A Comparative Anatomical Study of Some Species of Cypraceae Family in Iraq

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Abstract
In present study , some anatomical characters of species belonging to the cypraceae family were studied, namely(Bolboschoenus maritimus ، Carex distans، Carex aequivoca ، Carex otrubae، Carex stenophylla، Carex pseudofoetida ، Fimbristylis ferruginea ، Fimbristylis dichotoma، Eleocharis atropurpurea، Eleocharis palustris، Eleocharis uniglumis، Schoenoplectus litoralis) And the anatomical comparison of the species, where the results showed the studied anatomical characteristics of the species such as (stomatal length, stomatal diameter, number of stomata in a single microscopic field, length of long cells in stomatal rows, width, length of long cells in non-stomatal rows, width, number of long cells in the field in Single microscopy) of taxonomic significance at the species level.
Keywords: Cypraceae, Abaxial Epidermis, stomata, anatomical traits.

1. Introduction

Cypraceae family is one of the large plant families belonging to monocots, as it is spread in most parts of the world and ranks third after the Poaceae and Orchidaceae families. [1, 2]. Whereas [3] mentioned that the Cypraceae family includes (5010) species spread all over the world divided into (104) genus, and [4] mentioned that the family numbered about (106) and (400) species, while [5] mentioned that the number of family types in Iraq reached about (69) species divided into (17) genus. Cypraceae are annual or perennials by means of rhizomes. The stems are circular or triangular, and the leaves are few, linear with parallel venation, some at the base of the stem and others at the top of the stem or below the flowering branches [6]. The species lengths range from 5 cm - 5 m [7]. The anatomical study has influenced, decades ago and until this day, the classification and isolation of plant families, and anatomical evidence has been used in the taxonomic process, no less important than the phenotypic characteristics, being more stable and not affected by the changing environmental conditions that were used for the purpose of identification and diagnosing the species [8]. so the current research has dealt with a study of some anatomical characters to some types of the family Cyperaceae in Iraq with the aim of helping to classify these species.

2. Material and Methods

The current study was conducted on fresh samples collected directly from the field and other dry samples deposited in the national herbarium in Abu Ghraib. The samples were diagnosed based on [9, 10] The leaf samples were preserved in 70% alcohol for later use.

Preparing the epidermis of the leaves

The epidermis was prepared from the fresh leaves of the collected plants and from dry samples. As for the fresh leaves, they were used directly in the preparation. As for the leaves of the dry samples, they were placed in hot water for (15) minutes for the purpose of softening the leaves. The middle part of the leaves was used in the study. The preparation of the epidermis was followed by [11]. With some of a change (change in the time the samples boiled and the change in pigmentation when you mixed the pigment of safranin with glycerin).The leaf was cut (the middle part) lengthwise into two halves from the main vein area and cut lengthwise into two halves, and then cleaned one of the two halves of the tissues that are under the epidermis after turning the epidermis to the bottom and the scraping and removal of that tissue is done, and one of the halves of the leaf is placed on a glass slide under an Dissecting Microscope, The upper epidermis and the middle tissue layer (mesophyll) were removed by a sharp blade using the scrape method, and then the prepared leaf was transferred by forceps to hot water for the purpose of cleaning it from the remnants of the intermediate tissue and then it was dyed with Safranin dye by placing a drop of the dye on it after that it was washed well from the excess dye, and then turned it over and placed on a clean slide and put a drop of glycerin or lactic acid on it, then covered it with the cover slide, where it became ready for examination, after which the slides were kept in a slides container and put in the refrigerator at a temperature of 4 ° C until studying . Note: (C. refers to the genus Carex, F. refers to the genus Fimbristylis, E. refers to genus Eleocharis, S. refers to genus Schoenoplectus).

3. Result and Discussion

Stomata

Stomatal diameter was large in E. palustris species, the stomatal diameters ranged between (72.5 - 85) m and a rate of (78) µm. then the species B. maritimus,

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whose stomatal diameters ranged between (35-47.5) m and a rate of (40) m. Although it overlaps with the rest of the species, the average stomatal diameter is greater than the rest of the species, . In two species C.otrubae. and S. litoralis, were identical in the average and differed in the lower and upper limits, as the stomatal diameters ranged between (32.5 - 42.5) µm, (35 - 40) µm, respectively, and a rate of (37.5) µm. Despite their overlap with the rest of the species in the countries, it is possible to depend at the rate that was greater than the remaining species and less than the previous two species, and this trait can be relied upon to distinguish and isolate it from the rest of the species, In the species F. dichotoma, stomatal diameters ranged between (30 - 42.5) m, at a rate of (37) µm, In the C. distans, stomatal diameters ranged between (25 - 35) µm and also rate (30) m, then the species C. pseudofoetida stomatal diameters ranged between (32.5 - 27.5) µm and a rate also (29.5) m. These three species have overlapped in the lower and upper limits of the diagonals, and this indicates the close relationship between them, but in general they have fewer diameters than the previous species and at a greater rate than the rest of the species that will be mentioned, As for the species C. aequivoca, F.ferruginea and E. atropurpurea, which matched the average and the upper and lower limits, as the stomatal diameters ranged between (25 - 30) µm and a rate of (27.5) m, and in the species C. stenophylla (22.5 - 27.5) µm with a rate of (25) µm. It is worth noting that the studied species recorded the stomatal diameters for the first time, and the current study did not find any prior study dealing with this trait for these species, except for [12] study on the genus Fimbristylis which dealt with a study of size Stomata (length x width) and confirm their importance as a taxonomic trait. From the above, it is possible to divide the species into three groups depending on the average stomatal diameter, as the stomatal diameter rates were (78) m and included the type E. palustris. The second group had rates ranging between (37- 40) m and included the species (B. maritimus, C. otrubae, S. litoralis and F. dichotoma) and the third group, with rates ranging between (25-30) m, included the rest of the species (C. distans, C. pseudofoetida, C. aequivoca, F.ferruginea, E. atropurpurea and C. stenophylla). Table (1) figure (1).

Among the other quantitative characteristics that studied the characteristic of stomatal length (which includes the upper subsidiary cell through the guard cell and the lower subsidiary cell) and also the variation of the species among them in the lengths of the stomata and this trait was useful in isolating some species and overlapping others, and the stomatal lengths were recorded in the species E. palustris where its lengths ranged between (32.5 - 45) µm and a rate of (38.7) µm. Although the lengths overlap with other species, the rate can be adopted to distinguish between species. It is smaller than the previous species, but its rate is greater than in other species, followed by the two species S. litoralis, B. maritimus. The two overlapped and matched in the average for the length of the stomata, so the stoma length ranged between (27.5 - 37.5) µm, (30 - 32.5) µm respectively, with a rate of (30) µm. In F. dichotoma it ranged between (22.5 - 35) µm with a rate of (28.75) µm, then in species C. otrubae the length ranged between (25 - 32.5) µm, while in the species F. ferruginea and E. atropurpurea they were identical in average and overlapped in the lower and upper limits, as the length ranged between (15-30) µm and (30-25) µm, respectively, and (27.5) µm, followed by C.aequivoca, stomatal length between (25-22.5) µm and with a mean (23.5) µm, In C.distans the length between (25-20) µm with a rate of (22.5) µm, while the species C. pseudofoetida, which recorded the lowest species in stomatal length, ranged between (22.5-17.5) µm and a rate of (20) µm , [12,13,14,15] emphasized the importance of stomatal length as a taxonomic characteristic . The species can be divided into two groups based on the characteristic of the rates of stomatal lengths, the first group ranged between (38.75-31) µm including the species (E. palustris, C. stenophylla, S.litoralis, B.maritimus) and the second group was at rates ranging between (20-28.75) µm. The rest of the species included (F. dichotoma, C. otrubae, F. ferruginea, E. atropurpurea, C. aequivoca, C. distans, C. pseudofoetida). Table (1) figure (1).

Table (1) The abaxial epidermis of leaves in some species of Cypraceae

Quantitative triatsSpecies	The diameter of the stomata(40x) µm	The length of the stomata(40x) µm	number of stomata in a single microscopic field	number of long cells in a single microscopic field
Bolboschoenus maritimus	35(40) 47.5	27.5(31) 37.5	30(32)34	199(209)223
Carex distans	25(30) 35	20(22.5) 25	36(38)40	140(163)173
Carex aequivoca	25(27.5) 30	22.5(23.75) 25	39(41)42	219(225)230
Carex otrubae	32.5(37.5) 42.5	25(28.3) 32.5	22(24)26	124(129)135
Carex stenophylla	22.5(25) 27.5	30(32.5) 35	39(43)47	188(200)220
Carex pseudofoetida	27.5(29.5) 32.5	17.5(20) 22.5	40(45)50	215(222)230
Fimbristylis ferruginea	25(27.5) 30	15(17.5) 20	22(29)35	163(170)189
Fimbristylis dichotoma	30(37) 42.5	22.5(28.75) 35	32(33)35	122(137)140
Eleocharis atropurpurea	25(27.5) 30	25(27.5) 30	37(39)40	198(216)224
Eleocharis palustris	72.5(78) 85	32.5(38.75) 45	8(9)10	84(90)95
Eleocharis uniglumis	52.5(56.25) 60	25(30) 35	2(3)4	30(34)39
Schoenoplectus litoralis	35(37.5) 40	30(31) 32.5	24(27)30	155(173)193

* Numbers outside the parentheses represent the upper and lower bounds, and the numbers in the parentheses represent the average.

the number of stomata in a single microscopic field (40X), was studied which is an important characteristic used in distinguishing and separating species from others. The highest number of stomata was recorded in the species C. pseudofoetida as the number of stomata between (40 - 50) stomata and a rate of (45) stomata, then the species C. stenophylla In which the number of stomata between (39 - 47) stomata, with a rate of (44) stomata, and the rate is less than the previous species, but it is more than in the rest of the species, It is followed by species C. aequivoca. The number between (39 - 42), with a rate of (41 stomata). In the species E. atropurpurea, in which the number of stomata ranged between (37-40) stomata, with a rate of (39) stomata, which is also lower than the previous species and greater than in the rest of the species that followed, in the species C. distans the ranged between (36 - 40) stomata, and in the species F. ferruginea, the numbers between (22-35) stomata and (29) stomata, and S. litoralis. The number of stomata ranged between (24-30) stomata with a rate of (27) stomata, in the species C. otrubae the number of stomata ranged between (26-22) stomata with a rate of (24) stomata, and the lowest number of stomata was recorded in the species E. palustris which distinguished for other species, It ranged between (8-10) stomata, with a rate of (9) stomata. [13,14] were mentioned in an anatomical study of some types of the Cyperaceae species and emphasized the importance of this trait in isolating the species. Depending on the characteristic of the number of stomata in the microscopic field, it was possible to take advantage of this characteristic by dividing the species into three groups, The first group had the numbers ranging from (38-45 stomata) and included the species (C. aequivoca, C.stenophylla, C. pseudofoetida), while the second group the number of stomata ranged between (24-33) stomata and included the species (C. otrubae, C. distans, F. Ferruginea, F. dichotoma, B. maritimus, S. litoralis), while the third group had an average number of stomata (9) Stomata which represented species E. palustris. Table (1) figure (1).

Long cells

A length of long cells were studied for species, including the characteristic of long cell in stomatal rows and in non- stomatal rows, as F. ferruginea recorded the highest longitudinal dimensions of cells in stomatal rows ranged between (177.5-85) µm with a rate of (122.9) µm, As for E. palustris, which overlapped with the previous species, the cell lengths ranged between (75 - 142.5) µm and a rate of (103.75) µm. Although they overlap, the rate can be used to distinguish between them. [13] showed in an anatomical study of some species of the Carex genus the importance of the longitudinal dimensions of cells in isolating and distinguishing the species, and from the above it is possible to take advantage of the characteristic of the length of cells in the stomatal rows by dividing the species into three groups depending on the rates, the first group was with rates (103.7-122.9) µm and included the two species (F. ferruginea and E. palustris.). The second group had rates ranging from (70.8-84.5) µm and included the species (S. litoralis, F. dichotoma, B. maritimus, E. atropurpurea and C. otrubae), The third group was with

rates ranging from (43.1-50) µm and included the species (C. aequivoca, C. stenophylla, C. pseudofoetida, and C. distans). Table (2) figure (1).

As for the width of the long cells in the stomatal rows, the species E. palustris was distinguished from the rest of the studied species, as it recorded the highest rate, as its width ranged between (30 - 50) µm and a rate of (41.6) µm, while the species C. otrubae were less it ranged between (20 - 30) µm with a rate of (24.6) µm, the rest species were overlapped . The species can be divided into three. Groups due to overlap and depending on the rates, so the first group was at a rate of (41.6) µm and was represented by the species E. palustris the second group had rates ranged between (24.6-18.3) µm and included (F. dichotoma, C. aequivoca, C. stenophylla, C. otrubae, S. litoralis, B. maritimus, E. atropurpurea and C. distans). And the third group was with rates (15-20) µm and included the two species (C.pseudofoetida. and F. ferruginea). Table (2) figure (1).

Table (2) Quantitative characteristics of the abaxial epidermis of leaves of species from the cypraceae family

Quantitative triatsSpecies	Length of cells in stomatal rows(40x) µm	width of cells in stomatal rows(40x) µm	Length of cells in non-stomatal rows(40x) µm	width of cells in non-stomatal rows(40x) µm
Bolboschoenus maritimus	55(71) 87.5	20(23.75) 27.5	30(37.5)45	10(15)20
Carex distans	32.5(48.5) 67.5	16.5(21) 25	25(32)40	10(13.7)17.5
Carex aequivoca	37.5(46.8) 52.5	18(20) 23.5	30(36.8)45	35(41.25)50
Carex otrubae	62.5(84.5) 97.5	20(27.1) 37.5	30(37.75)47.5	10(12.5)15
Carex stenophylla	37.5(43.12) 47.5	17.5(20) 22.5	32.5(36.8)42.5	12.5(15.8)20
Carex pseudofoetida	45(50) 55	12.5(15) 17.5	35(37.5)40	10(11.25)12.5
Fimbristylis ferruginea	85(122.9) 177.5	7.5(11.25) 15	72.5(91.2)112.5	7.5(8.7)10
Fimbristylis dichotoma	65(77.1) 97.5	15(21) 27.5	32.5(46.5)62.5	12.5(15)17.5
Eleocharis atropurpurea	55(71) 87.5	15(18.3) 22.5	32.5(40)52.5	10(11.25)13.5
Eleocharis palustris	75(103.75) 142.5	30(41.6) 50	50(62)72.5	10(13.7)17.5
Eleocharis uniglumis	62.5(76.66) 92.5	22.5(25) 27.5	127.5(138.5)140	50(59.3)65
Schoenoplectus litoralis	67.5(78.75) 90	15(19.2) 25	50(61.2)75	10(12.5)15

So, the length of cells in the non-stomatal rows was studied, as the species E. uniglumis was distinguished from the rest of the species, which recorded the highest longitudinal dimensions of cells in the non-stomatal rows ranging from (127.5-140) µm with a rate of (138.5) µm, followed by the species F. ferruginea, which distinguished. Also, for the rest of the species, the lengths of the cells ranged between (72.5 - 112.5) µm, but the rate was lower than the previous species, which reached (91.25) µm, the rest species were overlapped. [13,14] emphasized the importance of this trait as taxonomical trait .It is possible to take advantage of the rates to divide the species into four groups, the first was at a rate of (138.5) µm and included the species E. uniglumis and the second group was at a rate (91.25) µm and included the species F. ferruginea, and the third group rates ranged between (40-62) µm and included the species(S. litoralis, E. palustris., E. atropurpurea and F. dichotoma). As for the fourth group, their rates ranged between (32-38.75) µm and included the species (C. aequivoca, C. stenophylla, C. otrubae, C. pseudofoetida., B. maritimus, and C. distans). Table (2) figure (1).

As for the width of the long cells in the non-stomatal rows, some of the studied species were distinguished and others overlapped, in the type E. uniglumis the largest transverse dimensions of the cells were found in the epidermis of its lower leaves, which was distinguished from the rest of the species, it ranged between (50 - 65) µm and a rate of (59.37) µm, followed by the species C. aequivoca, in which the dimensions were less than in the previous species, but it was also distinguished from the rest of the species, as it ranged between (35 - 50) µm and a rate of (41.25) µm, and in the species C. stenophylla, the lengths ranged between (12.5 - 20.) µm, with a lesser rate of (15.8) µm, the rest species were overlapped .No previous studies are available on this trait, and the species can be divided into four groups depending on the rates. The first group was at a rate of (59.37) µm and was represented by the species E. uniglumis and the second group was at a rate of (41.25) µm and included the species C. aequivoca and the third group was at rates of (11.25) -15.8) µm and included (C. stenophylla, C.otrubae, C. pseudofoetida., B. maritimus, and C. distans, S. litoralis, E. palustris., E. atropurpurea and F. dichotoma). And the fourth group was (8.75) µm and included the species F. ferruginea. Table (2) figure (1).

As for the width of the long cells in the non-stomatal rows, some of the studied species were distinguished and others overlapped, in the type *E. uniglumis* the largest transverse dimensions of the cells were found in the epidermis of its lower leaves, which was distinguished from the rest of the species, it ranged between (50 - 65) µm and a rate of (59.37) µm, followed by the species *C. aequivoca*, in which the dimensions were less than in the previous species, but it was also distinguished from the rest of the species, as it ranged between (35 - 50) µm and a rate of (41.25) µm, and in the species *C. stenophylla*, the lengths ranged between (12.5 - 20.) µm, with a lesser rate of (15.8) µm, the rest species were overlapped .No previous studies are available on this trait, and the species can be divided into four groups depending on the rates. The first group was at a rate of (59.37) µm and was represented by the species *E. uniglumis* and the second group was at a rate of (41.25) µm and included the species *C. aequivoca* and the third group was at rates of (11.25) -15.8) µm and included (C. *stenophylla, C.otrubae, C. pseudofoetida., B. maritimus, and C. distans, S. litoralis, E. palustris., E. atropurpurea and F. dichotoma*). And the fourth group was (8.75) µm and included the species *F. ferruginea*. Table (2) figure (1).

The number of long cells in the microscopic field was studied under (40X) on the lower epidermis, the largest numbers were found in the species C. aequivoca, whose numbers ranged between (230 - 219) cells and a rate of (225) cells, which is greater than what was recorded in the rest of the species. In spite of its overlap with the C. pseudofoetida, However, it can take advantage of the rate to distinguish between them, in which the numbers ranged between (230-215) cells. As for the two species B. maritimus and E. atropurpurea, they matched on average and overlapped in the upper and lower limits, as the numbers ranged between (199 - 223), (224-198) cells respectively, and a rate of (209) cells, which also overlapped with the previous species. Followed by the species C. stenophylla, where the numbers ranged between (188-220) cells and a rate of (200) cells, which also overlapped with the previous species, The two species S. litoralis and F. ferruginea were identical, on average, as they ranged between (159-193) cells and (189-163) cells, with a rate of (170) cells, and in the species C. distans the numbers ranged between (140-173) cells, which overlapped with the species .The previous species, as for the species F. dichotoma, which was distinguished that it did not interfere with the previous species, the number of cells ranged between (122-140) and the rate of (137) cells, but it overlapped with the species C. otrubae, as the numbers ranged between (124-135) cells except It is possible to rely on the rates to separate these species, either species, E .palustris. was distinguished from the rest of the species and did not interfere from the rest of the species, so this trait was useful in isolating it from the rest of the species, as the number of cells in it ranged between (84 - 95) cells and a rate of (90) cells. The same is the case in the species E. uniglumis, it was also distinguished from the rest of the species did not interfere with it, as the numbers ranged between (30-39) cells and a rate of (34) cells. No previous studies were available on this trait. Table (1), figure (1).

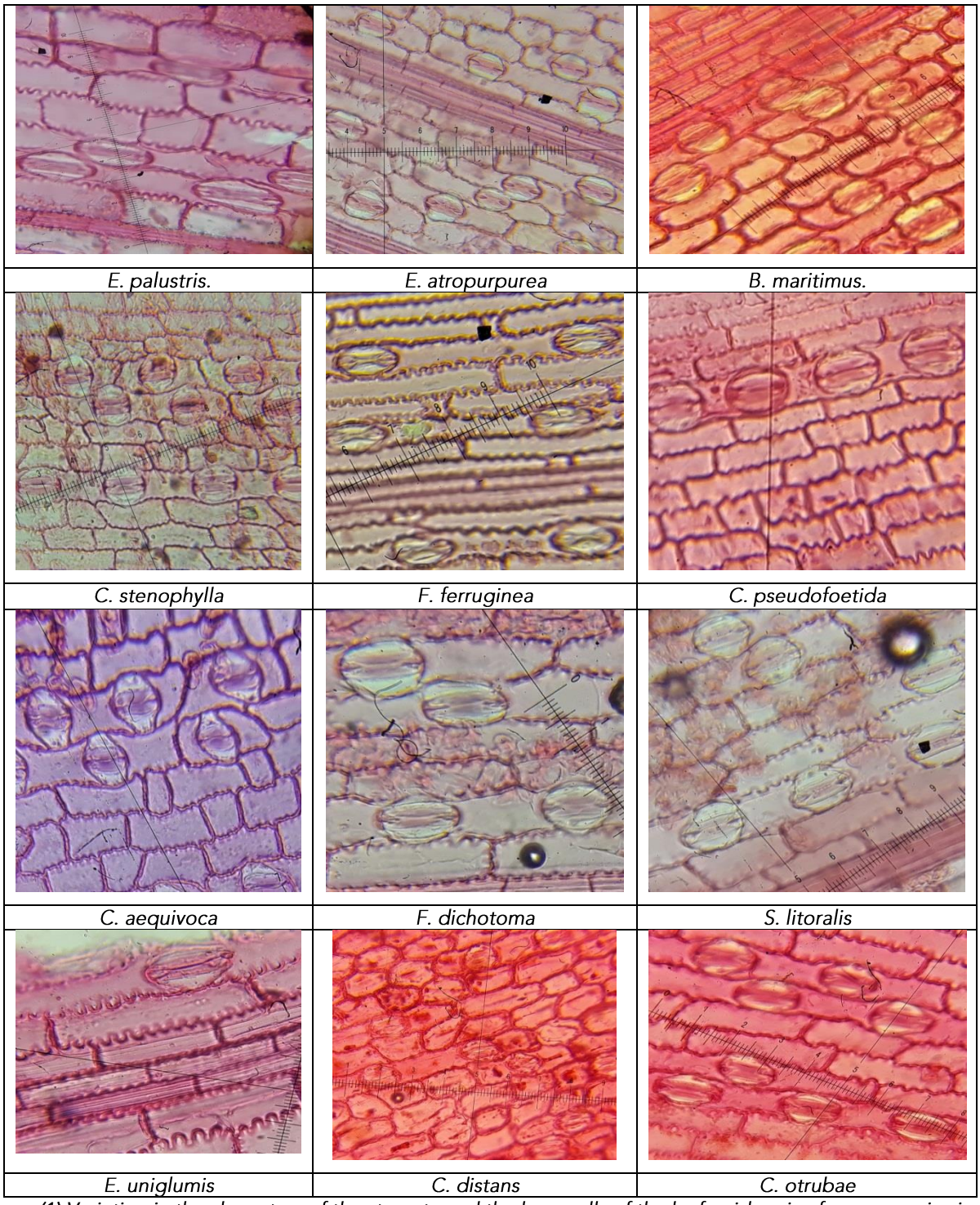

Figure (1) Variation in the characters of the stomata and the long cells of the leaf epidermis of some species in the Cypraceae. (40x)

4. Conclusions

We conclude from this research that the studied anatomical characteristics of the species under study such as (stomatal length, stomatal diameter, number of stomata in a single microscopic field, length of long cells in stomatal rows, width, length of long cells in non- stomatal rows, width, number of long cells in stomatal rows in single microscopic field) has taxonomic importance in distinguishing species and isolate them from one another.

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