et al., 2014).

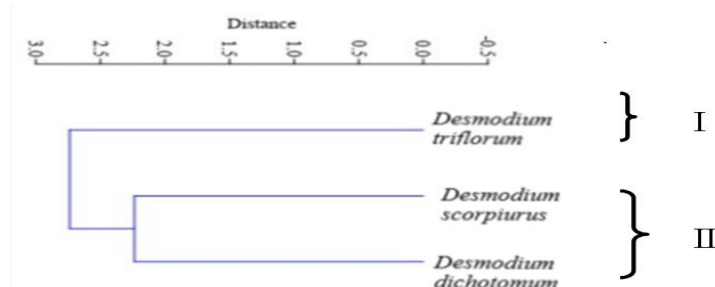
Trichome

Trichome is found in all the species of the *Desmodium* except in adaxial surface of *D. triflorum*. In all species of *Desmodium* unbranched, eglandular trichome is observed, long trichome is found in adaxial and abaxial surface of *D. dichotomum*. Both long and short trichomes are observed in *D. scorpiurus*, short trichome is found in abaxial surface of *D. triflorum*, whereas trichome is absent in adaxial surface, among the studied species tallest trichome is seen in adaxial surface of *D. dichotomum* (495.2 ± 153.6) and smallest trichome is seen in adaxial surface of *D. scorpiurus* (59.3 ± 3.1). No of trichome per unit area is considerably more in adaxial surface of *D. scorpiurus* and less in adaxial surface of *D. dichotomum* (Vandana, et al., 2018).

Cluster analysis

The result of cluster analysis is illustrated in the phenogram (Figure 3). This analysis divided the *Desmodium genera* into two main groups. The first group consists *Desmodium triflorum* which shares Irregular, polygonal epidermal cell shape and cell wall will be sinous, wavy and curved, stomata type will be diacytic, hemicytic, paracytic, tetracytic and also shows trichome and it is absent in adaxial surface uniseriate short, unbranched, eglandular, unicellular, clavate cylindrical. Second group is represented by *Desmodium dichotomum* and *Desmodium scorpiurus* which shares the characters as described in Table 2 (Zoric, et al., 2012).

Figure 3. Dendrogram showing phylogenetic category.



DISCUSSION

The investigated taxa showed significant difference in epidermal characters viz epidermal cell shape and structure, stomata and trichome. Taxonomic significance of epidermal studies in Leguminosae was described by Leelavathi PM and Ramayya N, et al., but as far as *Desmodium* species is concerned no attempt was carried to deliberate the epidermal characters relationship to its Taxonomic significance. So, a serious attempt was made to study the epidermal characters of *Desmodium* species of study area and also its relationship based on epidermal characters. Current study shows slight correlation with work done by Leelavathi PM and Ramayya N, et al., where all Papilionoids possess uniseriate, unbranched, trichome. Epidermal characters also helped to develop phenogram which shows relationship among them.

Taxonomic keys for identification of *Desmodium* species

- Subsidiary length less than 100 µm
- Epidermal cell wall wavy and sinous
- Irregular epidermal cell
- Stomata length more than 14 µm.....
-*Desmodium*
- Trichome length more than 450 µm
- D.
- dichotomum
- Guard cell length is 20 µm.....
-*D. scorpiurus*
- Trichome absent on adaxial surface.....
-*D. triflorum*

CONCLUSION

Papilionoideae show great diversity of stomata; however, the stomatal features may prove to be of little taxonomic value unless the development of different stomata types is studied. In the present work three *Desmodium* species studied they shows some similarity such as unicellular, unbranched trichome, that helps to assign them to the family Papilionoideae and cell wall wavy and irregular epidermal cell, helps to assign them to the genus *Desmodium*. With the distinct character they were assigned to respective species. Nevertheless, the taxonomic value of stomata type and distribution will be better understood when more information on a greater number of taxa is available.

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