J. King Saud Univ., Vol. 6, *Science* (2), pp. 181–194 (A.H. 1414/1994).

Morphological Studies within the Caryophyllaceae.

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(Received 20 February 1993; accepted for publication 9 February 1994)

Abstract. This paper reports upon a study of the macro- and micro-morphological characters of 72 Egyptian species from the family Caryophyllaceae, based mainly on herbarium specimens. From this study, it was obvious that leaf characters such as trichomes, stomata and venation have significant value in the identification of some species. Accordingly, we can conclude the following:

1) The genera *Stellaria* and *Spergula*, which have been treated as a single genus and later separated on the basis of the presence or absence of stipules, share the same morphological features.
2) The genera *Arenaria* and *Minuartia*, which have been separated by according to the number of teeth opening in the capsule, share the same morphological characters.
3) The genera *Scleranthus*, *Paronychia* and *Herniaria*, which have been treated as a separate family, Illecebraceae, have the same morphological characters as the Caryophyllaceae which does not support their separation.

Introduction

The Caryophyllaceae, which is one of the main Centrospermous families, has drawn the attention of many scientists. According to Pax and Harms [1] the family can be divided into three subfamilies: Alsinoideae, characterised by the absence of stipules and flowers with free sepals; Silenoideae, without stipules but flowers with connate sepals; Paronychioideae, characterised by the presence of stipules and flowers with either free or connate sepals. Davis and Cullen [2], Davis [3] and Hutchinson [4] separated the genera *Scleranthus, Paronchia, Herniaria* and *Corrigiola* and included them in the Illecebranceae. These flowers and the one-seeded indehescent capsule. On the other hand, Walter [5, pp. 340-344] grouped the genera *Herniaria, Paronychia* and *Polycarpon* in subfamily Paronychioideae, since they have stipulate leaves, while the genus *Scleranthus* with exstipulate leaves, was placed in the subfamily Alsinoideae. Thus, the leaf characters are used, in all the proposed classifications, as a primary diagnostic feature for the segregation of major groups in the family. The

following account aims at the study of the morphological characters of the genera of the Caryophyllaceae in Egypt.

Materials and Methods

Only the Egyptian species recorded in Täckholm [6] have been included in the present investigation. Dried herbarium specimens from Cairo (CAI) and Alexandria (ALE) University herbaria were used in the present study. Dried mature leaves were softened by immersing in lactic acid overnight, then whitened using dilute HCL, and stained with a few drops of safranin for study of stomata and epidermal cells. For electron microscopy abaxial and adaxial surfaces of the leaves were stuck on aluminum stubs and examined at 15 kv. All characters are summerised in Table 1. These characters are subjected to numerical analysis using a clustering programme "ASF4" designed and written by the Department of Applied Statistics, University of Reading, England.

Results

Plants within the Caryophyllaceae are annual or perennial herbs, undershrubs or shrubs. The stem is either erect or prostrate which varies greatly in color from the greyish white in *Gymnocarpose decandrum* and *Polycarpon prostratum;* yellow in *Cometes abyssinica, Silene succulents* and *Minuartia picta;* orange in *Minuartia geniculata* and *Paronychia arabica* to green and even brown in the other species. The stem is either glabrous, sparsely villous or hairy. The hairs are pointed or glandular, unicellular or multicellular(Fig. 1). In *Silene tridentata* and *S. pseudatocion* both unicellular and multicellular pointed hairs occur on the stem. Pointed unicellular and glandular multicellular hairs are found is *Silene biappendiculata,* while in *Minuartia procumbens* and *M. meyeri* both glandular and pointed multicellular hairs cover the stem. Both glandular and tabular hairs are found in *Spergularia rubra, S. marina* and *Minuartia geniculata.*

The leaf is morphologically the most variable plant organ [7, pp. 115-203; 8-10, pp. 107-134]. In Carophyllaceae, the leaf is either stipulate or exstipulate; petiolace or sessile; opposite or alternate; simple unifoliate with acuminate, apiculate, cuspidate, acute, mucronate or rounded apices and angustate, cuneate or auriculate bases. Their margins are mostly entire or dentate, while crenate margins are found in *Sagina apetala* and *Silene rubella.* The venation is either parallelodromous, paralleloreticulodromous, reticulodromous, eucamptodromous or brochidodromous (Fig. 2). Their shapes exhibit a wide range of variation among the different genera and species (Table 1, Fig. 1). The leaf shapes vary from linear in *Silene linearis, Minuartia picta, M. tenuifolia* and the genera *Spergula, Spergularia, Robbairea, Pteranthus, Gymnocarpos* and *Sphaerocoma.* In the latter two genera, the leaves are linear and succulent. In *Silene vulgaris, Minuartia procumbens, M. geniculata* and the

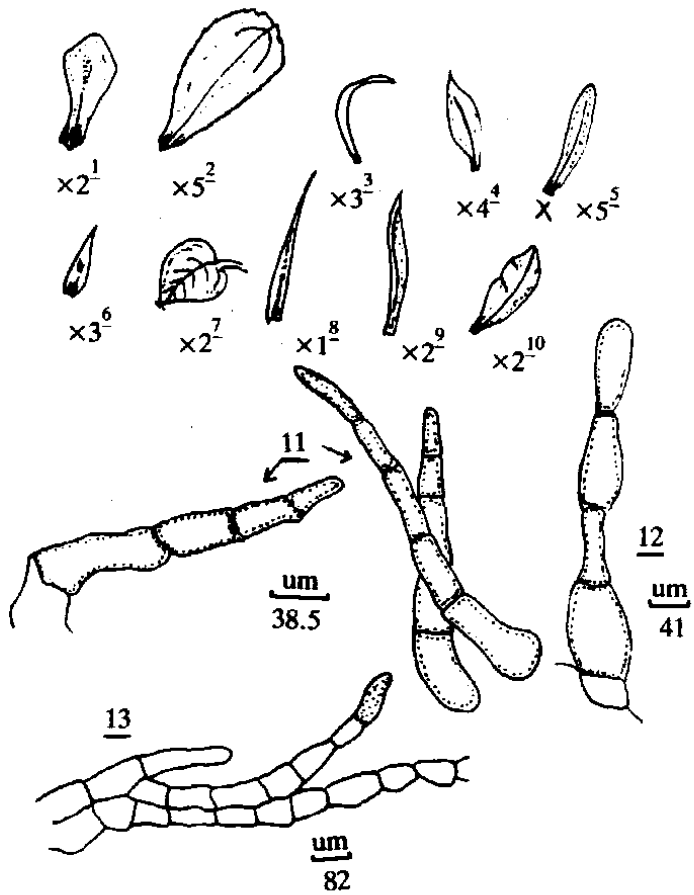

Fig. 1. (1-10) Leaf shape and (11-13) Leaf hair.

1 Leaf shape in *Silene succulenta* (Obovate).
2 Leaf shape in *Cerastium dichotomum* (Lanceolate).
3 Leaf shape in *Minuartia picta* (Linear).
4 Leaf shape in *Telephium sphaerospermum* (Elliptic).
5 Leaf shape in *Gypsophila viscosa* (Ensiform).
6 Leaf shape in *Polycarpaea repens* (Subulate).
7 Leaf shape in *Stellaria media* (Cordate).
8 Leaf shape in *Dianthus cyri* (Acicular).
9 Leaf shape in *Silene tridentata* (Falcate).
10 Leaf shape in *Silene rubella* (Spathulate).
11 Leaf hair in *Cerastium dichotomum* (Pointed multicellular).
12 Leaf hair in *Gymnocarpos decandrum* (Tabular multicellular).
13 Leaf hair in *Silene succulenta* (Pointed multicellular).

Table 1. Variation in the vegetative characters in Caryophyllaceous species in the Egyptian flora.

TAXA	Vegetative characters																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Subfamily: Paronychioideae																		
Tribe: Paronychieae																		
Subtribe: Paronychienae																		
Sphaerocoma hookeri T. Anders.	1	20-70	2	1	10-14	9-12	1	1	1	2	1	4	4-10	1.5-4	1	4	2	1
Gymnocarpos decandrum Forssk.	1	10-20	2	10	5-9	2-4	1	1	1	1	1	1	3-7	1-2.5	1	3	2	1
Paronychia argentea Lam.	2	5-30	1	1	21-26	1-1.5	4	2	3	1	2	3	4-20	1-2	1	1	2	1
P. nivea DC.	2	5-20	1	3	5-9	1-1.5	2	2	2	2	1	4	3-10	1-2.5	1	6	2	1
P. arabica DC.	2	5-17	1	9	8-12	1-1.5	3	2	2	2	2	3	4-12	1-3	1	4	2	1
Herniaria hemistemon J. Gay	2	5-15	1	8	1.5-5	1-1.5	2	2	2	2	1	5	3-9	1.5-3.5	1	4	2	1
H. fontanesii J. Gay	1	6-14	1	6	3-6	1-1.5	2	2	2	1	2	5	3-10	1-2	1	4	2	1
H. glabra	2	5-16	1	6	2.5-6	0.5-1	2	2	3	2	1	5	2-8	1-2	1	4	2	1
H. hirsuta var, cinerea Herm.	2	5-14	1	5	3-8	1-1.5	3	2	2	2	2	5	2-9	1-2	1	4	2	1
Tribe: Pterantheae																		
Cometes abyssinica R.Br. ex Wall.	1	10-28	1	7	7-18	1-2	3	2	3	2	2	2	5-13	1-2.5	1	1	2	1
C. surattensis	1	10-26	1	1	11-23	1-2	2	2	2	2	1	4	6-15	2.5-6	1	4	1	1
Pteranthus dichotomus Forssk.	2	10-20	1	2	10-20	1-2	1	1	1	2	2	2	8-17	1-1.5	1	4	2	2
Tribe: Polycarpeae																		
Polycarpon tetraphyllum	1	5-12	1	1	2-5	1-1.5	1	1	1	2	2	3	4-8	1-1.5	1	4	2	1
P. alsinifolium (Biv.) DC.	1	4-12	1	2	5-10	1-1.5	1	1	1	2	2	4	4-10	1.5-3	1	1	2	1
P. prostratum (Forssk.) Pax	2	5-12	1	10	3-8	1-2	4	3	4	2	2	4	3-8	1-2	1	4	2	1
P. succulentum (Del.) J. Gay	2	5-11	1	3	3-6	1-1.5	1	1	1	2	2	3	4-8	1-2	1	1	2	1
Polycarpaea repens (Forssk.) Asch.	2	4-14	1	8	1-2	1-2	2	2	3	2	2	5	1-2	1-1.5	1	4	2	1
P. spicata Wight ex Arn.	1	5-14	1	1	15-26	1-2	1	1	1	2	1	3	6-12	2-3	1	1	2	1
P. corymbosa Lam.	1	5-15	1	1	10-17	1-2	1	1	1	1	1	3	3-8	1-1.5	1	1	2	1

Table 1. (Cont.)

TAXA	Vegetative characters																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Loeflingia hispanica	1	4-12	1	2	3-8	1-2	3	3	1	2	2	1	2-4.5	1-1.5	1	1	2	1
Robbairea delileana Milne-Redh. Var. *major* (Asch. & Schweinf.) Tack.	2	9-16	1	6	12-22	1-1.5	1	1	1	1	2	1	4-8	1-1.5	1	4	2	2
Tribe: Sperguleae																		
Subtribe: Spergulinae																		
Spergula fallax E.H.L.	1	5-25	1	8	7-18	1-2	1	1	1	2	2	1	1-3.5	1-1.5	1	1	2	2
S. arvensis	1	5-70	1	5	10-25	1-2	2	2	1	1	1	3	2-6	1-1.5	1	1	2	1
Spergularia diandra Boiss	1	3-30	1	2	6-14	0.5-0.8	1	1	2	2	2	2	5-13	0.5-1	1	1	2	1
S. bocconii Asch. et Graebn.	1	5-25	1	7	12-28	1-2	1	1	1	2	2	1	8-22	1-1.5	1	4	2	2
S. media	2	5-40	1	2	1-3	1-1.5	2	2	1	2	2	1	1.5-4	1-1.5	1	2	2	2
S. rubra J. & C. Presl	1	5-25	1	5	10-21	1-1.5	2	4&5	3	2	2	1	9-20	1-1.5	1	1	2	2
S. marina Griseb.	1	5-20	1	5	3-10	0.3-0.7	3	4&5	3	2	2	1	4-12	1-1.5	1	1	1	1
Subtribe: Telephiinae																		
Telephium sphaerospermum Boiss.	2	6-30	1	4	2-5	1-2.5	1	1	1	1	2	5	3-7	1.5-3	1	5	2	1
Subfamily: Alsinoideae																		
Tribe: Alsineae																		
Arenaria serpyllifolia	1	3-30	1	6	1-1.5	1-1.5	2	2&5	2	2	1	3	2.5-8	1.5-3	1	4	2	2
A. deflexa Decne	1	5-30	1	6	10-30	1-1.5	2	3&5	3	2	1	3	4-9	3-5	1	4	1	2
Holosteum umbellatum	1	20-35	1	5	7-7	0.3-0.8	2	2	1	1	1	3	4-8	1-3	1	4	3	1
Stellaria media Vill.	1	15-90	1	5	10-20	1-1.5	1	1	2	2	1	1	8-16	5-9	3	4	2	2
S. pallida (Dumortier) Pire	1	11-30	1	7	7-16	0.3-0.8	1	1	1	2	1	2	6-12	3-7	1	4	2	2
Cerastium viscosum	1	10-20	1	5	8-17	1-1.5	2	5	3	2	1	4	7-13	2-4	1	4	2	1
C. dichotomum	1	10-18	1	6	4-13	1-1.5	2	5	3	2	1	4	8-20	2-4	1	1	2	1

Table 1. (Cont.)

TAXA	Vegetative characters																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Sagina apetala Ard.	1	3-30	1	5	5-13	0.3-0.7	2	5	1	2	1	2	3.5-6	1.5	1	4	2	2
Minuartia geniculata (Poiret) Thell.	2	10-30	1	9	7-18	0.5-1	2	4&5	2	2	1	4	4-8	1-2.5	1	4	2	2
M. tenuifolia Hiern	1	5-25	1	6	8-18	0.5-1	1	1	1	1	1	1	3.5-8	1-1.5	1	4	2	2
M. procumbens Graebn.	2	4-30	1	5	15-35	0.5-1	2	3&4	2	2	1	4	4-9	1-2.5	1	4	2	2
M. meyeri Bornm.	1	4-11	1	6	7-15	0.5-1	2	3&4	2	1	1	1	5-12	1-1.5	1	1	2	2
M. picta Bornm.	1	4-9	1	7	8-20	0.5-0.7	2	2	1	1	1	2	1.5-3	1-1.5	1	1	2	2
Bufonia multiceps Decne.	1	5-12	1	6	5-12	0.5-1	3	2	2	2	1	1	6-12	2-4	1	1	2	3
Subfamily: Silenoideae																		
Tribe: Lychnideae																		
Subtribe: Sileninae																		
Silene rubella	1	10-50	1	7	20-45	1-2	2	2	3	2	1	3	12-25	3.5-6	2	4	2	2
S. succulenta Forssk.	2	10-28	1	7	6-14	1.5-3	3	2	3	1	1	4	7-13	4-9	1	4	3	2
S. tridentata Desf.	1	9-48	1	6	20-36	1-2	3	2&3	2	2	1	4	10-27	3-6	1	6	2	2
S. conoidea	1	15-23	1	6	5-13	1-1.5	2	2	3	2	1	4	15-30	3-6	1	4	2	2
S. nocturna	1	12-26	1	1	4-11	1-1.5	4	4	4	2	1	2	6-12	1.5-2	1	4	2	2
S. burchelii Otth. ex DC.	1	10-20	1	7	6-14	1-1.5	3	3	4	2	1	4	5-8	1-2	1	4	2	2
S. pseudatocion Desf.	1	30-60	1	7	8-20	1-1.5	4	2&3	4	2	1	1	10-16	3-5	1	4	2	3
S. biappendiculata Rohrb.	2	10-30	1	6	7-16	1-1.5	3	2&4	3	2	1	4	4-8	1-2	1	1	2	2&3
S. gallica	1	15-45	1	1	6-16	1-1.5	3	3	4	2	1	2	4-18	2-3	1	4	2	2
S. palaestina Boiss.	1	10-17	1	1	3-10	1-1.5	3	4	4	2	1	4	10-20	1.5-2.5	1	4	2	2
S. villosa Forssk.	2	9-20	1	1	3-10	1-1.5	4	3	4	2	1	3	7-13	1.5-2.5	1	4	2	2
S. apetala Willd.	1	10-35	1	6	6-15	0.3-0.6	3	3	3	2	1	2	7-13	1-2	1	4	2	2
S. longipetala Vent.	1	10-30	1	8	15-28	1-1.5	3	1	3	2	1	2	10-15	1.5-2.5	1	4	2	2&3
S. colorata Poiret	2	10-50	1	6	6-14	1-1.5	3	3	4	2	1	4	8-14	1-2.5	1	4	2	3

Table 1. (Cont.)

TAXA	Vegetative characters																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
S. behen	1	15-20	1	1	3-10	1-1.5	1	1	1	1	1	2	5-15	1.5-3	1	4	2	2&3
S. vulgaris Garcke	1	15-60	1	1	5-17	1-1.5	1	1	1	2	1	2	8-12	1.5-2	1	4	2	2
S. arabica Boiss.	1	10-27	1	8	6-17	1-1.5	2	2&5	3	2	1	3	4-8	1-2	1	4	2	2
S. setacea Vivn	1	10-25	1	8	5-17	1-1.5	2	2	3	2	1	2	10-16	1-2.5	1	4	2	2
S. oliveriana Otth.	1	10-30	1	2	8-29	1-2	3	2	3	2	1	3	8-13	1-2	1	4	2	2
S. aegyptiaca L.	1	8-20	1	2	3-8	1-1.5	1	1	1	2	1	4	7-12	1-2	1	4	2	2
S. linearis Decne	1	12-22	1	6	4-11	1-1.5	1	1	2	2	1	1	8-12	1-2	1	4	2	2
Dianthus cyri Fisch. & Mey.	1	25-48	1	6	15-32	1-1.5	1	1	1	2	1	1	36-60	4-6	1	1	2	2
D. strictus Banks et Sol.	1	30-50	1	5	14-30	1-1.5	1	1	2	1	1	1	8-12	1-2	1	1	2	2
D. sinaicus Boiss.	1	27-40	2	1	16-36	1-2	1	1	1	2	1	1	16-23	1-2	1	1	2	2
Tunica compressa Fisch. & Mey.	1	10-20	1	7	4-8	0.3-0.7	1	1	1	2	1	2	3-6	1-1.5	1	1	2	2
Gypsophila viscosa Murr.	1	10-25	1	2	2-6	1-1.5	1	1	1	2	1	4	5-8	1-1.5	1	1	2	2
G. capillaris Forssk.	1	10-23	1	6	7-20	1-1.5	1	1	1	2	1	3	4-6.5	1-1.5	1	1	2	1
Vaccaria pyramidata Medicus	1	30-60	1	6	12-38	1-1.5	1	1	1	2	1	2	50-70	12-20	1	1	2	1
V. oxyodonta Boiss.	1	28-50	1	6	20-38	1-1.5	1	1	1	2	1	3	20-28	4-7	1	1	2	1&2

Key to Table 1 of Vegetative Characters

Character 1: Plant habit: 1-perennial 2-annual.
Character 2: Average length of plant in mm.
Character 3: Plant strength: 1-herb 2-shrub.
Character 4: Stem color: 1-brown 2-light brown 3-dark brown 4-olive 5-green 6-light green 7-yellow 8-yellowish brown 9-orange 10-greyish white.
Character 5: Average internode length in mm.
Character 6: Average internode width in mm.
Character 7: Stem indumentum: 1-glabrous 2-sparsely villous 3-villous 4-hairy.
Character 8: Trichome type: 1-glabrous 2-pointed unicellular 3-pointed multicellular 4-glandular multicellular 5-tabular
Character 9: Leaf indumentum: 1-glabrous 2-sparsely villous 3-villous 4-hairy.
Character 10: Presence of crystals: 1-absent 2-present.
Character 11: Presence of stipules: 1-absent 2-present.
Character 12: Type of leaf venation: 1-parallelodromous 2-reticuloparallelodromous 3-reticulodromous 4-eucamptodromous 5-brochidodromous.
Character 13: Average length of leaf in mm.
Character 14: Average width of leaf in mm.
Character 15: Type of leaf margin: 1-entire 2-crenate 3-dentate.
Character 16: Type of leaf apex: 1-acuminate 2-apiculate 3-cuspidate 4-acute 5-rounded 6-mucronate.
Character 17: Type of leaf bases: 1-angustate 2-cuneate 3-auriculate
Character 18: Type of stomata: 1-anomocytic 2-diacytic 3-anisocytic.

genera *Telephium* and *Arenaria,* the leaves are elliptic. Obovate leaves are found in *Polycarpaea,* while the genus *Stellaria* has cordate leaves.

The micro-morphology of mature leaves has been considered of great importance in taxonomy. Solereder [11], Payne [12], Dilcher [13], Wilkinson [14], Vesque [15] and others have proposed different terminolog for descriping the cells surrounding the stomata. The terminology we are dealing with here follows that proposed by Wilkinson [14], while the terminology used in descriping the trichomes follows that proposed by Payne [12].

Within the Caryophyllaceae three types of stomata are present: anisocytic, diacytic and anomocytic. The first two are found together in *Silene biappendiculata, S. longipetala, S. behen* and *Vaccaria oxyodonta.* Anisocytic stomata are found in *Paronychia nivea, Polycarpon prostratum, Cometes surathensis, Bufonia multiceps, Silene pseudatocion* and *S. colorata.* Diacytic stomata are found in *Pteranthus dichotomus, Spergula fallax, S. arvensis, Spergularia bocconii, Arenaria serpyllifolia, A. deflexa, Sagina apetala, Minuartia geniculata, Silene rubella, S. gallica, S. villosa, S. arabica, Tunica compressa* and *Robbairea delileana v. major;* while the anomocytic

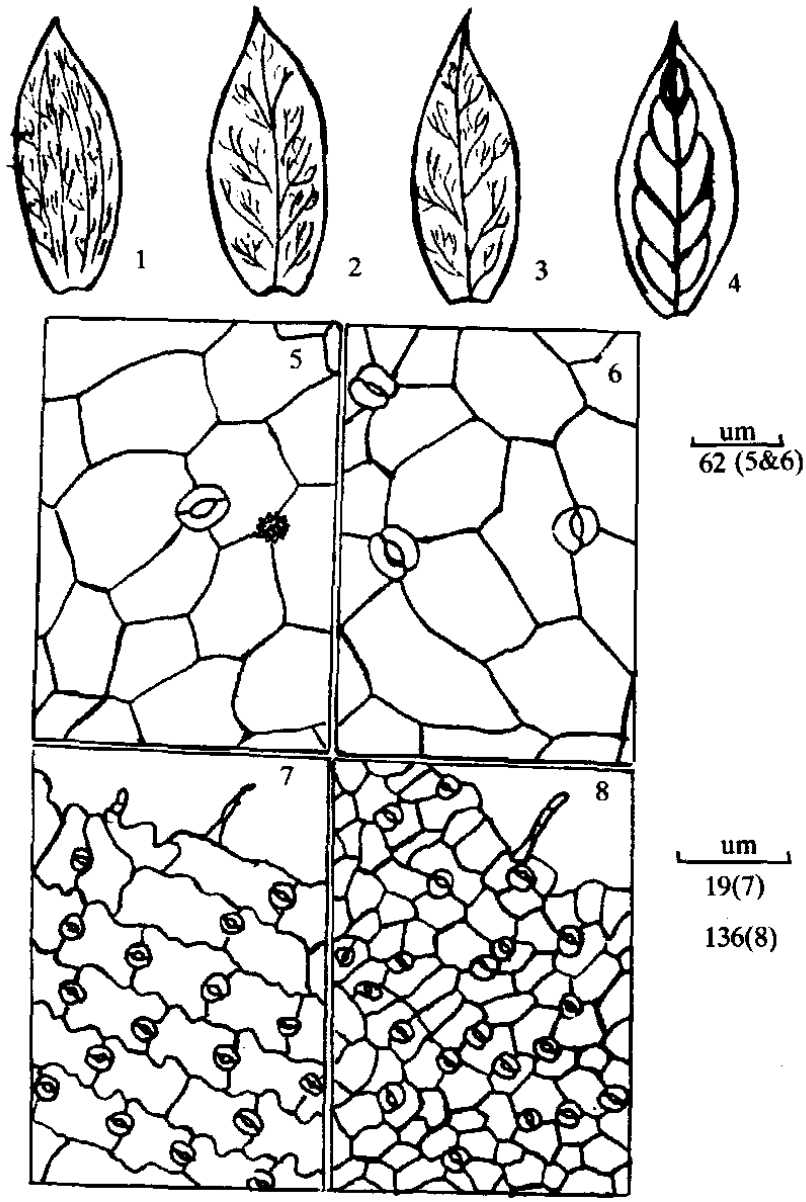

Fig. 2. (1-4) Leaf venation and (6-8) Type of subsidiary cells.

1 Leaf venation in *Pteranthus dichotomus*.

2 Leaf venation in *Holosteum umbellatum*.

3 Leaf venation in *Cerasteum dichotomum*.

4 Leaf venation in *Herniaria hemistemon*.

5 Type of subsidiary cells in *Silene colorata* (Anisocytic).

6 Type of subsidiary cells in *Telephium sphaerospermum* (Anomo.).

7 Type of subsidiary cells in *Sagina apetala* (Diacytic).

8 Type of subsidiary cells in *Vaccaria pyramidata* (Anomocytic).

stomata is the common type in the rest of the family. Hairy leaves are covered by either pointed, tabular or glandular hairs which may be unicellular or multicellular (Fig. 1). Mixed types of hairs can be found in a few species (Table 1).

Discussion

From our findings we can say that the most significant vegetative character is the type of trichomes on the stems and leaves which are similar to a great extent on both, while their size or density, which can be affected by environmental conditions [16, pp. 97-162] as quoted by Cutler [17] are not of great importance in the taxonomy of the group.

In subfamily Paronychioideae the stems and leaves are either glabrous or covered by pointed unicellular or multicellular hairs, except in *Spergularia rubra* and *S. marina,* which have both glandular and tabular hairs. Tabular and glandular hairs occur more frequently within species of the Alsinoideae and in few species of the Silenoideae such as *Silene nocturna, S. biappendiculata* and *S. palaestina* which have glandular multicellular hairs and *Silene arabica* with only tabular hairs.

According to the type of subsidiary cells, three groups can be distinguished. The first one has diacytic stomata; the second group as anisocytic, or both anisocytic and diacytic, stomata; while the third group has the anomocytic type. These groups are not in accordance with the division of the family into three subfamilies, but all these tomatal groups can be found in the three subfamilies.

Leaf venation is second to the leaf micro-characters in identifying the genera and even some species [8]. Three types of leaf venation can be recognised, the parallelodromous, brochidodromous and reticulodromous (Fig. 2). According to the morphological characters studied, the genera *Stellaria* and *Spergula,* which have been taxonomicaly lumped by Bentham [18] and split afterwards by Pax and Harms [1] on basis of the presence or absence of stipules, share most of the leaf morphological characters *e.g.* the type of stomata, trichomes and venation. The genera *Arenaria* and *Minuaria,* which have been treated as a single genus by Maguire [19, pp. 9-11] and separated by McNeill [20, pp. 148-152; 21] who evaluated the generic limits in the Alsinoideae and considered the number of teeth opening the capsule as the character separating the two genera, share the same leaf micro-characters but they differ in their leaf venation. The genera *Cleranthus, Paronychia & Herniaria* have the same taxonomic characters as the rest of the genera within the family Caryophyllaceae and this does not support their isolation in a separate family *i.e.* Illecebraceae as proposed by Davis and Cullen [2], Davis [3] and Hutchinson [4].

The phenogram obtained from the numerical analysis (Fig. 3) does not give clear separation of the genera within the family. This is due to the equal weighting of the characters and is in support of the family Caryophyllaceae as a natural group.

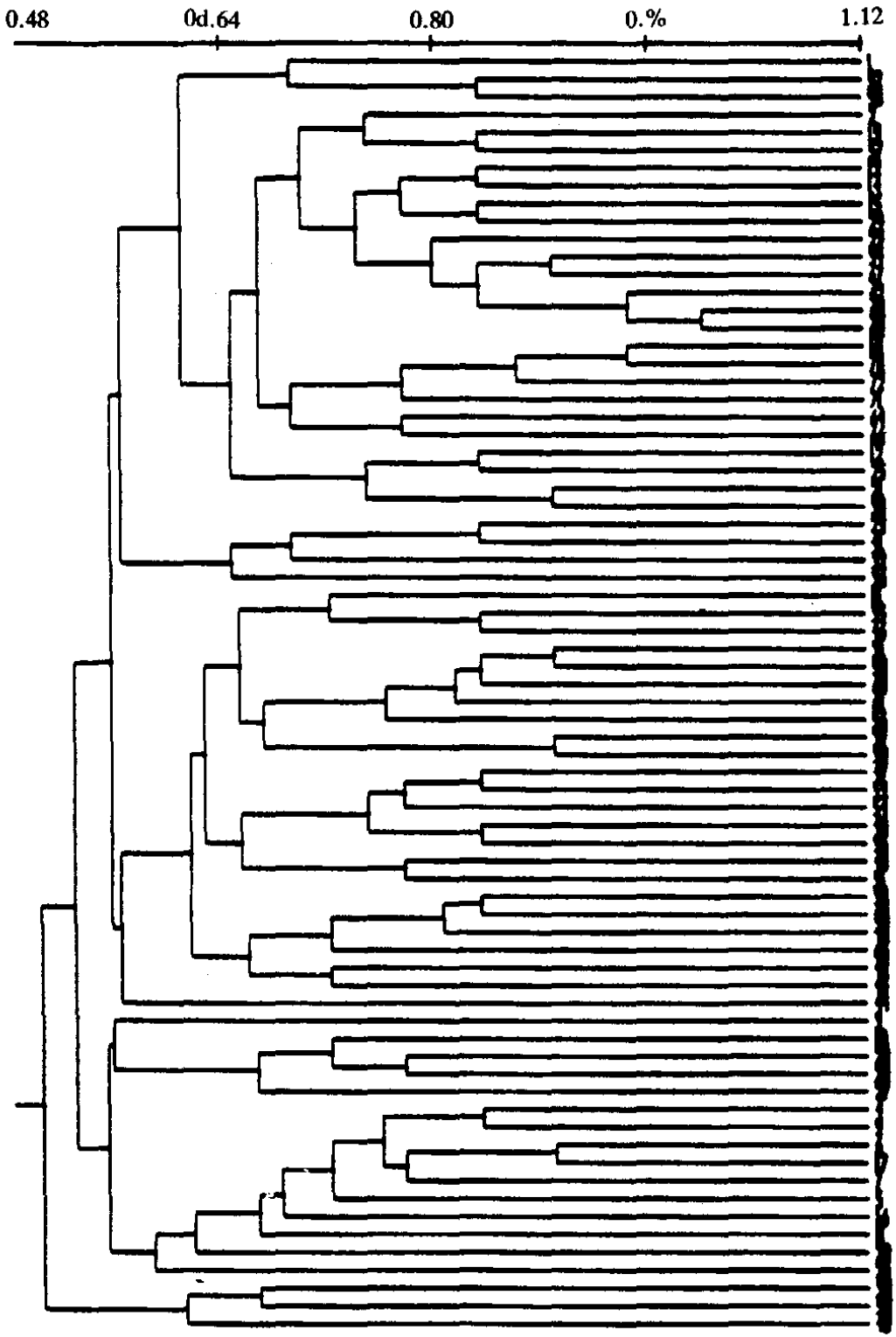

Fig. 3. Phenogram showing the relation between the different groups in family Caryophyllaceae, using ASF4 program.

Key to Fig. 3

1- *Sphaerocoma hookeri*
52- *Silene biappendiculata*
58- *S. behen*
2- *Gymnocarpos decandrum*
19- *Polycarpaea corymbosa*
57- *S. longipetala*
13- *Polycarpon tetraphyllum*
15- *P. alsinifolium*
14- *P. succulentum*
21- *Robbairea delileana* var. *major*
72- *Vaccaria oxyodonta*
33- *Stellaria media*
47- *S. conoidea*
62- *S. oliveriana*
60- *S. arabica*
68- *Tunica compressa*
69- *Gypsophila viscosa*
64- *S. linearis*
18- *Polycarpaea spicata*
20- *Loefingia hispanica*
22- *Spergula fallax*
24- *Spergularia diandra*
71- *Vaccaria pyramidata*
70- *Gypsophila capillaris*
61- *S. setacea*
66- *Dianthus strictus*
12- *Pteranthus dichotomus*
25- *Spergularia bocconii*
11- *Cometes surathensis*
38- *Minuartia geniculata*
26- *Spergularia media*
31- *Arenaria deflexa*
32- *Holosteum umbellatum*
36- *Cerastium dichotomum*
43- *Bufonia multiceps*
35- *Cerastium viscosum*
46- *S. tridentata*
59- *S. vulgaris*
40- *Minuartia procumbens*
41- *Minuartia meyeri*
50- *S. burchelii*
37- *Sagina apetala*
49- *S. colorata*
56- *S. apetala*
54- *S. palaestina*
55- *X. villosa*
39- *Minuartia tenuifolia*
51- *X. pseudatocion*
30- *Arenaria serpyllifolia*
63- *S. aegyptiaca*
48- *S. nocturna*
65- *Dianthus cyri*
42- *Minuartia picta*
45- *S. succulenta*
44- *S. rubella*
6- *Herniaria hemistemon*
3- *Paronychia argentia*
10- *Cometes abyssinica*
23- *Spergula arvensis*
28- *Spergularia marina*
27- *Spergularia rubra*
8- *Herniaria glabra*
9- *Herniaria hirsuta* var. *cinerea*
17- *Polycarpaea repens*
4- *Paronychia arabica*
5- *Paronychia nivea*
16- *Polycarpon prostratum*
7- *Herniaria fontanesii*
29- *Telephium sphaerospermum*
34- *Stellaria pallida*
53- *S. gallica*
67- *Dianthus sinaicus*

Acknowledgement. Thanks are due to M.A. Ayyad, Prof. of Ecology, Botany Department, Alexandria University or the invaluable help in all aspects of this study.

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دراسات مورفولوجية في الفصيلة القرنفليّة

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ملخص البحث. تمت دراسة الصفات المورفولوجية لأوراق وسيقان ٧٢ نوعًا تابعين للفصيلة القرنفليّة الموجودة بالفلورا المصرية. ومن هذه الدراسة تبين أن الصفات الدقيقة للأوراق لها أهمية في تمييز الأجناس وبعض الأنواع مثل نوع الزوائد والثغور، كما أن تعرق الورقة له أهمية تلي أهمية الصفات الدقيقة في تمييز الأنواع المختلفة ومن هذا البحث نستخلص النقاط التالية:

١ ـ الجنسان *Spergula & Stellaria* لهما الصفات المورفولوجية نفسها فيما عدا وجود الأذينات بأوراق.

٢ ـ الصفات المورفولوجية الدقيقة للجنسان *Minuartia & Arenaria* متشابهة بينما التعرق في الأوراق مختلف مما يسهل تمييزهما.

٣ ـ الأجناس *Scleranthus, Paronychia & Herniaria* التي تم وضعها في فصيلة Illecebraceae لها الصفات المورفولوجية للفصيلة القرنفليّة نفسها مما لا يؤيد فصلها عنها.