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Full Length Research Paper

Taxonomic diversity of stomata in dicot flora of a district tank (N.W.F.P.) in Pakistan

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A total of 36 dicot species distributed in 34 genera and 20 families were investigated for stomatal diversity. Seven types of stomata were found in which amphianisocytic was the dominant one found in 12 species while staurocytic and diacytic were found in 7 and 6 species respectively. In 7 species two and in one species three different types of stomata were found.

Key words: Dicots, stomata, district tank.

INTRODUCTION

Stomata is usually termed for the opening in the epidermis through which gaseous exchange takes place between the intercellular spaces of the sub epidermal cells and the atmosphere (Eames and MacDaniels, 1947). The stomata was first studied by Stresburger (1866), followed by Vesque (1889) who recognized four broad categories of stomata based on the presence and arrangement of accessory cells as well as their mode of development. Leaf epidermal anatomical features such as stomata, trichomes and other characters are useful anatomical tools. Anatomical features are of particular value to scientists who need to identify small scraps of plant material (Stace, 1980). Ghahreman et al. (1999) conducted leaf epidermal studies in the genus *Hyoscyamus* L. in Iran and concluded that the most useful anatomical characters are stomatal occurrence, stomatal index, pattern of anticlinal walls and type of trichomes. Radford (1974) dealt with leaf anatomy and the characters which he has proven to be of systematic value are: cuticular characters, epidermis, stomata, subsidiary cells and trichomes. On the basis of arrangement of the epidermal cell neighboring the guard cell, more than 25 main types of stomata in dicots have been recognized (Metcalfe and Chalk, 1979). Stace (1980) reported 31 different types of stomata among cotyledonous plants. The present study was undertaken to elaborate the taxonomic diversity of stomata within dicots flora.

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MATERIALS AND METHODS

Fresh leaf samples of dicot flora obtained from N.W.F.P. district tank in Pakistan for stomatal studies were prepared according to the modified method of Bibi et al. (2007). The leaves were treated with 88% lactic acid, in water bath (model: memert GmbH$^+$Co.KG D-91\26, Schwabach FRG, Germany) at 100°C for 30 min. Slides of both abaxial and adaxial sides of leaves were prepared and observed under light microscope.

Microphotographs were taken by using CCD digital camera (Model: DK 5000) fitted on Leica light Microscope (model: DM 1000). These micrographs were useful for identification and differentiation of stomata on the basis of microscopic features.

RESULTS AND DISCUSION

In the present study a total of 36 dicot species were studied which were distributed in 34 genera and 20 families for stomatal details (Table 1 and Figure 1). Seven different types of stomata; diacytic, amphianisocytic, staurocytic, axillocytic, anomotetracytic, actinocytic and anisocytic were found in which amphianisocytic was the dominant one found in 12 species; *Brassica Compestris*, *Cynoglosum lanceolatum*, *Lepidium apitalum*, *Raphanus sativus*, *Sisymbrium irio*, *Cleome brachycarpa*, *Lycopersicon esculentum*, *Vicia faba*, *Rumex vesicarius*, *Vaccaryia pyramedica*, *Calendula*

Table 1. Stomatal diversity and quantitative characters anylysis.

S/N	Taxon	Family	Type of stomata	Length x width of stomatal aperture (µm)	Length of stomatal complex (µm)
	Carum copticum	Apiaceae	Diacytic but sometime like amphianisocytic	12.65 (12.5 - 17.5) x 3.125 (1.25 - 5)	28.12 (30 - 40)
	Coriandrum sativum	Apiaceae	Staurocytic	13.75 (17.5 - 20) x 5.84 (5 - 7.5)	43.75 (17.5 - 20)
	Calotropis procera	Asclepiadaceae	Diacytic	18.75 (15 - 22.5) x 8.125 (6.25 - 10)	31.56 (27.5 - 47.5)
	Convolvulus arvensis	Convolvulaceae	Axillocytic and staurocytic	21.45 (20 - 22.9) x 8.75 (6.67 - 8.34)	50.84 (45 - 62.5)
	Cynoglosum lanceolatum	Boraginaceae	Amphianisocytic	35.83 (30 - 40) x 13.34 (12.5 - 15)	60.62
	Brassica compestris	Brassicaceae	Amphianisocytic	15 (12.5 - 17.5) x 5.94 (3.75 - 7.5)	26.07
	Lepidium apitalum	Brassicaceae	Amphianisocytic	13.75 (12.5 - 15) x 4.06 (2.5 - 5)	40.41 (32.5 - 50)
	Raphanus sativus	Brassicaceae	Amphianisocytic	13 (12.5 - 15) x 3.08 (2.5 - 5)	26.5 (20 - 32.5)
	Sisymbrium irio	Brassicaceae	Amphianisocytic	11.25 (7.5 - 12.5) x 3.75 (2.5 - 5)	34 (27.5 - 40)
	Cleome brachycarpa	Capparidaceae	Amphianisocytic	22.5 (15 - 27.5) x 10 (7.5 - 12.5)	48.12 (37.5 - 62.5)
	Dianthus caryophyllus	Caryophyllaceae	Diacytic	16.87 (15 - 22.5) x 10.62 (7.5 - 12.5)	64.5 (45 - 87.5)
	Spergularia arvensis	Caryophyllaceae	Amphianisocytic	23.75 (22.5 - 25) x 4.68 (3.75 - 5)	35.5 (30 - 42.5)
	Vaccaryia pyramedica	Caryophyllaceae	Amphianisocytic	20.62 (17.5 - 25) x 6.87 (5 - 8.75)	45 (42.5 - 47.5)
	Chenopodium album	Chenopodiaceae	Staurocytic	17.91 (17.5 - 18.75) x 9.17 (8.75 - 10)	63 (30 - 87.5)
	Chenopodium murale	Chenopodiaceae	Staurocytic	18.125 (17.5 - 20) x 7.18 (5 - 8.75)	58.33 (55 - 65)
	Calendula arvensis	Asteraceae	Amphianisocytic	22.5 (20 - 25) x 7.08 (6.25 - 7.5)	28.5
	Euphorbia helioscopia	Euphorbiaceae	Staurocytic	15 (12.5 - 17.5) x 7.5 (5 - 10)	30 (27.5 - 32.5)
	Salvia aegyptica	Lamiaceae	Amphianisocytic and staurocytic	15 x 7.5	15 x 7.5
	Melia azedarrach	Meliaceae	Staurocytic	28.75 (20 - 35) x 10	55.84 (50 - 65)
	Bougainvillea glabra	Nyctaginaceae	Anisocytic	32.5 (30 - 35) x 5.84 (5-7.5)	32.5 (30 - 35)
	Alhagi maurorum	Papilionaceae	Diacytic	8.125 x 4.68	26.5 (22.5 - 30)
	Lathyrus aphaca	Papilionaceae	Diacytic	14.16 (12.5 - 15) x 4.16 (2.5 - 5)	35 (30 - 40)
	Melilotus indica	Papilionaceae	Amphianisocytic and staurocytic	13.125 (12.5 - 15) x 4.375 (3.75 - 5)	38.21 (30 - 52.5)
	Trifolium alexandrianum	Papilionaceae	Staurocytic	5 x 1.25	30.5 (25 - 37.5)
	Vicia faba	Papilionaceae	Amphianisocytic	14.16 (12.5 -15) x 4.16 (2.5- 5)	35 (30 - 40)
	Plantago major	Plantaginaceae	Diacytic and amphianisocytic	15 x 8 (6 - 10)	53.34 (45 - 65)
	Plantago ovata	Plantaginaceae	Amphianisocytic	20 x 5	49 (37.5 - 55)

Table 1. Contd.

	Polygonum plebijum	Poaceae	Diacytic and amphianisocytic	23.4 (20 - 25) x 10.42 (8.75 - 12.5)	26.5 (22.5 - 30)
	Rumex vesicarius	Polygonaceae	Amphianisocytic	13.75 x 4.14	32.5
	Salix acmophylla	Salicaceae	Amphianisocytic, anomotetracytic and diacytic	7.91 (7.5 - 8.75).	46.25 (30 - 55)
	Datura stramonium	Solanaceae	Amphianisocytic	1`6.25 (12.5 - 22.5) x 4.37 (2.5 - 7.5)	37.5 (32.5 - 45)
	Solanum surratense	Solanaceae	Amphianisocytic and anomotetracytic	13.75 (10 - 17.5) x 5.32 (5 - 6.3)	36.25 (30 - 42.5)
	Lycopersicon esculentum	Solanaceae	Amphianisocytic	14 (12.5 - 15) x 3.75 (2.5 - 5)	30 (27.5 - 37.5)
	Fagonia indica	Zygophyllaceae	Staurocytic and anomotetracytic	13.34 (12.5 - 15) x 5.41 (5 - 6.25)	46.25 (35 - 55)
	Peganum harmalla	Zygophyllaceae	Anomotetracytic	18 (10 - 22.5) x7.75 (3.75 - 10)	31.5 (30 - 32.5)
	Tribulus terristris	Zygophyllaceae	Actinocytic	9.37 (7.5 - 12.5) x 3.75 (2.5 - 5)	38 (30 - 42.5)

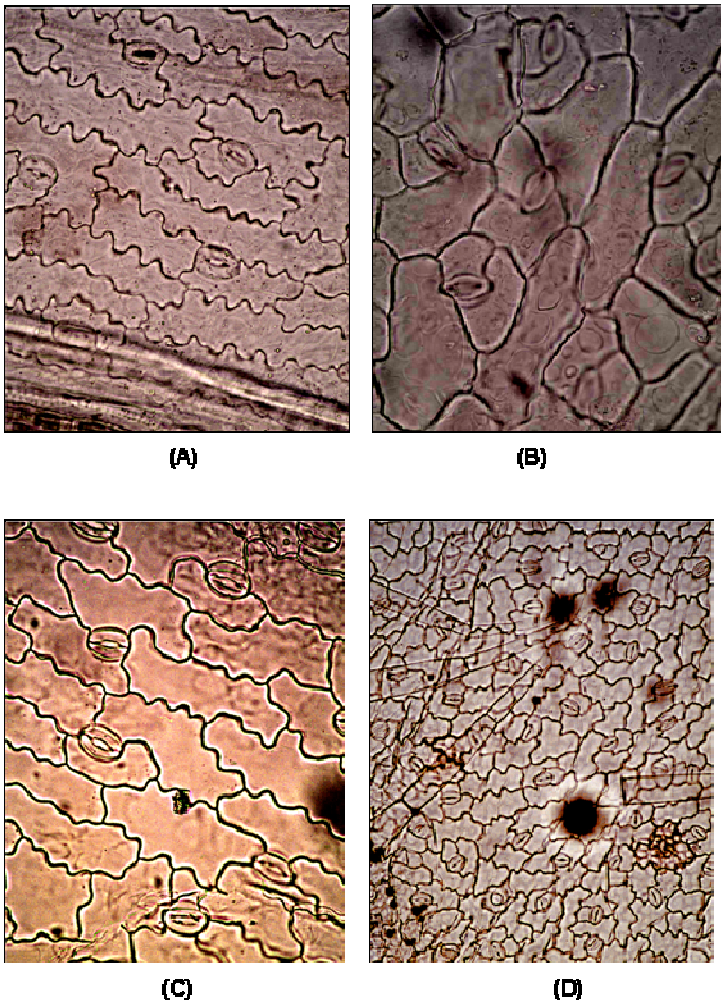

Figure 1. Leaf epidermal anatomy of weeds. A: *Lathyrus aphaca* (40X), B: *Polygonum plebijum* (40X), C: *Vicia faba* (40X), and D: *Lycopersicon esculentum* (40X).

arvensis and *Spergularia arvensis* while staurocytic were found in *Coriandrum sativum*, *Chenopodium album*, *Chenopodium murale*, *Trifolium alexandrianum*, *Euphorbia helioscopia* and *Melia azedarrach* and diacytic were found in *Calotropis procera*, *Alhagi maurorum*, *Lathyrus aphaca* and *Dianthus caryophyllus.* In seven species two different types of stomata were observed; in *Fagonia indica* staurocytic and anomotetracytic, in *Polygonum plebijum* diacytic and amphianisocytic, in *Plantago major* diacytic and amphianisocytic, in *Melilotus indica* amphianisocytic and staurocytic, in *Salvia aegyptica* amphianisocytic and staurocytic and in *Carum copticum* diacytic but sometime like amphianisocytic. In *Salix acmophylla* three different types of stomata, that is, amphianisocytic, anomotetracytic and diacytic were found.

According to Perveen et al. (2007), *Melilotus indicus* and *Tribulus terrestris* have anomocytic while *C. procera* and *C. brachycarpa* have paracytic type of stomata. The structure and ontogeny of the stomata has been studied in 26 species of Rubiaceae by Bahadur et al. (2008) in relation to their organographic distribution. The stomata are mostly paracytic on the leave.

Metcalfe and Chalk (1950) reported that the orders Centrospermae and Polygonales have usually anomocytic type of stomata. Presently anomocytic type is found in most of the dicot species irrespective of the specific orders or families except that of the family Amaranthaceae in which all taxa having anomocytic type but there are some other reports on the stomata of Amaranthaceae (Sen, 1958; Padmini and Rao, 1995) in which it was observed that this family has various types of stomata like anomocytic, anisocytic, diacytic and paracytic. A study of the foliar epidermis and floral trichomes in seven Cuban taxa of *Indigofera* L. was performed by Quesada (1997). According to him epidermal cell shape and anticlinal wall patterns are variable from taxon to taxon and even within the same taxon. Stomata are mostly anisocytic and all taxa have amphistomatic leaflets. Stomatal morphology of 69 dicot species distributed in 64 genera and 28 families was examined by Perveen et al. (2007). According to them 6 types of stomata, that is, anomocytic, paracytic, diacytic, parallelocytic, cyclocytic and anisocytic were found in the dicot flora of Karachi. Within the dicot flora, anomocytic type is the most dominant found in 54 taxa, followed by paracytic and diacytic type, represented by 9 and 3 taxa respectively. Whereas, parallelocytic, cyclocytic and anisocytic types are found only in one species each. Binns and Blunden (1980) reported paracytic and anomocytic types in *Salix* species.

Correlations of characters provide a strong base to assign taxonomic rank. Stomatal diversity is useful at all levels of taxonomic hierarchy. In some cases it is useful at family level as all the four species of Brassicaceae have amphianisocytic type of stomata but at the other hand the Papilionacious species show much variation. Similarly the two species of the *Chenopodium* have staurocytic stomata while *Plantago major* and *Plantago ovata* show variations at some occasions. Further and comprehensive work is needed to elaborate and explain this potential taxonomic character and its implication at specific taxonomic level.

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