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Stomatal Frequency and Resistance in Leaves of some Tropical Members of Asteraceae

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The family Asteraceae with 20 genera belonging to 9 tribes was found dominant on the University of Hyderabad campus, Hyderabad. *Flaveria australasica* Hook., possessing a typical chlorophyllous bundle sheath recorded low CO_2 compensation point. Stomatal resistance to water and CO_2 flux in leaves measured under natural habitat were found to increase with leaf temperature except in *F. australasica* and *Acanthospermum hispidum* DC. There was no apparent correlation between stomatal frequency and stomatal resistance among the species. The stomatal frequency is higher on the abaxial side than on the adaxial side in all the plants except in *A. hispidum*. Chlorophyll content and specific leaf weight were recorded.

Key Words: Asteraceae, Stomatal frequency, Stomatal resistance

Introduction

Stomata are the major sites of gaseous exchange such as CO_2, O_2 and water vapour in plants (Burrows & Milthorpe 1976, Meidner & Mansfield 1968). They are also sites of entries for many foliarly applied compounds such as herbicides, fungicides and other agrochemicals. So it is felt that knowledge on the periodicity of stomatal opening in plants under natural habitat may be useful, since many Asteraceae are seen as weeds in crops. The present study concerns the frequency of stomata and their movements as measured by diffusive resistance and chlorophyll content in leaves of Asteraceae.

Materials and Methods

The plant species in the University of Hyderabad campus (560 hectares) were collected and made into an herbarium. From the field survey it was found that species belonging to the family Asteraceae are dominant in this area and are listed in table 1.

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Table 1 *Species of Asteraceae occurring predominantly in the University of Hyderabad campus*

Series	Tribes	Genera and Species
Tubuliflorae	Vernonieae	*Vernonia* sp *Vernonia cinerea* Less
	Eupatorieae	*Ageratum* sp
	Astereae	*Conyza* sp *Aster* sp
	Inulae	*Blumea oxydonta* DC. *Sphaeranthus indicus* Linn.
		Gnaphalium indicum Linn.
		Vicoa indica DC.
		Caesulia axillaris Roxb.
	Heliantheae	*Lagasca mollis* Cav. *Eclipta alba* Hassk.
		Tridax procumbens Linn.
		Acanthospermum hispidum DC
	Helenieae	*Flaveria australasica* Hook
	Synecioneae	*Emilia sonchifolia* DC
	Cynareae	*Echinops echinatus* DC
Liguliflorae	Cichorieae	*Sonchus oleraceus* Linn.
		Launaea nudicaulis Less
		Notonia sp

Stomatal Frequency and Stomatal Diffusion Resistance

Stomatal frequency was determined by taking the imprints of the leaf with nail polish (Sampson 1961), and the frequency was expressed as number of stomata/mm^2 area. Stomatal resistance in leaves of plants under natural habitat was measured with an automatic porometer MK II Delta-T-Devices. Leaf temperature was also recorded. Frequency and resistance were recorded for young and fully expanded leaves from the apex of the plant, on sunny days. Light intensity was measured in a Li-Cor light meter. The results are average of five observations on five different days.

Specific Leaf Weight (SLW), Chlorophyll Content and CO_2 compensation Point

Five fully expanded leaves of the plants were taken and area was noted on a graph sheet. The leaf dry weights (dried at 80°C for 48 hr) were determined and SLW was expressed as mg per decimeter square area of leaf. Chlorophyll content and chlorophyll a/b ratios were determined according to Arnon (1949). CO_2 compensation point was measured in an infra-red gas analyzer (IRGA-20 Grubb Parsons & Co. Ltd., England) in a closed circuit.

Results and Discussion

Geographically the University of Hyderabad, Hyderabad is located on 17° 30' N 78° 30'E with the annual rainfall of 100 cm to 150 cm. 32 dicotyledonous families of angiosperms were recorded in the university campus. Of these, the family Asteraceae is dominant with 20 genera belonging to 9 tribes (table 1). Physiologically the members of Asteraceae can be classified as C_3, C_4 and CAM plants based on the mode of carboxylation reactions (Downton 1975, Szarek 1979). In the present study *F. australasica* possessed a typical chlorophyllous bundle sheath and a low CO_2 compensation point indicating the presence of C_4 dicarboxylic acid metabolism. Dense pubescence was observed in leaves of *G. indicum* and in young leaves of *B. oxydonta*, which may be an ecological adaptation for high solar radiation and temperature.

Table 2 brings out the stomatal frequency and stomatal resistance to water and CO_2 flux in leaves of the plants under natural habitat. The stomatal frequency was higher on the abaxial side than on the adaxial side in all plants except in *A. hispidum*, which possessed highest stomatal frequency and lowest stomatal resistance among the plants. Thus a negative correlation was observed between the stomatal frequency and resistance to the abaxial and adaxial side of the

Table 2 *Stomatal frequency and resistance, and leaf temperature in some members of Asteraceae (Light intensity at 9.00 AM 2000 μ E/M² Sec; at 1.00 PM 3,300 μ E/M² Sec; and at 5.00 PM 500 μ E/M² Sec. Maximum temperature 38°C)*

Plant Species		Stomatal frequency/mm²	9.00 AM		1.00 PM		5.00 PM	
			Resistance S/cm	Leaf temp. °C	Resistance S/cm	Leaf temp. °C	Resistance S/cm	Leaf temp. °C
Tridax procumbens	adaxial	175.37	2.0	31.0	4.9	34.5	4.5	36.0
	abaxial	294.88	3.4		6.0		7.0	
Sphaeranthus indicus	adaxial	125.45	3.8	28.0	4.2	35.0	5.2	32.5
	abaxial	178.56	2.5		3.6		3.4	
Flaveria australasica	adaxial	97.88	6.5	29.5	4.4	34.0	16.8	29.0
	abaxial	160.45	2.9		2.5		5.3	
Echinops echinatus	adaxial	90.13	—	—	—	—	—	—
	abaxial	448.64	—	—	—	—	—	—
Blumea oxydonta	adaxial	80.10	6.3	29.0	7.2	34.00	6.8	29.0
	abaxial	157.35	4.8		5.1		5.3	
Sonchus olderaceus	adaxial	159.88	high	29.5	high	37.0	high	31.0
	abaxial	383.38	2.4		3.2		7.8	
Emilia sonchifolia	adaxial	114.30	2.0	28.5	3.0	34.0	6.8	29.5
	abaxial	138.67	1.5		2.0		4.3	
Caesulia axillaris	adaxial	149.52	6.8	28.5	3.0	34.0	6.8	29.5
	abaxial	155.58	4.2		5.3		6.7	
Lagasca mollis	adaxial	182.15	7.4	28.0	10.6	34.5	9.6	29.0
	abaxial	342.60	5.6		8.3		10.8	
Acanthospermum hispidum	adaxial	546.00	2.1	29.5	1.5	35.5	6.5	28.5
	abaxial	271.87	2.1		1.4		3.2	
Eclipta alba	adaxial	150.26	2.0	30.0	3.7	35.0	7.5	30.0
	abaxial	321.89	1.4		3.0		5.2	
Aster sp	adaxial	106.04	3.2	30.5	4.1	33.5	4.4	28.5
	abaxial	122.35	1.6		2.8		2.6	

leaf. But such a correlation was not observed among different species. This phenomenon can be attributed to the variations in stomatal size and structure among the species and also may be due to variations in the texture of leaf surface.

The stomatal resistance at 9.00 AM is low in the plants indicating maximum gaseous diffusion rates. The resistance was increased along with increase in leaf temperature and light intensity except in *A. hispidum*, *C. axillaris* and *F. australasica*. The phenomenon of recording low resistance at 1.00 PM in these plants is interesting since mid-day closure of stomata was reported (Hyalth & Orchard 1957, Meidner & Mansfield 1968). In the evening all the plants have recorded maximum resistance. *B. oxydonta* has recorded very little variations in the stomatal resistance from morning to evening. Thus its stomatal movements are not much influenced by increasing daylight and temperature. This may be due to the presence of pubescence on the leaf which may protect from high solar radiation.

The CO_2 compensation points did range from 65 ppm in *T. procumbens* to 97 ppm in *B. oxydonta* except in *F. australasica* which has recorded a very low compensation point (table 3). Apparently there was no positive

Table 3 *Pigment levels, CO_2 compensation point and SLW in leaves of some tropical Asteraceae*

Plant Species	Chlorophyll content mg/g fr. wt.	Chlorophyll content $\mu g/cm^2$	Chlorophyll a/b	CO_2 compensation point	Specific leaf weight mg/dm^2
Tridax procumbens	1.841	48.25	1.20	65	232.91
Flaveria australasica	1.857	47.49	2.20	2	429.83
Echinops echinatus	2.124	40.56	1.51	86	—
Blumea oxydonta	2.445	43.83	1.46	97	283.83
Sonchus oleraceus	1.932	51.24	1.80	78	314.75
Emilia sonchifolia	1.862	48.33	2.75	75	307.34
Caesulia axillaris	2.517	40.42	1.42	84	395.68
Lagasca mollis	2.817	49.45	1.52	85	416.69
Acanthospermum hispidum	2.661	35.33	1.11	78	274.77
Ecliptaalba	2.134	39.52	1.42	70	533.73
Aster sp	2.681	45.92	1.13	68	385.17

correlation between SLW and chlorophyll content of leaf either on area basis or on fresh weight basis among these plants. Though the dry matter production depends on chlorophyll content, such a relationship was not observed, because, the net productivity is an integration of many physiological, biochemical, genetical and morphological traits of plant. Similarly a definite relationship was not observed between SLW and stomatal resistance. However, the plants which possessed high SLW such *F. australasica* and *E. alba* have recorded low stomatal resistance.

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