J. Phytol. Res. **20**(1) : 61-66, 2007

MICROMORPHOLGY OF THE LEAF EPIDERMIS OF *ACHYRANTHES ASPERA L.*

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Epidermal characteristics were studied in the three varieties of *Achyranthes aspera L.* All the three varieties have simple and unicellular trichomes, however, the length of trichomes and their number was highly variable in different varieties. All the three varieties are amphistomatic and have anomocytic type of stomata, the stomatal frequency and stomatal index was, however, different in these varieties. The epidermal cells on the abaxial surface were highly irregular or sinuous in *A. aspera* var. *argentea* than the other two varieties. Hence, the micromorphological features of *Achyranthes aspera* suggest that all the three varieties are quite distinct from each other.

Keywords : Abaxial surface; Adaxial surface; Stomatal index; Trichomes.

Introduction

Micro-morphological features such as epidermal trichomes, type and number of stomata and stomatal indices may be valuable in the identification of plant species. Bruschi *et al.*[1] reported that *Quercus petraca* and *Q. pubescens* may be distinguished by using micro-morphological characters. Juan *et al.*[2] identified five morphological types of fruits on the basis of hair types, symmetry and dehiscence. Since the classification of different types of stomata given by Metcalfe and Chalk[3], the epidermal characteristics of different plant species have been studied[4-7]. In India, Sharma[8] has studied the epidermal characters of 21 species of *Grewia*, Chauhan and Agarwal[9] studied the micromorphology of epidermis of stem and leaf of *Centella asiatica*. Recently, Patel[10] investigated the normal and abnormal stomata of leaf of the eight species of Apocyanaceae. Kotresha and Savitha[11] studied the epidermal characters of *Guaiacum officinale* in Karnataka. Bhatt[12] and Bhatt and Dodia[13] sutdied the structure of stomata in Plantaginaceae and Ebneaceae, respectively.

Environmental factors play important role in determining the structural variations of epidermal characteristics of plant organs. The role of stomatal apparatus in regulation of plant water has also been emphasized by many workers[14-16]. Inspite of immense value of epidermal features in the study of plant taxonomy, environmental bilogy and eco-physiology, so far no attempt has been made to study these characters in *Achyranthes aspera*. Hence, the present study has been carried out to evalute the type and size of epidermal trichomes, stomata and stomatal indices in *Achyranthes aspera* growing in Alwar district of Rajasthan.

Material and Methods

For the study of trichomes three varieties of *Achyranthes aspera* were studied. Fresh leaves of these varieties were collected from the area where they were growing profusely and in their peak vegetative phase. The epidermal peel were taken by using chemical treatment. For this three chemicals, Trichloro-acetic acid, Phenol and Lactic acid were used . The leaves were placed in the perti dishes in which trichloro-acetic acid and phenol were taken in 3:1 ratio. Then these petridishes were placed into the oven at 30-35°C for 30 minutes to liquify the chemicals. From the treated leaves TCA and phenol solution were decanted and leaves were placed in lactic acid for preservation for a longer time period. Different epidermal features such as number of trichomes and their size were studied. The fresh epidermal peels were also obtained from the tip, middle and basal part of leaves mechanically for all the three varities of *A. aspera*. The epidermal peels were stained in Delafield hematoxylin and mounted in glycerine. The epidermal cell and stomatal characteristics were studied under the microscope. The stomatal index was calculated using the formula given by Salisbury[17].

Results and Discussion

Trichomes - The observations on the study of trichomes indicate that unicellular, cylindrical, simple and one kind of hairs were present in the three varieties of *A. aspera* (Fig.1). However, the lenght of hairs was 85 µm in *A. aspera var argentea*, 32 µm in *A. aspera var aspera* and 25-28 µm in *A. aspera var porphyristachya* (Table1). The

Table 1. Epidermal characteristics of the three varieties of *Achyranthes aspera* (±S.E.).

Varieties	Number of trichome per microscopic area	Length of trichome (μm)	Stomatal frequency	Stomatal index	Size of stomata (μm)
A. aspera var argentea					
Adaxial Surface	48.31±0.86	85.23±2.57	2.33±0.33	0.10±0.02	8.3x6.3
Abaxial Surface	84.77±2.39	85.23±2.62	9.0±0.58	0.30±0.01	8.3x6.3
A. aspera var aspera					
Adaxial Surface	17.87±0.77	31.07±1.26	4.8±0.58	0.16±0.02	8.2x6.0
Abaxial Surface	32.60±1.43	29.47±1.84	16.2±0.58	0.33±0.02	6.6x4.0
A. aspera var porphyristachya					
Adaxial Surface	29.27±1.38	31.07±2.03	4.66±0.88	0.15±0.03	5.9x4.3
Abaxial Surface	44.80±1.36	27.87±2.12	13.33±0.88	0.27±0.02	6.9x3.8

number of hairs per microscopic area on abaxial surface were 85, 33 and 45 in *A. aspera var argentea*, *A. aspera var aspera* and *A. aspera var porphyristachya*, respectively whereas the corresponding values on the upper surface were 48, 18 and 29, respectively. Although the general structure of hairs in all the three varieties is similar. The number and size of hairs are quite distinct in each variety (Fig.1). *A. aspera* var. *argentea* has considerably higher number of trichomes per unit surface area and longer trichomes as compared to the other two varieties (Table 1). This indicates that the former variety is adapted to relatively dry habitats such as the rocky substrates of hill slopes in Aravalli mountain range. This is in agreement with Bruschi *et al.*[1] who suggested that smaller leaf size, increased hairiness in *Quercus pubescens* can promote efficient water use and lower evapotranspiration demands. Among the remaining two varieties, *A. aspera* var. *porphyristachya* has longer and larger number of hairs per unit surface area of leaf than that of *A. aspera* var. *aspera*. The number of trichomes on the abaxial surface were twice that of on the abaxial surface which suggest that all the three varieties are adapted to dry habitats. The length of trichomes was equal on both the surface of the leaf in all the three varieties of *A. aspera*. However , the length of trichomes was almost three times in *A. aspera* var *argentea* than that in the other two varieties. The length of trichomes was almost equal in *A. aspera* var *aspera* and *A. aspera* var. *porphyristachya*. These observations clearly indicate that *A. aspera* var. *argentea* is quite different from the other two varieties with respect to the length of foliar epidermal trichomes. The considerable differences in the number of foliar epidermal trichomes in the three varieties of *A. aspera* suggest that all three varieties are quite different from each other.

Stomatal complex -The leaves in all the three varieties of *A. aspera* are amphistomatic and possses anomocytic stomata (Fig. 2). The stomata are well developed with two guard cells (Ranunculaceous type). Stebbins and Khush[4] suggested that anomocytic stomata are derived type. Hence, in this respect, *A. aspera* is an advanced genus and the stomata are surrounded by 3 to 4 subsidiary cells which are indistinguishable from neighbouring epidermal cells. In all the three varieties the stomata are oval shaped on both the surface of leaf. The average stomatel size was 8.3 x 6.3 μm in *A. aspera* var. *argentea*, 6.0 x 4.0 μm in *A. aspera* var. *aspera* and 6.0 x 3.8 μm in *A. aspera* var. *porphyristachya* (Table 1). Although the size of stomata was equal on both surface of leaf in *A. aspera* var. *argentea* and *A. aspera* var. *porphyristachya*, however, in case of *A. aspera* var. *aspera* the stomata present on adaxial surface were larger than those present on the abaxial surface.

All the three varieties showed high stomatal frequency on the abaxial surface than the adaxial surface (Table 1). The frequency of stomata was very less in *A. aspera* var. *argentea* as compared to the other two varieties. However, all the three varieties possess almost four times higher number of stomata per unit leaf surface area on the abaxial surface as compared to that on adaxial surface. Similar trend was observed with respect to the

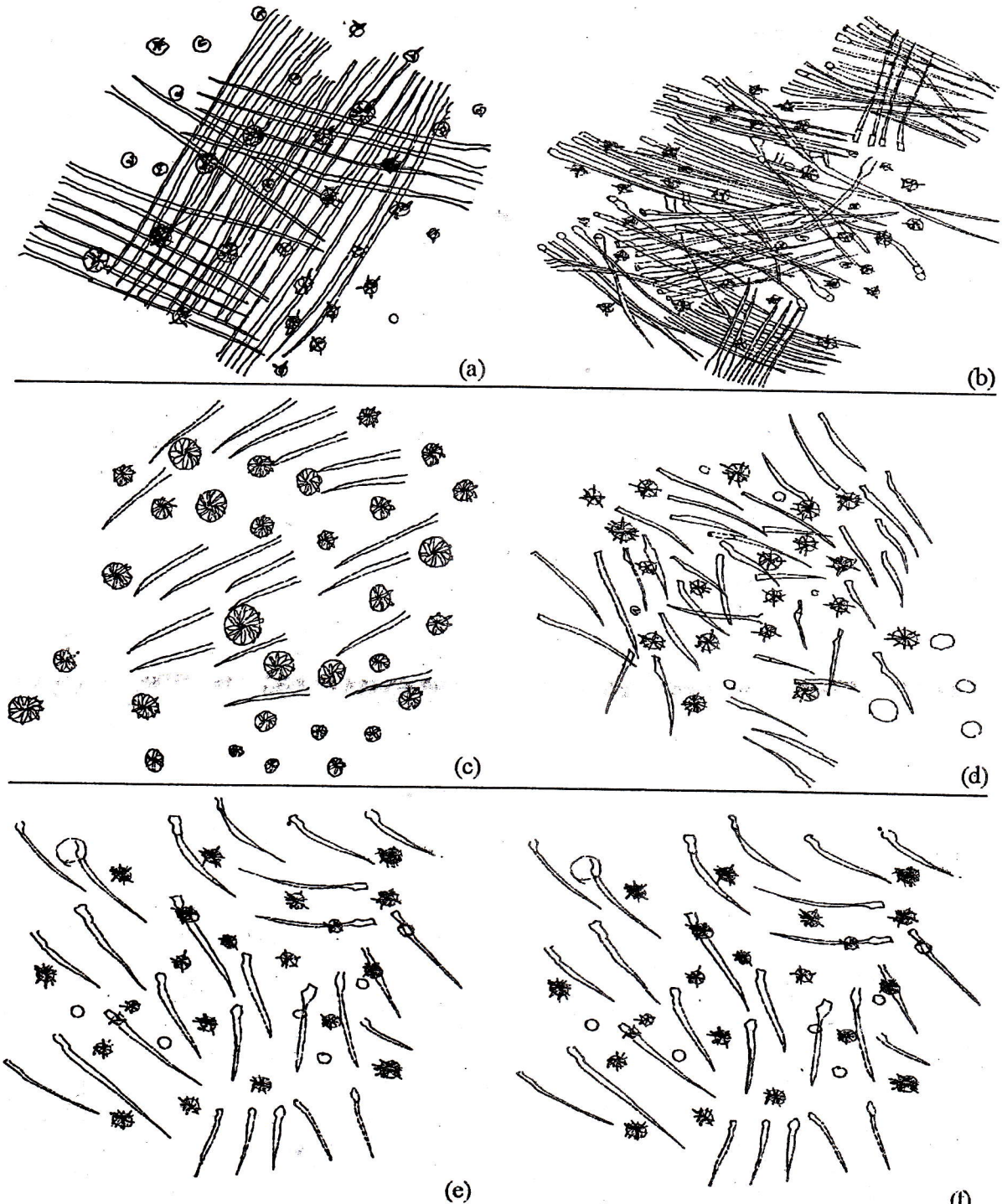

Fig.1. *Achyranthes aspera* var. *argentea*, Epidermal trichomes (a) Upper surface, (b) Lower surface (X 44), *Achyranthes aspera* var. *aspera*, Epidermal trichomes (c) Upper surface, (d) Lower surface (X 44) and *Achyranthes aspera* var. *porphyristachya*, Epidermal trichomes (e) Upper surface, (f) Lower surface (X 44).

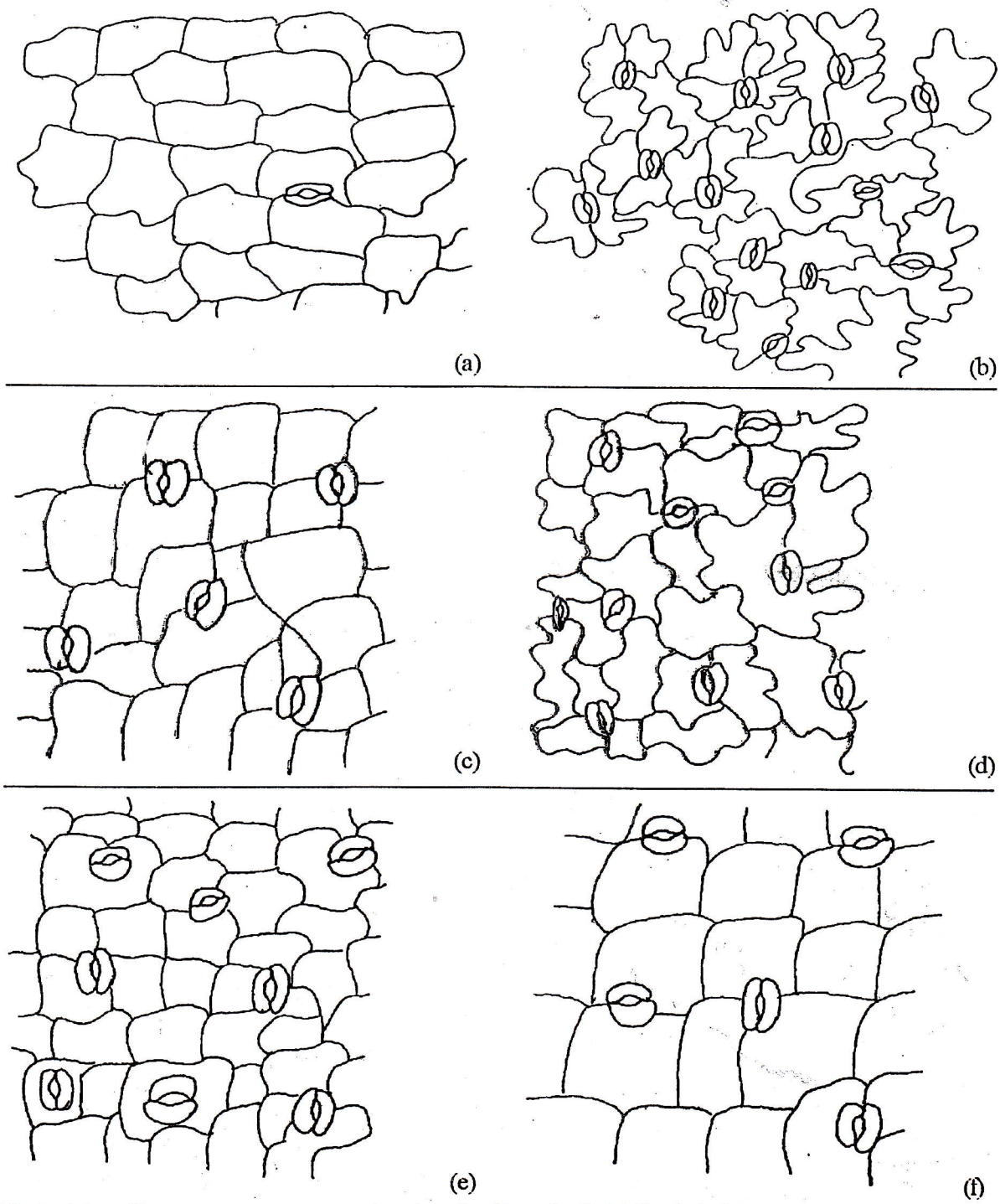

Fig.2. *Achyranthes aspera* var. *argentea*, stomata and epidermal cells (a) Upper surface, (b) Lower surface (X 44), *Achyranthes aspera* var. *aspera*, stomata and epidermal cells (c) Upper surface, (d) Lower surface (X 44), *Achyranthes aspera* var. *porphyristachya*, stomata and epidermal cells (e) Upper surface, (f) Lower surface (X 44).

stomatal index in all the three varieties of *A. aspera* (Table 1). The stomatal index was 0.10 and 0.30 on adaxial and abaxial surface, respectively in *A. aspera* var. *argentea* while it was about 0.15 and 0.30 on adaxial and abaxial surface, respectively in the other two varieties. These results exhibit that *A. aspera* var. *argentea* is adapted to more xeric condition than the other two varieties. This is agreement with Hussain and Karatela[7]. However, Karatela and Gill[18] and Stanley *et al.*[5] suggested that stomatal count per unit leaf surface area is higher in species growing in drier regions than that is the case with the species growing in rain forest. Abrams[19] and Bruschi *et al.*[1] reported that higher humber of stomata in the xeric oak species.

The smaller size of leaves and dense long haris on lower surface may be an adaption of *A. aspera* var. *argentea* to moisture stress conditions particularly on hill slopes whereas large leaf size and less number of short hairs may indicate the adaptation of *A. aspera* var. *aspera* and *A. aspera* var. *porphyristachya* to relatively mesic conditions. This finds support from Bruschi *et al.*[1] who suggested that smaller leaf size and increased hairness can promote highly efficient water use and lower evapotranspiration demands in *Quercus pubescens*. The very long dense hairs present of on both the leaf surface in *A. aspera* var. *argentea* as compared to *A. aspera* var. *aspera* and *A. aspera* var. *porphyristachya* suggest that the former variety should be raised to the rank of species. Bruschi *et al.*[1] also reported that the length of rays of stellate hairs alongwith freedom of rim and number of glandular hairs is sufficient to attribute individual to *Quercus pubescens* and *Quercus petraca*.

Epidermal Cells -The epidermal cells are polygonal with some degree of sinuous walls in all the three varieties of *A. aspera* (Fig. 2). However, the epidermal cells on abaxial surface exhibited highly irregular or sinuous walls in *A. aspera* var. *argentea* than the other two varieties. Among the remaining two varieties, *A. aspera* var. *aspera* exhibtied more irregular wall than that of *A. aspera* var. *porphyristachya*. The epidermal cells were largest in *A. aspera* var. *argentea*, followed by that of *A. aspera* var. *aspera* and then in *A. aspera* var. *porphyristachya*.

Acknowledgements

The authors are grateful to Dr. G.K. Rustagi, Principal, R.R. College, Alwar for providing necessary facilities. The financial assistance received by Miss Teena Agarwal from CSIR, New Delhi is gratefully acknowledged.

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