Basrah Journal of Science (B) *Vol.23(1) ,59-73, 2005*

Taxonomic significance of anatomical characters of different species of the family Chenopodiaceae in Iraq.

Abdullah H. Lafta Sahar A. A. M. Al-Saadi *Taha Y. El-Edani

Department of Biology, College of Science. Basrah University

***Department of Plant protect, College of Agriculture. Basrah University**

Abstract

Details of the cuticular, epidermal and anatomical features of stems, petioles and leaves of eight species of the family Chenopodiaceae were described, these species belong to seven genera, these are *Cornulaca, Spinacia, Bassia, Halocnemum, Beta , seidlitzia* and *Bienertia.* Anatomical comparison between species was provided also. The results showed that the anatomical characters such as the number of vascular bundles in the stem are of considerable taxonomic value on the generic level. The anatomical characters of the leaf and stem have a good taxonomic value on the species level

الأهمية التصنيفية للصفات التشريحية لأنواع مختلفة من العائلة الرمرامية في العراق

عبد الله حمد لفته ، سحر عبد العباس السعدي و طه ياسين العيداني*

قسم علوم الحياة – كلية العلوم – جامعة البصرة.

*قسم وقاية النبات – كلية الزراعة – جامعة البصرة.

الخلاصـــة

تم في هذا البحث دراسة الخصائص التشريحية لصفات الادمة والبشـرة والجوانـب التشـريحية للورقة والساق والسويق لثمانية انواع من العائلة الرمرامية تعـود الـى سـبعة اجنـاس مختلفـة هـي *Cornulaca* و *Spinacia* و *Bienertia* و *Bassia* و *Halocnemum* و *Beta* و *Sediltzia* . كما تم

مقارنة هذه الانواع من الناحية التشريحية. اظهرت النتائج ان لبعض الصفات التشريحية مثل عدد الحزم الوعائية في الساق قيمة تصنيفية معتبرة على مستوى الاجناس، بينما اعطت الصفات التشريحية للورقة والساق قيمة تصنيفية جيدة على مستوى الانواع.

Introduction

The family Chenopodiaceae, to which the genera, *Halocnemum, Beta, Bassia, Cornulaca, Bienertia, Seidlitzia* and *Spinacia* belong is composed of (100) genera containing about (1500) species, most of them distributed through out the world but has centres in saline regions of Asia, north and south America and Australia (McArthur and sanderson,1983)

Anatomical features are widely used in taxonomic and palaebotanical studies. The importance of cuticular characters in systematic studies has been investigated by many authors (Stace, 1965;Ferguson,1974; Dickison,1975; Cutler, 1979,Barthlott ,1981;Al-Mayah,1983;Lafta,1996 and EL-Edani,1998).

Metcalf and Chalk (1950) summarized few anatomical characters about some species of Chenopodiaceae. There have been a few papers on the anatomy of Chenopodiaceae, such as Black (1959); Uotilo (1974); lafta (1996)AL-Ghizzi (2001); Lafta and AL-Mayah (2002).

The aim of this study is to description of leaf and stem anatomy for eight species of Chenopodiaceae and to determine its taxonomic value.

Materials and Methods

Fresh material of the eight species of Chenopodiaceae listed in tabel (1) were collected from south and north of Basrah province, the cuticle were prepared by macerating the leaves in Jeffrey's solution (equal parts of 10 % chromium trioxide solution and 10% nitric acid) and then mounted in safranine Jelly glycerine (Al-Mayah, 1980). Transverse sections of leaf and stem were prepared by fixed in F.A.A. And them passed through alcohol dehydrations series (Johanson, 1968). Sections of 10-20 um thickness were cut with rotary microtom after they were embedded in

paraffin, stained in safranin– fast green and mounted in Canada balsam (Henry, 1981). Sections for petiols were also made using the above method. The sections were examined with light microscope and photomicrograph were taken also. Surface view of leaf epidermis was drawing by camera Lucida.

Results and Discussion

A. Surface view of leaves

Stomata usually rounded or elliptic shaped, presence on both surfaces, usually more numerous on the abaxial epidermis than adaxial epidermis. stomata usually anomocytic or hemiparacytic, guard cells kidney shaped, pore usually elliptic, T-pieces some times present. Hairs unicelular, non glandular. The number of stomata on the upper epidermis may vary from species to species and can be used to assist in the identification of some species like *Bassia hysopifolia* and *Bassia eriophora* (table1). Wall of ordinary epidermal cells was undulated in *Spinacia oleracea* and these walls usually show deeper undulation abaxially than adaxially, other species have straight curved walls (Fig 1 and 2)

B-Transverse section of leaves

The five genera examined showed two types of mesophyll, bifacial which occur in *Beta* and *Spinacia,* and isobilateral which occur in *Bassia, Bienertia* and *Seidlitzia* (plate 1 and Table 2). Lamina thick 401.07-210.40um.Cuticle 5.88-1.63um, always adaxially thicker than abaxially. Epidermal cells squar or rectangular,uniseriate. Hypodermis present in *Bassia* and *Bienertia* species. Mesophyll of 1-2 layers of palisade cells and several rows of compact or loose spongy tissue or 2 layers of palaside cells on adaxial or abaxial. Midrib usually grooved some times flattend, supptied with 3 collateral vascular bundle. The genera *Seidlitzia, Bienertia* and *Bassia* characteristic with the presence of squar cells surrounding the

primary veins, chloroplast very densely in this cells comparatively with other palasid and spongy cells. Druses crystal very common in most species.

C- Transverse section of petioles

Outline circulr or semicircular, usually with two wings except *Spinacia oleracea* (plate2). Epidermis uniseriate with thin cuticle, usually glabrous. Ground tissue paranchymatas, usually with crystales. Vascular system usually more than one bicollateral strand except *Bassia hysopifolia* (plate 2). Phloem several rays of narrow cells, phloem fibers usually absent.Xylem composed of radial rows of vessels. Druses crystals present.

D- Transverse section of stems

Outline circular, semicircular or angular (plate 3), epidermis uniseriate, cuticle thick in *Halocnemum strobilaceus,Bassia eriophora* and *Cornulaca monacantha* (table 3) periderm absent. Cortex usually paranchymatous and collenchymatous. Sclerenchyma and chlorenchyma absent in all species except *Seidlitzia rosmarinus* having chlorenchyma (table3). Vascular tissue either continuos cylinder as in *Bassia hysopifolia*, Cornulaca monacantha, *Halocnemum strobilaceum* or separated vascular bundle as in *Bassia eriophora*, *Beta vulgaris*, *Bienertia cycloptera* and *Spinacia oleracea* plate (3,4). Vascular bundles vary in number and size between species have been examined, *Spinacia oleracea*
have (28) vascular bundle but *Bassia eriophora* have only (8) (plate 3), interfascicular cambium usually inconspicuous, but some times well developed in some species like *Spinacia oleracea* and *Bassia eriophora* (plate 3). Xylem composed of radial rows of vessels, phloem several rays of narrow cells, phloem fibers usually absent. Ground tissue parenchymatous with druses crystals.The pith is made-up of ordinary parechyma cells; composing a wide or narrow area some times empty like *Spinacia oleracea* (plate 3).

The observation in this study show that the two genera *Beta* and *Spinacia* are antomically very similar although each one belong to different subfamily, the first to the Betoideae, and the second to the Chenopodieae.

The two species of *Bassia* examined are anatomically very similar or uniform especially in leaf and cuticular characters, but there are some variations between the two species in stem anatomy. *Halocnemum strobilaceumv* can be separated from other species which examined on the basis of presence of anomalous secondary growth, this feature is common in different genera of Chenopodiaceae (Metcalfe and Chalk,1950).The two varieties of *Beta vulgaris* are very similar on anatomical characters, although there is some variation in the distribution of stomata.

The Leaf anatomy of *Bassia, Seidlitzia* and *Bienertia* are closely resembles, particularly in mesophyll type. Species which belong to these genera are C4 plant like most species of *Atriplex* so that, the mesophyll is bifacial, however, species of *Spinacia* and *Beta* have isobilateral mesophyll and are C3 plants like the genus *Chenopodium* (Al-Ghizzi,2001)

The number of vascular bundles in the stem are of high taxonomic value at generic levels and show considerable variation between species like *Spinacia oleracea, Bassia eriophora* and *Bienertia cycloptera* (plate 3).

The anatomical characters of the leaf and stem have a good taxonomic value, while other characters having limited taxonomic value. Features such as mesophyll type,number of vascular bundles and cortex structure do not support subdividing Chenopodiaceae to three subfamilies on the basis of morphological characters by Williams and Ford-L1oyd(1974).

Table(1):Anatomical characters of leaf surface of eight species of Chenopodiaceae

Stomatal index		Stomatal number		Stomata				Species
				Lower epidermis		Upper epidermis		
Lower epidermis	Upper epidermis	Lower epidermis (mm^2)	Upper epidermis (mm^2)	Wide (um)	Length (um)	Wide (um)	Length (um)	
14.22	14.92	(33-41) 36	(41-58) 50	(26.3-39.45) 29.58	(39.45-52.6) 43.78	(13.15-26.3) 22.35	(26.5-39.45) 34.19	*Bassia eriophora* (Schard.) Ascherson
16.78	18.25	(158-175) 168	(158-200) 186	(16.35-19.62) 18.31	(22.89-26.16) 23.41	(19.62-22.82) 20.92	(19.62-32.7) 27.63	*Bassia hyssopifolia* (Pall.) Kuntze
14.50	8.66	(116-133) 125	(50-66) 61	(19.62-26.16) 22.89	(22.89-32.7) 30.34	(26.3-26.3) 26.3	(39.45-39.45) 39.45	*Beta vulgaris* var. *cicla* L.
22.58	25.29	(191-225) 213	(150-191) 173	(22.89-22.89) 22.89	(22.89-22.89) 22.89	(22.89-29.43) 25.34	(22.89-32.7) 27.79	*Beta vulgaris* var. *vulgaris* L.
12.50	9.20	(125-154) 144	(73-91) 85	(18.62-38.54) 25.85	(30.5-41.41) 36.30	(15.13-23.42) 21.10	(33.25-39.50) 36.71	*Bienertia cycloptera* Bunge.
-	-	-	-	-	-	-	-	*Cornulaca monacantha* Del.
-	-	-	-	-	-	-	-	*Halocnemum strobilaceum* (Pall.) Bunge
15.20	13.85	(118.132) 126	(59-75) 66	(19.62-25.51) 21.98	(27.91-39.25) 31.90	(17.3-23.42) 19.55	(20.17-33.40) 23.55	*Sedlitzia rosmarinus* (Ehrenb.) Bunge
19.10	11.07	(116-125) 120	(75-91) 79	(22.89-26.16) 23.96	(29.43-35.97) 33.09	(22.80-22.84) 22.84	(32.7-39.24) 36.62	*Spinacia oleracea* L.

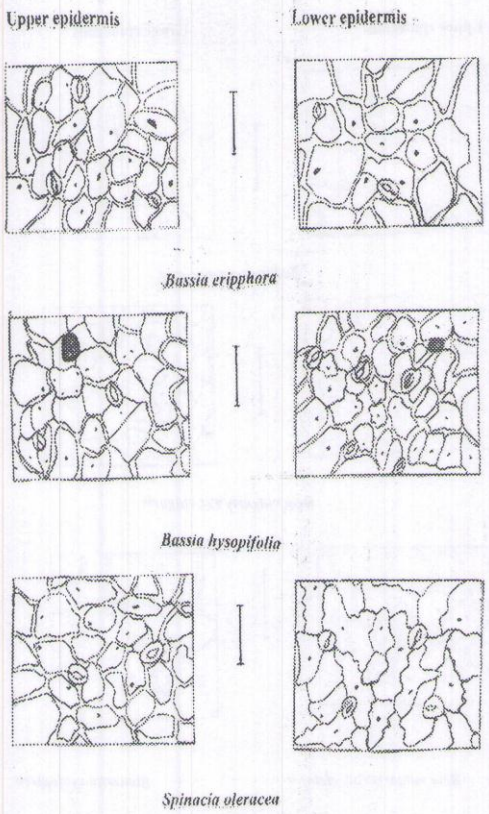


Fig (1) : Surface view of leaf epidermis.
(scale = 100 um)

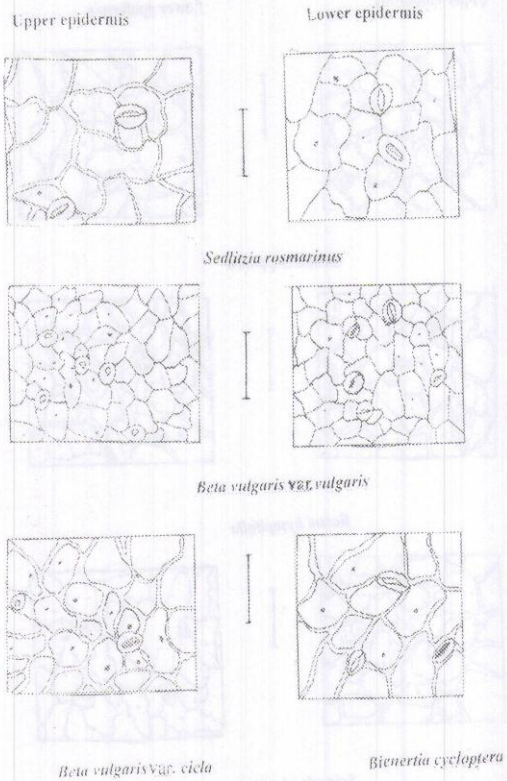
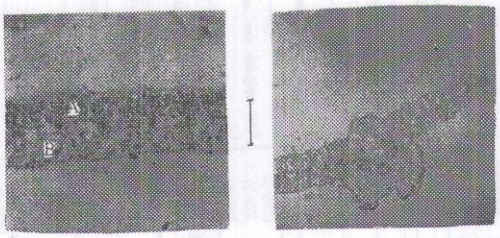


Fig (2) : Surface view of leaf epidermis.
(scale = 100 um)

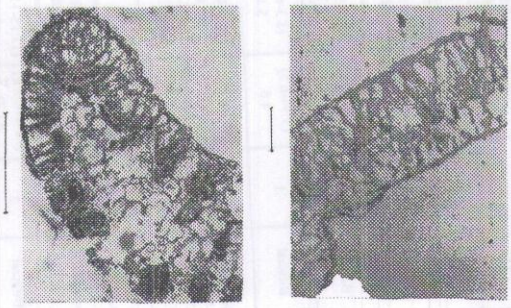
Table(2):Leaf anatomical characters of eight species of Chenopodiaceae

Species	Lamina thick (um)	Epidermis thick		Cuticle thick (um)	No. of palaside layer	Mesophyll type	Midrib vein		
		Upper epidermis	Lower epidermis				No. of vascular bundles	Thick (um)	Length of xylem arch
Bassia eriophora (Schard.) Aschers	(289.3-526) 379.15	(13.15-26.3) 19.72	(13.15-26.3) 18.08	(3.94-5.26) 4.6	1	isobilateral	-	-	-
Bassia hysopifolia (Pall.) Kuntze	(328.7-395.5) 351.10	(39.45-52.6) 46.02	(13.15-65.75) 43.50	(2.6-5.26) 3.93	1	isobilateral	-	-	-
Beta vulgaris var. *cicla* L.	(341.9-460.25) 401.07	(1.31-1.31) 1.31	(6.5-13.15) 9.82	(3.94-6.50) 5.22	1	Bifacial	3	(1.20-1.31) 1.05	(328.7-381.3) 359.4
Beta vulgaris var. *vulgaris* L.	(289.3-328.7) 309.02	(3.3-6.63) 5.19	(3.94-6.5) 4.6	(5.26-6.5) 5.88	1	Bifacial	3	(1.05-1.18) 1.11	(315.6-341.9) 324.36
Bienertia cyclopiera Bunge.	(328-460.6) 401.07	(26.3-46.02) 32.87	(39.45-52.6) 48.65	(1.31-2.63) 1.63	-	isobilateral	-	(0.78-2.63) 1.84	(65.75-105.2) 82.18
Cornulaca monacantha Del.*	-	--	-	-	-	-	-	-	-
Halocnemum strobilaceum (Pall.) Bunge*	-	-	-	-	-	-	-	-	-
Sedlitzia rosmarinus (Ehrenb.) Bunge	(289.3-310.5) 260.6	(32.42-65.75) 49.08	(32.42-56.3) 44.36	(1.31-2.63) 1.97	-	isobilateral	-	(2.10-2.76) 2.53	(104.3-340.2) 215.52
Spinacia oleracea L.	(197.2-223.5) 210.40	(13.15-13.15) 13.15	(32.87-52.6) 42.73	(2.6-3.94) 3.27	2	Bifacial	3	(1.70-210) 1.90	(302.45-328.75) 318.23

* without leaves



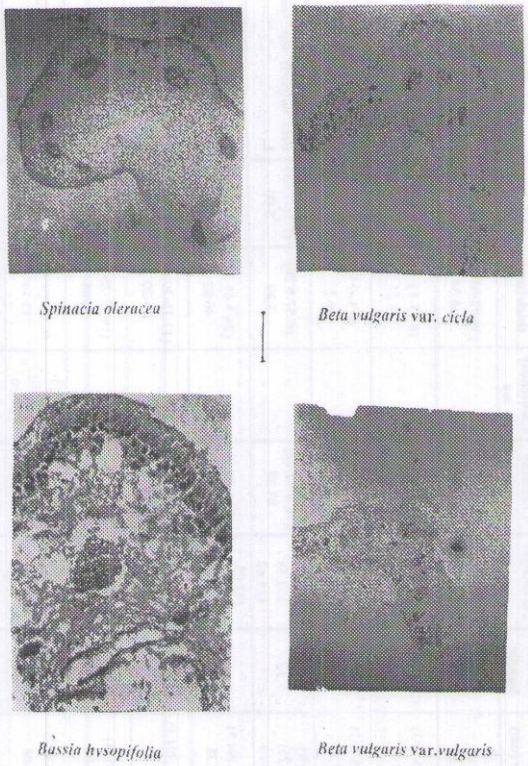
Spinacia oleracea *Beta vulgaris* var. *vulgaris*



Bassia hysopifolia isobilateral mesophyll

Beta vulgaris var. *cicla* Bifacial mesophyll

Plate (1) Transvers section of leaf lamina.
(scale = 100 um)
A-palisade layer B-spongy layer



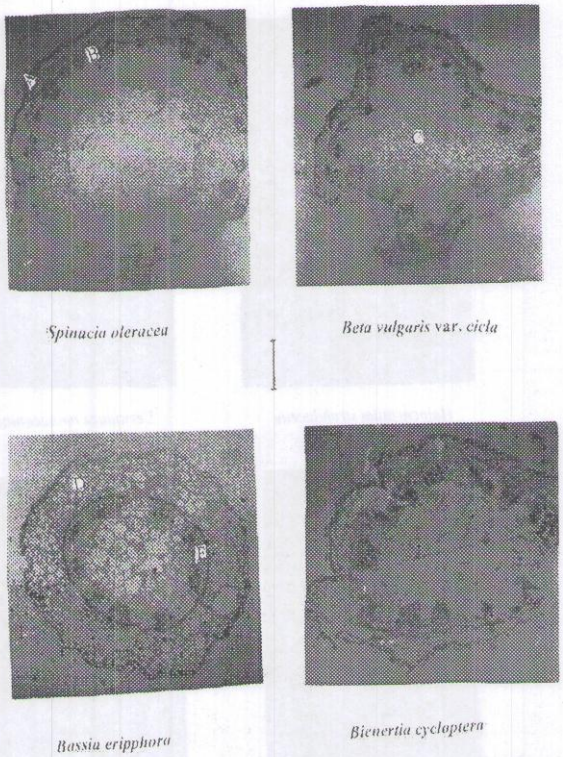
Spinacia oleracea *Beta vulgaris* var. *cicla*

Bassia hysopifolia *Beta vulgaris* var.*vulgaris*

Plate (2) Transvers section of petioles.
(scale = 100 um)

Table(3):Stem anatomical characters of eight species of Chenopodiaceae

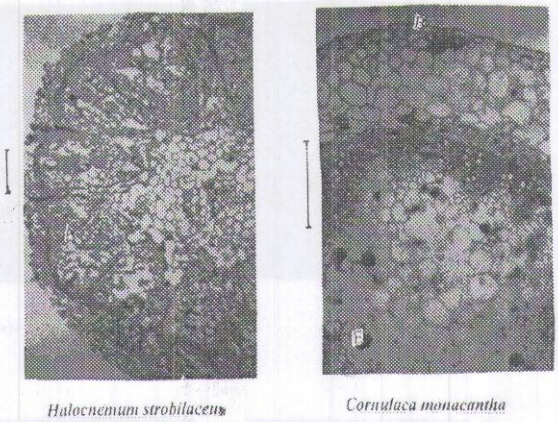
species	Cuticle thick (um)	Epidermis thick (um)	Cortex thick (um)			No. of vascular bundle	Length of vascular bundle (um)	Diameter of pith wide (um)	Stem wide diameter (um)
			Chlorenchyma	Collenchyma	Parenchyma				
Bassia eriophora (Schard.) Aschers	(3.94-6.57) 5.2	(46.02-65.75) 56.54	-	-	(131-394.5) 279.43	8	(197.25-223.55) 206.01	(0.98-1.05) 1.01	(1.84-2.36) 2.09
Bassia hysapifolia (Pall.) Kuntze	(1.30-2.63) 1.90	(6.57-13.15) 8.21	-	(39.45-65.75) 52.60	(65.75-197.25) 138.07	Continuos V.B	(223.55-263) 240.45	(0.85-1.02) 0.98	(2.03-2.03) 2.03
Beta vulgaris var. *cicla* L.	(1.31-3.20) 1.90	(6.5-6.5) 6.5	-	(65.75-92.05) 78.9	(118.35-131.50) 122.73	19	(197.25-263) 236.75	(1.31-1.97) 1.79	(1.97-306) 2.51
Beta vulgaris var. *vulgaris* L.	(1.31-2.63) 1.90	(6.57-9.20) 7.89	-	(78.9-92.02) 83.28	(105.2-131.5) 121.63	12	(170.95-197.25) 184.10	(0.78-0.98) 0.87	(1.57-2.82) 2.20
Bienertia cycloptera Bunge.	(1.31-3.94) 2.62	(26.3-65.75) 46.02	-	(52.6-78.9) 65.75	(92.05-328.7) 241.08	16	(197.2-394.5) 267.38	(0.92-1.31) 1.07	(3.22-3.61) 3.41
Cornulaca monacantha Del.	(6.57-6.57) 6.57	(13.15-39.40) 25.20	-	(52.6-263) 149.03	(263-294.5) 328.75	Continuos V.B	(144.65-394.5) 324.36	(1.11-1.24) 1.18	(2.76-2.89) 2.82
Halocnemum strobilaceum (Pall.) Bunge	(6.57-19.72) 13.15	(19.72-26.3) 24.65	-	-	(131.50-197.25) 162.18	Continuos V.B	(328-526) 410.93	(8.45-9.20) 8.87	(1.99-2.49) 2.30
Scalilzia rosmarinus (Ehrenb.) Bunge	(2.63-3.94) 2.62	(6.57-19.72) 13.14	(13.15-26.30) 21.36	(19.72-26.3) 24.10	(157-263) 197.25	Continuos V.B	(263-328.7) 293.68	(2.95-3.02) 2.99	(1.05-1.11) 1.08
Spinacia oleracea L.	(2.63-6.57) 4.33	(13.15-52.6) 35.87	-	(118.3-184.1) 140.26	(394.5-499) 429.56	28	(249-263) 258.06	hallow	(2.69-3.94) 3.44



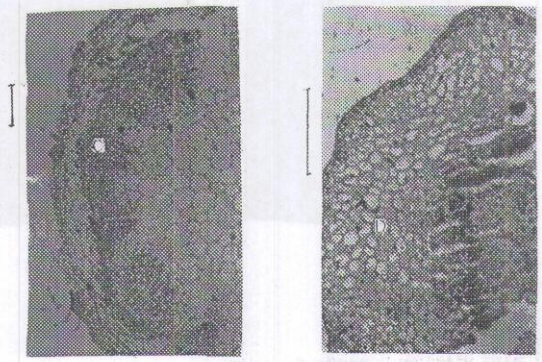
Spinacia oleracea *Beta vulgaris* var. *cicla*

Bassia eripphora *Bienertia cyclaptera*

Plate (3) Transvers section of stem.
(scale = 200 um)
A-collenchyma B-interfascicular cambium C-pith D-cortex
E-separated vascular bundle



Halocnemum strobilaceum *Cornulaca monacantha*



Bassia hysopifolia *Sedlitzia rosmarinus*

Plate (4) Transvers section of stem.

(scale = 200 um)

A_anomalous secondary growth B_epidermis

C_Concentric vascular bundle D_chlorenchyma E_druses crystals

References

AL-Edani, T.Y.(1998).A systematic study of the family Convolvulaceae in Iraq. Ph.D.Thesis, Basrah University.

AL- Ghizzi,H.R.,(2001).Systematic study of the genus *Chenopodium* L.In Iraq.M.SC. Thesis. Basrah University.

AL-Mayah,A.A.,(1983).The Taxonomy of *Terminalia*.Ph.D.Thesis. University of Lecester, U.K.

Barthlott, W. (1981). Epidermal and seed surface characters of plants: Systematic applicability and some evolutionary aspects. Nord. J. Bot., 1:345-355.

Black, R.F. (1954). The leaf. anatomy of Australian members of the genus *Atriplex*. The Amer. Mid. Natu. :270 - 285.

Cutler, D.F. (1979). The leaf surface studies in *Aloe* and *Haworthia* Species.

Dickison,W.C. (1975). The bases of Angiosperm phylogeny: vegetative anatomy. Ann. Miss. Bot. Card. 62: 590-620.

Ferguson, D.K. (1974). The significance of the epidermis for the taxonomy of *Cocculus*. Kew. Bull. 29: 483-492.

Henry, S. (1981). Plant anatomy. In: Staining procedures. Baltimore London: pp. 315-325.

Johansen,D.A. (1968). Plant microtechnique. McGraw-Hill Book Company. New York.

Lafta, A. H. (1996) A comparative systematic study of the genus *Atriplex* L. in Iraq . Ph. D. Thesis, Basrah University.

Lafta, A.H. and AL-Mayah, A. A. (2002). Taxonomic significance of anatomical characters in the genus *Atriplex* in Iraq. Basrah J. Agric. Sci. 15(2): 20-32

McArthur, E.D. and Sanderson, S.C. (1983). Distribution systematic and evolution of Chenopodiaceae. Provo. Utah: 14-23.

Metcalfe,C.R. and Chalk, L. (1950). Anatomy of the dicotyledons. Clarendor Press, Oxford.

Stace. C.A. (1965). Cuticular studies as an aid to plant taxonomy. Bull. Brit (Nat. Hist.) Bot. 4(1):3-78.

Uotila, P. (1974). Leaf anatomy in European species of *Chenopodium* sect. *chenopodium*. Ann. Bot. Fennici. 11:44-58.

Williams, J.T. and Ford-Lioyd, B.V. (1974). The systematics of the Chenopodiaceae. Taxon. 23:353-354.