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CUTICULAR DIFFERENTIATION IN *KALANCHOE FEDTSCHENKOI* HAMET & PERRIER AND *KALANCHOE DAIGREMONTIANA* HAMET & PERRIER (CRASSULACEAE)

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ABSTRACT

Two species of *Kalanchoe* (Crassulaceae) were investigated for their leaf cuticular dynamics to determine the usefulness of leaf cuticular features for taxonomic purposes in the genus. Stomatal frequency values on both the adaxial and abaxial surfaces, length of the largest stoma on the abaxial surface, length of the smallest stoma on the adaxial surface, epidermal wall undulations on both the adaxial and abaxial surfaces, and the frequency of undeveloped stomata on the abaxial surface were found to be reliable taxonomic traits in the two taxa. Subsidiary cell complex was found to be reliable at the generic level.

INTRODUCTION

Kalanchoe fedtschenkoi Hamet & Perrier and *Kalanchoe Daigremontiana* Hamet & Perrier are two of the several clonal herbaceous species of *Kalanchoe* cultivated as ornamentals by fanciers of succulent plants. Previous studies (Stebbins and Khush, 1961; Dunn, Sharma, and Campbell, 1965; Stace, 1966) indicate the significance of cuticular studies in taxonomic and ecological interpretations. Sinclair and Sharma (1971) stress the significance of cuticular features in phylogenetic and paleobotanical studies of plant taxa. Recently, Sharma (1983) used leaf cuticular dynamics in the taxonomy of *Lamium*. The criteria for the demarcation of taxa in Crassulaceae are few and weak (Lawrence, 1964) and hence the present investigation was initiated to use leaf cuticular features in the two species of *Kalanchoe* for taxonomic purposes.

MATERIALS AND METHODS

Kalanchoe fedtschenkoi and *Kalanchoe Daigremontiana* had been growing in a uniform greenhouse environment at The University of Tennessee at Martin since 1969. Five mature leaves from the lower portions of five plants were collected for each species in autumn to ensure maximum maturity of the samples. These leaves were washed with distilled water and a mild detergent and then dried. Duco cement was applied to the leaf surfaces to prepare epidermal imprints of the adaxial and abaxial leaf surfaces as explained by Williams (1973). A small section from the central portion of each imprint sample was selected to make slides for observing leaf cuticular dynamics of the two taxa. Stomatal frequency of the developed and undeveloped stomata, stomatal size, epidermal cell frequency, epidermal wall undulations, and subsidiary cell complex were studied from these slides by selecting at random 20 fields from each microscope slide and viewed with a microscope equipped with a 20x objective and 10x oculars. Data on cuticular dynamics were analyzed. Photomicrographs of the cuticular complex were also taken.

RESULTS AND DISCUSSION

Statistical analysis of the data (Table 1) shows that stomatal frequency of the developed stomata was higher in *K. fedtschenkoi* than in *K. Daigremontiana* for both the adaxial and abaxial leaf surfaces. However, the reverse was true for the frequency of the undeveloped stomata, i.e., higher values were found in *K. Daigremontiana*. There was a significant difference in the size of the largest stoma on the abaxial surfaces of the two taxa. *K. Daigremontiana* had higher values (81.4 μm) while the values were lower (72.7 μm) in *K. fedtschenkoi*. There seemed to exist no significant difference in the size of the largest stomata on the adaxial surfaces of the two taxa. The size of the smallest stoma also was larger (60.7 μm) in *K. Daigremontiana* compared to the size (53.0 μm) found in *K. fedtschenkoi* . However, this was found on the adaxial side while the abaxial surface had no significant difference. Epidermal cell frequency on the adaxial surface was found to be higher (15.0) in *K. Daigremontiana* than in *K. fedtschenkoi,* while the values on the abaxial surfaces of the two species were about the same. There were more epidermal wall undulations in *K. fedtschenkoi* than in *K. Daigremontiana* for both the abaxial and adaxial leaf surfaces. Trichomes were absent in both the species. Subsidiary cell complex remained the same in both the taxa. One of the subsidiary cells was considerably smaller than the other two and was aligned along the long axis of one of the guard cells. The other two subsidiary cells were larger and of two different sizes.

Table 1. Statistical analysis of the cuticular features* of *Kalanchoe fedtschenkoi* and *Kalanchoe Diagremontiana.*

Trait	*K. fedtschenkoi*		*K. Daigremontiana*	
	U	L	U	L
Stomatal frequency ($x \pm \sigma$)** (developed stomata)	8.2 ± 1.2	10.6 ± 1.9	6.4 ± 1.1	7.6 ± 0.8
Stomatal frequency ($x \pm \sigma$)** (undeveloped stomata)	0.2 ± 0.1	0.5 ± 0.3	0.7 ± 0.2	2.3 ± 1.1
Largest stoma (μm)	78.2 ± 12.1	72.7 ± 5.9	79.7 ± 7.2	81.4 ± 11.3
Smallest stoma (μm)	53.0 ± 8.2	57.1 ± 3.4	60.7 ± 6.5	52.6 ± 6.1
Epidermal cell frequency	11.2 ± 2.3	15.0 ± 2.1	15.0 ± 2.1	15.3 ± 1.5
Epidermal wall undulations (number)	8.2 ± 2.2	8.7 ± 2.4	3.6 ± 2.0	2.8 ± 1.6
Subsidiary cell complex (cells)	3	3	3	3

* The values represent means of 20 measurements ± standard deviation.

** Mean stomatal frequency = stomata of the leaf surface observed through a 20x objective and 10x oculars (field area = 0.581 mm^2).

U = upper surface, L = lower surface

It can be seen from the above data that some features of the cuticular complex of these two species of *Kalanchoe* can be used for taxonomic purposes. Frequency of developed stomata was higher in *K. fedtschenkoi* than in *K. Daigremontiana* for both the adaxial and abaxial leaf surfaces. Frequency of the undeveloped stomata is higher on the abaxial leaf surface of *K. Daigremontiana* than in *K. fedtschenkoi.* Length of the largest stoma on the abaxial leaf surface is greater in *K. Daigremontiana* than in *K. fedtschenkoi,* while the length of the smallest stoma on the adaxial leaf surface was greater in *K. Daigremontiana.* Epidermal cell frequency on the adaxial side was higher in *K. Daigremontiana* than in *K. fedtschenkoi.* There were more epidermal wall undulations on both the abaxial and adaxial leaf surfaces of *K. fedtschenkoi.* Subsidiary cell complex consisting of usually three cells seems to be a reliable trait for *Kalanchoe* at generic level, but is of little use for species differentiation. Additional studies on other taxa of Crassulaceae are underway to determine the usefulness of cuticular dynamics for taxonomic purposes.

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WORKS CITED

Dunn, D.B., Sharma, G.K. and Campbell, C., 1965. Stomatal patterns of dicotyledons and monocotyledons. American Midland Naturalist 74, 185–195.

Lawrence, G.H., 1964. Taxonomy of vascular plants, 823 pp. The Macmillan Co., New York.

Sharma, G.K., 1983. Cuticular differentiation in *Lamium amplexicaule* L. and *Lamium purpureum* L. Journal Tennessee Academy of Science 58, 43–45.

Sinclair, C.B. and Sharma, G.K. 1971. Epidermal and cuticular studies of leaves. Journal Tennessee Academy of Science 46, 2–11.

Stace, C.A., 1966. The use of epidermal characters in phylogenetic considerations. New Phytologist 65, 304–318.

Stebbins, G.L. and Khush, G.S., 1961. Variation in the organization of the stomatal complex in the leaf epidermis of monocotyledons and its bearing on their phylogeny. American Journal of Botany 48, 51–60.

Williams, J.A., 1973. A considerably improved method for preparing plastic epidermal imprints. Botanical Gazette 134, 87–91.