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Research Article

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A Comparative Anatomical Study for the species of the genus *Carex* L. (Cyperaceae) in Iraq

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Abstract This study examines the taxonomic significance of leaves epidermis for the some *Carex* L. species in Iraq , comprising diagnostic anatomical feature obtained from abaxial leaf epidermis micro morphology , the results of observations show that the characters studied (long cell length in stomatal & non stomatal Length , Stomata Length & Number) are different between taxa under study . Euclidean genetic distance values & Cluster analysis of species are investigated in this study.

Keywords *Carex* L. Anatomy, Abaxial epidermis

Introduction

Anatomy data are tightly correlated with traditional taxonomy and have been recognized since the variations with in species, genera or a family is usually reflected in traditional features. So, the anatomical parameters may provide valuable role and character states in assessing homology and elucidating phylogenetic relationships among plants [1]. Moreover, the evolution of anatomical characters is of great interest, as many of these features are of significant adaptive value and have been among the major selective pressures in plant evolution [2].

Cyperaceae contain 5010 species throughout the world that distributed on 104 genera [3]. In Iraq contain 69 species distributed on 17 genera [4]. In Turkey, [5] indicated 86 species of the genus *Carex*. In Iran, [6] pointed to that 85 species of the genus *Carex* present. [7] mentioned 3 species of the genus *Carex* in the low lands of Iraq. In Iraq, [4] indicated 23 species of the genus, while [8] and [9] mentioned 19 species of the genus *Carex*. [10] indicated 1 species of the genus which is *C. stenophylla* Wuhl. in Sinjar mountain and [11] pointed to 4 species of the genus which are *C. diluta* M. Bieb, *C. divisa* Huds., *C. pachystylis* J. Gay. and *C. polyphylla* Kar. et Kir. in Piramagrun mountain, while [12] did not state the plants of the family Cyperaceae in Peramagroon mountain. [13] mentioned 13 species of the genus *Carex*, also he stated that the species *C. stenophylla* is possibly used as fodder grass and it is reported to be a good pasture plant in Iraq and perhaps most of the species of Iraq are grazed by animals.

The present study aimed to conduct a comparative anatomical study for the species of the genus *Carex* in Iraq.

Material and Methods

Seven of Herberium Iraqi Species namely *C. otrubae, C. aequivoca , C. pachystylis , C. distans , C. orbicularis , C. diluta* and *C. elata* were studied anatomically .

Epidermal preparation were made by Scraping pieces of softened leaves (boiled in water for 3-5 minutes and washed with distilled water, stained with safranin, mounted in 1:1 glycerol and safranin. The anatomy character were observed and recorded photographically with a light microscope.

Results

The lower epidermis of the plant leaves was characterized by many variations in the characteristics of their cells. The long cells varied in size between stomatal and nonstomatal rows although some overlapping was found between species.

The stomas is not less important than the long cells, where the study dealt with the length and number of stoma for the species in this study.

The length of cells in the stomatal rows was (60.0) µm in *C. diluta* while largest length (237.5) µm in *C. pachystylis* in non stomatal rows of cells the length (27.5) µm was the smallest and overlapping between the *C. orbicularis* & *C. elata* and the largest length in *C. diluta* (182.5) µm. Table (1) Figure (1).

The smallest length of stoma (22.5) µm overlapped in *C. diluta* & *C. elata* while the largest length was in *C. aequivoca* (40.0) µm.

The smallest number of stoma (9.0) in *C.diluta* and the largest number (42.0) overlapped between *C. pachystylis* & *C. elata*, Table (1) Figure (1).

Table 1: Quantitative Characters of the Abaxial Leaves Epidermis

Species	Long cells Length in stomatal Rows	Long cells Length in non stomatal rows	Stomatal Length	No. of Stomata in Microscopic Field
C. otrubae	(75.0- 115.0)	(95.0-125.0)	(25.0- 37.5)	(6.0-11.0)
	93.75	100	32.25	8.8
C. aequivoca	(150- 225)	(30.0-55.0)	(25.0 – 40.0)	(14.0-32.0)
	150.0	41.5	33.0	20.9
C. pachystylis	(87.5-237.5)	(35.0-52.5)	(25.0-32.5)	(30.0-42.0)
	165.0	43.75	28.75	36.1
C. distans	(72.5-162.5)	(37.5-65.0)	(25.0-30.0)	(25.0-40.0)
	116.0	51.5	28.0	34.9
C. orbicularis	(65.0-200.0)	(27.5-62.5)	(25.0-32.5)	(30.0-37.0)
	142.85	43.0	28.75	33.6
C. diluta	(60.0-145.0)	(67.5-182.5)	(22.5-27.5)	(9.0-20.0)
	110.0	103.75	22.75	16.0
C. elata	(75.0-147.5)	(27.5-95.0)	(22.5-32.5)	(26.0-42.0)
	109.5	62.5	28.0	34.9

Values of genetic distance depends on anatomical characters

The results of our study show the genetic distance between species under study, table (2). The largest value (94.859) between *C. pachystylis* & *C. otrubae* while the smallest value between *C. elata* & *C. distans* (12.777) which is considered small genetic distance this is shown in table (2).

Table 2: Euclidean genetic distance by using anatomical characters

Species	*C. otrubae*	*C. aequivoca*	*C. pachystylis*	*C. distans*	*C. orbicularis*	*C. diluta*	*C. elata*
C. otrubae	0						
C. aequivoca	82.057	0					
C. pachystylis	**94.859**	21.89	0				
C. distans	59.553	38.432	49.629	0			
C. orbicularis	79.229	15.302	22.403	28.108	0		
C. diluta	20.499	74.861	84.054	56.132	71.476	0	
C. elata	48.514	47.982	58.599	**12.777**	38.575	45.679	0

The Cladogram Tree between species under study

As shown in figure (2) which explain cluster analysis was carried out using seven species from genus *carex* by studying genetic distance between them .depend is on anatomical character that are overlapped between them with a (45) Euclidean genetic distance .

The results of phylogenetic relationships appeared in topology order of anatomical trees designed based on UPGMA analysis for a bootstrap there is a (100%) bootstrap percentage. The tree involved seven species, five species were grouped into one main clade which subdivided into two secondary clade , the first one there is a

genetic distance of (12) gathered *C. distans*, *C. elata* which consider sister clade to the second clade gathering *C. pachystylis*, *C. aequivoca* and *C. orbicularis* clade with (22) genetic distance .
The Second main clade shows a genetic distance of (20) gathered *C. diluta* and *C. otrubae*, Figure (2).
The segregation of *C. distans*, *C. elata*, *C. pachystylis*, *C. aequivoca* & *C. orbicularis* in one main clade from *C. diluta* & *C. otrubae* indicated the anatomical similarity between these species with the second clade, finally all species are descendant from one common ancestor.

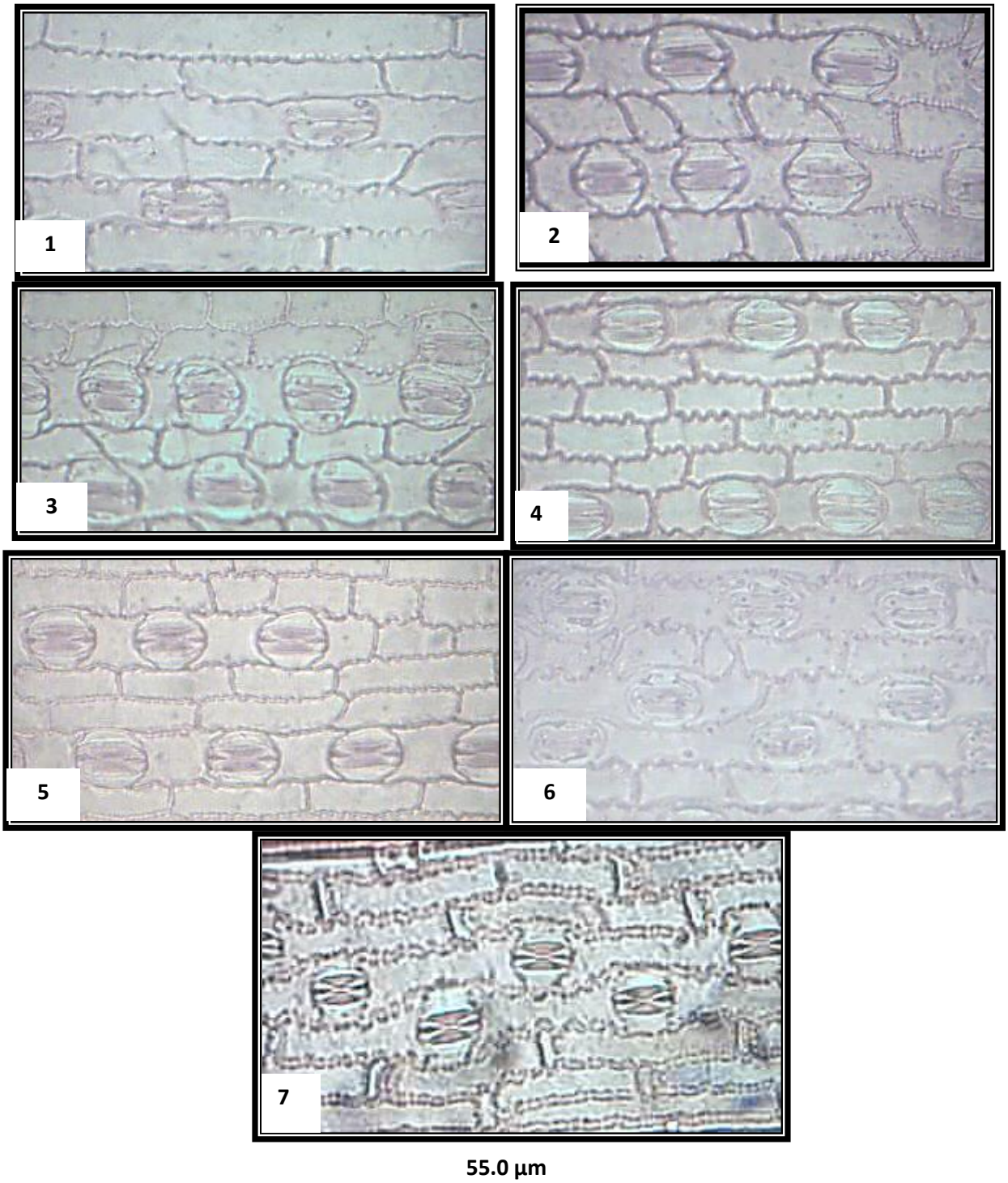

Figure 1: Abaxial Leaves Epidermis 1: C.otrubae 2: C.aequivoca 3: C.pachystylis 4: C.distans 5: C.orbicularis 6: C.diluta 7: C.elata

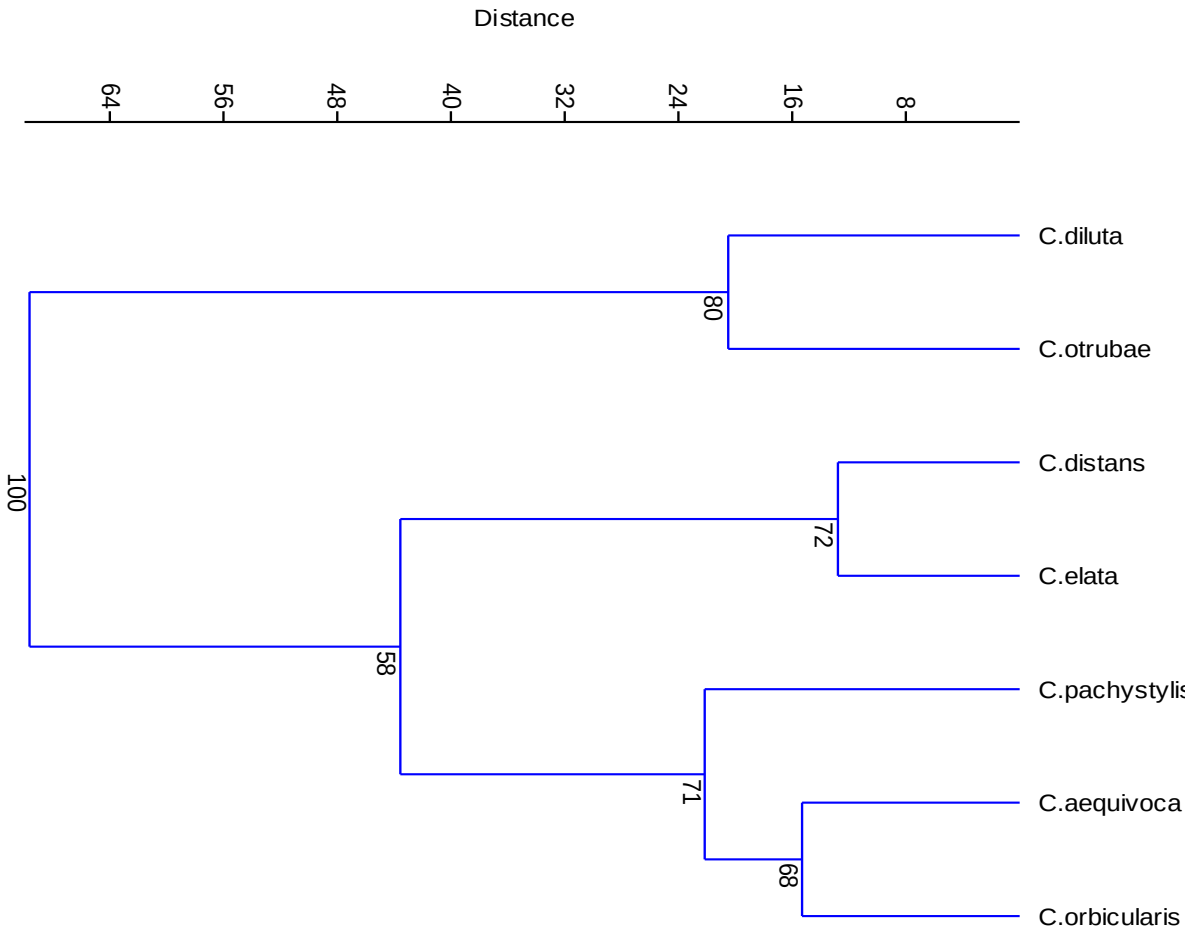

Figure 2: Cladogram Tree according to UPGMA methods depending on anatomical characters. The values on the clads represent (Bootstraping) the cluster strength scale

Principal Component Analysis (PCA)

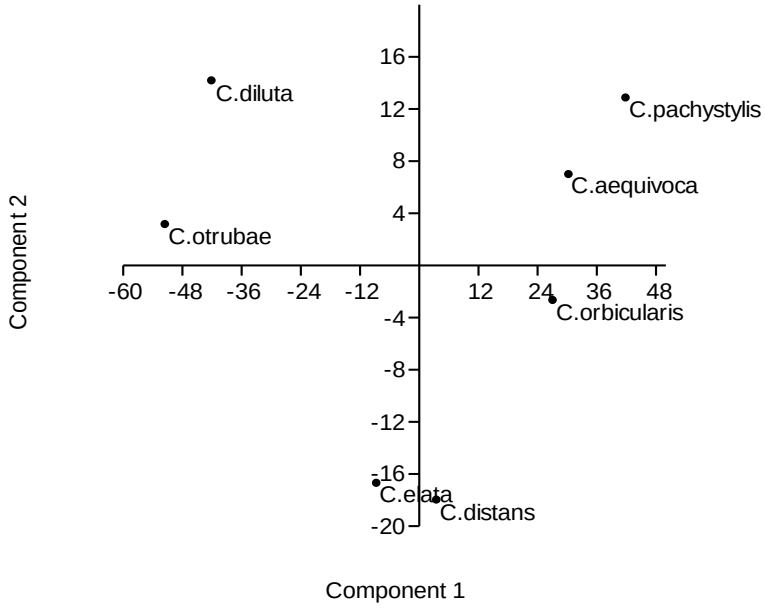

Figure 3: The distribution of Carex species in Iraq at the perpendicular level according to analysis (PCA) depending on the results of anatomical character

Figure (3) shows the distribution of Iraqi species on central perpendicular levels, which represent the highest levels of genetics variation among the studied species.

It is clear from this distribution show in figure (3) which is based on the anatomical character, the species that compose genetic cladogram relatives to each other are show by regression of *C. diluta* and *C. otrubae* and their isolation alone in one clade from the remaining species alone in a separate group.

Discussion

The plant Leaves is one of the important and useful parts of the plant in solving many problems in taxonomy because it has wide variations and shapes that are not found in any other vegetative organ and at the same level. Therefore, anatomical characters are often used for being more stable as well as for the use of evolutionary relationships and genetic variations between taxonomic unit.

In this study, the anatomy of Leaves of 7 species of the genus *Carex* were comparatively examined with light microscope.

The results of anatomical observation and analysis these results in Past program suggested that leaves anatomical data could have considerable taxonomic value or significance for separating the species in the genus *Carex* in the long cell length in stomatal & non stomatal rows , stomata length & number , Tables 1 shows that in many characters useful in identifying this group of plants .

The leaf blades study by light microscope indicated that the anatomical characters of leaf blades were of highly significant value in *Carex* systematic similar finding were concluded by [14-16].

Phylogenetic analysis is one of the most important indicators in grass systematic used by Taxonomist to illustrate evolutionary relationships between taxa. Recently, there has been a significant increase in research focusing on evolutionary relationships in the grasses and other families. [17-19] used many evidences (Chemical, anatomical, Morphological, molecular) for construction cladogram trees and they concluded that those data were accurate and reliable in the separation between taxonomic units and the results of current study have same indication.

Our findings, Provided a framework in the anatomy of Cyperaceae family, in general we consider that the features and programs past as an effective diagnostic tools in determining the genetic distance and Phylogenetic relationship between species under study.

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