



Research Article

Epidermal structure and stomatal ontogeny in some species of *indigofera* (leguminosae - papilionaceae) from Nigeria

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Abstract

Epidermal and stomatal ontogeny study was undertaken in three species of the genus *Indigofera* in the sub family papilionaceae belonging to the Family *Leguminosae* (Fabaceae). Mature stomatal types ranged from paracytic and anisocytic stomata on both leaf surfaces with eumesogoneous and hemimesogoneous development in and *Indigofera stenophylla* Guill et. perr var. *stenophylla* and *Indigofera numularifolia* L. Alston.. While *Indigofera prioureana* Guill et. Perr shows paracytic and anisocytic stomata on both leaf surfaces with eumesogoneous developmental pathway. *I. prioureana* shows wavy anticlinal cell wall while straight walls were observed in *I. stenophylla* and *I. numularifolia*. All the plants have unicellular unbranched trichomes except *I. prioureana* which have branched unicellular trichome. Stomatal measurements of length, pore size as well as frequencies also vary and may support the identification of these plants at specie level.

Keywords: *Indigofera*, Paracytic, anisocytic, ontogeny, trichome.

INTRODUCTION

The family Papilionaceae is distributed and found abundantly in warmer regions. In Nigeria it is represented by fifty (50) genera distributed in three hundred and fifty (350) species (Hutchinson and Dalziel, 1963). All the species of Papilionaceae have the ability to fix atmospheric nitrogen into nitrogenous compound which are stored in the seeds. Some species are cultivated as garden ornamentals. Leaf epidermal characters are of importance in pharmacognosy for the identification of plants used in herbal medicine and confirming the genuineness of foliar drugs. They are also use in the identification of fossil specimen specifically the leaf impression in paleobotany (Cutler, 1978). In addition to this epidermal characters have proved to be useful in systematic and phylogeny. These features can be employed as useful taxonomic characters in segregating the major groups of plants (Mbagwu *et al.*, 2007; Ayodele and Zhou, 2008. Albert and Sherma, 2013). There were several reports on the structure and development of stomata from Nigeria Gill and Karatela, 1982; Soladoye, 1982; Karatela *et al.*, 1990; Udok and Akpabio, 2005. Not much have been elucidated about the structure and development of stomata in the sub family papilionaceae. Some representative members of the species *Indigofera* were investigated with a view to finding the extent that which the leaf epidermal character can be of assistance in contributing to as an aid in the taxonomy of the genus *Indigofera*. Therefore, the objective of this paper is to determine the epidermal structure and stomatal ontogeny in some species of *indigofera* (leguminosae - papilionaceae) from Nigeria.

MATERIALS AND METHODS

Fresh young and mature leaves were collected from mature plants growing in old campus of Bayero University, Kano. Kano state, located between latitudes 10° 25' N to 13° 53' N and longitudes 7° 43' to 10° 35'E in the Sudan savanna zone of Nigeria. The leaves were fixed in formalin acetic acid (FAA) for 24 hours and washed in 70% ethanol. Epidermal peels were obtained for both stomatal study and stomatal ontogeny by direct peel method or by scraping off with a safety razor blade as described by Gill and Karatela (1982). Epidermal peels were stained with 2-3 drops of 1% alcoholic safranin and temporarily mounted in aqueous glycerol (50%) and used immediately. Observations were made from ten good slides of each specimen in measurements of stomatal length, pore size and stomatal frequency. Camera lucida drawings were made using ×180 magnification of Olympus MIC microscope. Measurements of stomatal length, stomatal pore size and trichome length were made using a calibrated eyepiece graticule (micrometers) and the standard deviation recorded. Stomatal frequencies were measured following the formula described by Mustapha (1984).

$$\frac{x}{y} \times 1\text{mm}^2$$

Where; x = average number of stomata per field of view
 y = calculated area of field of view (πr^2)
 r = 0.65

RESULTS

The qualitative and quantitative leaf epidermal features of the investigated taxa are presented in Table 1 and 2. The epidermal cell shape is isodiametric with straight anticlinal cell wall pattern in *I. stenophylla* and *I. numularifolia*. But *I. prieuriana* had irregular epidermal cell shape with wavy anticlinal cell wall pattern.

Stomatal distribution is amphistomatic (i.e stomata distributed in both abaxial and adaxial leaf surfaces) in all the investigated taxa. Mature stomatal types are paracytic and anisocytic (Figures 3 and 5) with eumesogoneous and hemimesogoneous stomatal ontogeny in *I. stenophylla* and *I. numularifolia*. But *I. prieuriana* had paracytic and anisocytic stomata (Figure 1) with eumesogoneous ontogeny.

The stomatal length, pore size and stomatal frequency also varied among species Table 2, with the maximum stomatal length and pore size appearing in *I. numularifolia* (26.3µm and 17.8µm) and minimum stomatal length in *I. prieuriana* (17.4 µm and 8.7 µm).

The type of trichome varied in different species. Unicellular unbranched trichomes were observed on both abaxial and adaxial leaf surface of *I. numularifolia* (Figure 6). While in *I. stenophylla* trichome is present on only the abaxial leaf surface (Figure 4). But in *I. prieuriana* unicellular branched trichome were observed on both abaxial and adaxial leaf surface (Figure 2).



Figure 1. Abaxial leaf surface (X40) showing showing Paracytic and anisocytic stomata in *I. prieuriana*

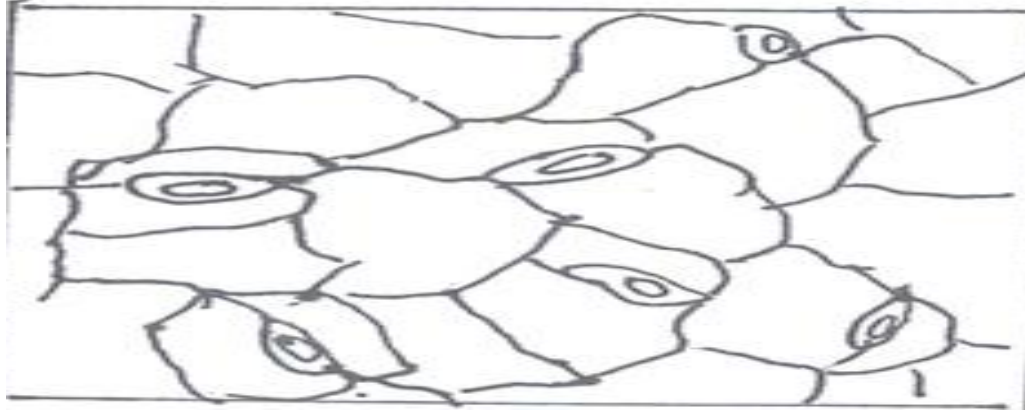


Figure 2. Adaxial leaf surface *prieuriana* and anisocytic stomata in *I. prieuriana*



Figure 3. Abaxial leaf surface showing *paracytic* and *anisocytic* stomata in *I. stenophylla*



Figure 4. Adaxial leaf surface showing anisocytic stomata in *I. stenophylla*



Figure 5. Abaxial leaf surface showing *paracytic* and *anisocytic* stomata in *I. numulariifoli*

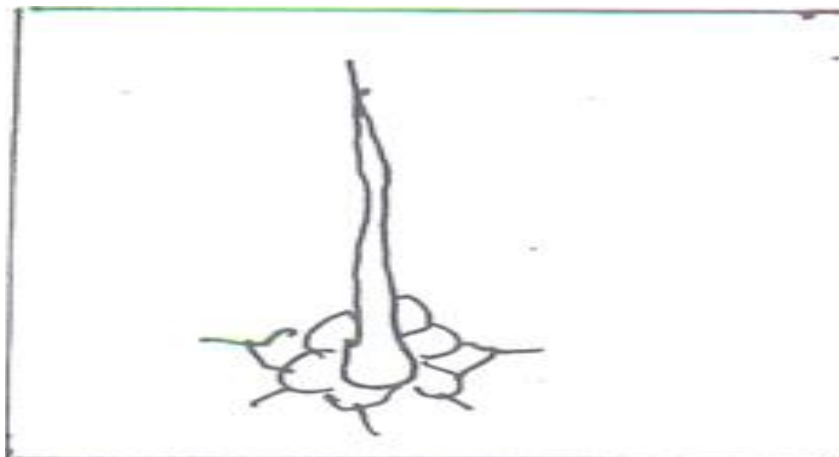


Figure 6. trichome type in *I. numularifolia*

Table 1. Qualitative leaf epidermal features in *Indigofera*

TAXA	Leaf surface	Epidermal cell shape	Anticlinal cell wall pattern	stomata on leaf surface	Distribution of stomata type of	ontogenic pathway	morphological	stomatal
1. <i>Indigofera prioureana</i> Guil et per	adaxial abaxial	irregular	wavy wavy	amphisto matic	para and aniso	eume		
2. <i>Indigofera stenophylla</i> Guil et per var stonophylla	adaxial abaxial	isodia metric	straight straight	amphisto matic	para and aniso	eume and hemi		
3. <i>Indigofera numularifolia</i> L. Alston	adaxial abaxial	isodia metric	straight straight	amphi stomatic	para and aniso	eume and hemi		

Key: para- paracytic aniso- anisocytic eume- eumesogeneous hemi- hemimesogeneous

Table 2. Quantitative leaf epidermal features and trichome type in *Indigofera*

Taxa	leaf surface	stomatal length (μm) ($1 \times 10 \mu\text{m}$)	stomatal pore size (μm) ($1 \times 10 \mu\text{m}$)	stomatal frequency mm^2	type of trichome	length of trichome (μm) ($1 \times 10 \mu\text{m}$)
1. <i>Indigofera prioureana</i> Guil et per	adaxial abaxial	17.4 ± 1.6 20.5 ± 1.4	8.7 ± 0.5 10.3 ± 0.6	71.3 86.6	branch branch	112.2 363.0
2. <i>Indigofera stenophylla</i> Guil et per var stonophylla	adaxial abaxial	19.7 ± 0.3 18.0 ± 1.7	10.6 ± 0.4 10.9 ± 1.4	85.5 56.1	--- unbranch	--- 168.3
3. <i>Indigofera numularifolia</i> L. Alston	adaxial abaxial	23.2 ± 0.1 26.3 ± 0.1	16.6 ± 0.3 17.8 ± 0.7	71.3 16.1	unbranch unbranch	346.5 495.0

Key: standard deviation -- absent

DISCUSSION

The present study found that there is variation in anticlinal cell wall and epiderma cell shape. Epidermal cell shape are isodiametric with straight anticlinal cell wall pattern in *I. stenophylla* and *I. numularifolia*. But *I. prioureana* has irregular epidermal cell shape with wavy anticlinal cell wall pattern. Quesada (1997) reported that epidermal cell shape and anticlinal cell wall pattern are variable from taxa to taxa and even within the same genus. Ahmad *et al*; (2010) reported that variations in the configuration of the epidermal cell can be used as an important supportive taxonomic tool to demarcate between species of the same genus.

Stomatal distribution is amphistomatic (i.e stomata distributed on both abaxial and adaxial leaf surface). Mature stomatal complex in all the investigated taxa are paracytic and anisocytic. There are differences in stomatal frequency between species of the same genus in the investigated taxa and can be use to distinguish between different species of the same genus. Variations in measurements of stomatal length and pore size also support the classification of the studied taxa. Albert and Sherma (2013) studied 5 species of *Bauhinia* L. reported that stomatal frequency, distribution and stomatal measurements varies within species and is of taxonomic importance in delimiting species. Gill and Nyawuame (1990) Ahmad *et al.* (2009), Ahmad *et al.* (2010) reported that stomatal diversity is a useful taxonomic tool

and can be used to assign taxonomic ranks at all levels of taxonomic hierarchy.

There is variation in the type of trichome structure in the investigated taxa. The unicellular unbranched trichome were observed on both abaxial and adaxial leaf surface of *I. numularifolia* and present on only the abaxial leaf surface of *I. stenophylla*. while the unicellular branch type of trichome were present on both the abaxial and adaxial leaf surface of *I. priureana*. Albert and Sherma (2013) reported that different species of the same genus may also be identified by their distinct trichome characters

CONCLUSION

Results revealed that there is variation in epidermal cell character such as epidermal cell shape, anticlinal cell wall pattern, stomatal distribution on leaf surface and structural type of trichome and its distribution on epidermal leaf surface can be used as an aid in the identification of the genus Indigofera.

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