MORPHOMETRIC AND ANATOMICAL COMPARATIVE FEATURES OF *CITRUSLIMON* (L.) BURM.,*CITRUS MAXIMA* (BURM.) MERR. AND *CITRUS*× *PARADISII*MACFAD.FRUITS

Razvan Dan Popoviciu, Rodica Bercu
Faculty of Natural and Agricultural Sciences,"Ovidius" University, Constantza
University Alley, No. 1, B, 900470, Constantza
E-mail: prof.rodicabercu@gmail.com

Key words: anatomy, exocarp,mesocarp, morphometry, Citrus

ABSTRACT

The purpose of this study is to present morphometric and anatomical features of the three species of Citrus L. fruit: Citrus limon(L.) Burm.,Citrusmaxima(Burm.) Merr. andCitrus× paradisii Macfad.Morphometrically were determined the length, width, area and volume for 10 fruits of each species. Anatomically, were analyzed the exocarp andmesocarp tissues, including the secretory cavities and endocarp components, respectively the number of carpels (segments) and the length of the juice vesicles.The studied species fruits disclose both similarities and differences concerning their morphometric and anatomical features.

INTRODUCTION

Citrus is a group of flowering plants belonging to Rutaceae family. The Latin word *Citrus* was borrowed from ancient Greek "kedros", but the Romans applied the word to several different trees with fragrant foliage or wood (compare the completely unrelated cedars (Andrews, 1961). The origin of *Citrus* flowering plants, belonging to Rutaceae family, due to the most recent research, is in Australia, New Caledonia and New Guinea (Calabrese, 2002; Liu and Tanumihardjo, 2005), whereas other researchers consider that the origin is in the part of S-E Asia, Mayanmar and in a province of China, Yunnan (Gmitter, Hu Xulan, 1990; Rainer, 1975).

Concerning the *Citrus* genus taxonomy, it is complex and no one can say precisely the right number of species due to the fact that many known species of them are clonally-propagated hybrids, evidenced by genetic research which showed that even some wild, true-breeding species are of hybrid origin (Nicolosi et al. 2000). Cultivated *Citrus* may be derived from as few as four ancestral species. Natural and cultivated origin hybrids include commercially important fruits such as the orange, grapefruit, lemon, some limes and some tangerines.

Lemon - *Citrus limon* (L.) Burm. (syn. *C. medica* L., *C. limonum*Risso, *Limon vulgaris* Mill.) is one of the most popular citrus plant because of its fruits active principles. *Citrus limon* is considered an evergreen shrub, native to Southeast Asia (China and North verses South India). It can reach 5 to 10 m height. Lime entered Europe during ancient Rome(web 4).The alternate elliptic in shape leaves are dark green at maturity and are6.25-11.25 cm in length, with a winged petiole. Slightly fragrant flowers can be solitary, the armpit two or more leaves. The flowers are white on the upper surface of the petals and purple on the lower one. The fruit is yellow but the color may vary from light green to bright yellow, sometimes it can be variegated. The fruit matures in late autumn in the northern hemisphere. Some fruits are seedless, but most have a few seeds (Morton, 1987).

Citrus maxima (Burm.) Merr. (syn .*C. grandis* (L.) Osbeck, *C*. *decumana*Murr. non L., *Aurantium maximum*Burma) –common known as pomelo or pummelo- was often considered a variety of grapefruit, but actually different varieties of pomeloderive

fromgrapefruit and different varieties of oranges. It is a tree that reaches 5-10 m (maximum 15 m) high, with low and scattered branches, the youngerpossessing thorns. The petiolate leaves, up to 7 cm long, are ovate to elliptic in shape, dark green with short hairs on them. They are 5-10 cm long and 2-5 cm width, rounded to sub cordate base, slightly crenate margins, and an acute apex. The flowers have five creamy white petalscovered with short hairs, with numerous stamens. In contrast to grapefruit where the flowers grow in clusters, the pomelo flowers and fruits born single. The pear-shaped green fruits are large (20-30 cm long) and ripen to yellow, orange, or red (Bailey and Bailey,1976; Morton, 1987; van Wyk, 2005).

Citrus ×*paradisii*Macfad. (syn. *Citrusparadisi*Macfad.,*Citrusdecumana* var. *paradisi* Nichols, *C. decumana* var. *racemosa*Roem., *C.racemosa* Maro), has received a scientific name *Citrus paradisi* only around half XIX century. Until then it was thought that is only another variety of pomelo - fruit of orange whose accidental crossing it results. It began to be widely cultivated in the early XX century. It is a tree, native to Asia, growing up to 10m, whose branches are devoid of thorns.The winged petiolate leaves are similar to those of *Citrus maxima*, lamina being shorter and narrower witha ciliate mid vein.Flowers are white growing in clusters of 2 to 20 flowers.The yellow or pink color fruits are almost spherical in shape and smaller than those of pomelo (Dianxiang et al., 2008).

In literature there are relatively many studies relating the species belonging to the genus *Citrus*, starting in the 19th century. Mostly researches followed the cytological aspects (Bacchi, 1944; Banerji, 1954; Chen, 1944, Gogoi et al, 2005, Nakamura, 1942; Randhawa and Choudhury, 1960; Yarnell, 1940), embryological aspects (El-Tomi, 1954; Furusato, 1951; Gurgel and Sobrinho, 1951; Johri and Ahuja, 1956; Pieringer and Edwards, 1965) and geneticalaspects (Koltunow et al., 1996; Rao et al., 1992; Reforgiato et al., 2005; Sharma and Bal, 1957) etc.Ample references on the structure of thevegetative organs, especially those concerning the secretory cavities and juice vesicles of some *Citrus* species are found in some ample studies of Bain (1958), Brent et al. (1990); Batanouny, 1992; Davis (1932); Kahn (2013); Turner et al. (1998);Matas et al. (2010), and succinct references are in general studies concerning the angiosperms anatomy (Esau, 1960; Metcalfe and Chalk 1950). The morphometric data of this fruits almost lack.In Romania literature there are few data on the structure of *Citrus* fruit species anatomy (Bercu, 2015; Tarnavschi et al., 1974) most of them referring to some vegetative organs being, mentioned in some lectures and manuals of Anatomy and Morphology of PlantsAnatomy (Buia and Péterfi, 1965; Niculescu, 2009).

The purpose of this study is to analyze the morphometric and anatomical features of this three species of *Citrus* fruits pericarpand to highlight the similarities and differences between them, contributing to the knowledge of this group of plants in general and particularly of their hesperidium - a modified berry.

MATERIAL AND METHODS

For the morphometric aspects, the measurements were carried out on 10 fruits of each studied species, as follows: the fruit length (L), the width (W) and for aria (A) and volume (V), were used conventional mathematical formulas (for sphere:$A = 4\pi r^2$, $V = 4/3\pi r^3$, for ellipsoid: $A = \pi ab$, $V = 4/3\pi abc$, where $c = \sqrt{a^2 - b^2}$, and for oblate ellipsoid: $A = \pi ab$, $V = 4/3\pi a^2 b$.

For the anatomical aspects, small pieces of the exocarp and mesocarp of the three species fruit were fixed in FAA (formalin: glacial acetic acid: alcohol 5:5:90). Cross sections of the leaf were performed by free hand made technique (Bercu and Jianu, 2003). The samples were stained with alum-carmine and iodine green. Anatomical observations and micrographs were performed with a BIOROM–T bright field microscope, equipped with a TOPICA 6001A video camera.

RESULTS AND DISCUSSION

Morphometric aspects. The lemon fruit is a typical ellipsoid in shape with two nipple-shaped protuberances at its ends. The lemons fruits are ellipsoid like in shape those of pomelo an oblong ellipsoid, whereas grapefruits are almost spherical in shape. It has been determined the length, width, surface and volume (Table 1) as follow:

The lemon fruits length is 7.00 – 9.20 cm
The lemon fruits width is 6.60 – 4.40 cm
The lemon fruits aria is 2417.8 - 4945.50 mm^2
The lemon fruits volume is 87530.64 – 152150.20 mm^3
The pomelo fruits length is 11 - 15 cm
The pomelo fruits width is 7 – 12.20 cm
The pomelo fruits aria is 6264.30- 14365.50mm^2
The pomelo fruits volume is 467421.18 – 1432958.62 mm^3
The grapefruit fruits length (diameter) is n 6.40 – 9.20cm
The grapefruitfruits radius is 3.20 – 4.60cm
The grapefruitfruits aria is 12861.44 – 26576.96 mm^2
The grapefruit fruits volume is 137188,69 – 407513.38 mm^3

Table 1.

The morphometric measurements of the studied Citrusspeciesfruits

The species	No. of fruct	The length (cm)	The width/radius (cm)	Aria (mm^2)	The volume (mm^3)
Citrus limon	1.	7.00	4.40	2417.8	87530.64
	2.	7.20	4.80	2712.96	72788.71
	3.	8.00	5.20	3265.60	124092.80
	4.	8.20	5.80	3733.46	108195.67
	5.	8.20	6.40	4119.68	105587.39
	6.	8.40	6.00	3956.40	116278.59
	7.	9.00	6.60	4662.90	142638.11
	8.	9.00	7.00	4945.50	139858.74
	9.	9.20	5.40	3899.88	145348.52
	10.	9.20	6.20	4477.64	152150.20
Citrusmaxima	1.	11.00	7.40	6389.90	467421,18
	2.	11.4	7.00	6264.30	474896,58
	3.	11.6	7.20	6556.32	505754,52
	4.	12.00	7.80	7347.60	586338,48
	5.	12.40	8.20	7981.88	658185,82
	6.	12.80	9.20	9244.16	786862.89
	7.	13.20	9.00	9325.80	818618.72
	8.	13.60	10.00	10676.00	965537.44
	9.	14.20	11.40	12707.58	1199976.77
	10.	15.00	12.20	14365.5	1432958.62
Citrus× paradisii	1.	6.4	3.20	12861.44	137188.69
	2.	6,8	3.40	14519.36	164557.74
	3.	7.00	3.50	15386.00	179503.33
	4.	7.20	3.60	16277.76	195333.12
	5.	7.40	3.70	17194.64	212067.22
	6.	7.80	3.90	19103.76	248348.88
	7.	8.00	4.00	20096.00	267946.66
	8.	8.20	4.10	21113.36	137188.69
	9.	8.40	4.20	22155.84	310181.76
	10.	9.20	4.60	26576.96	407513.38

Table 2

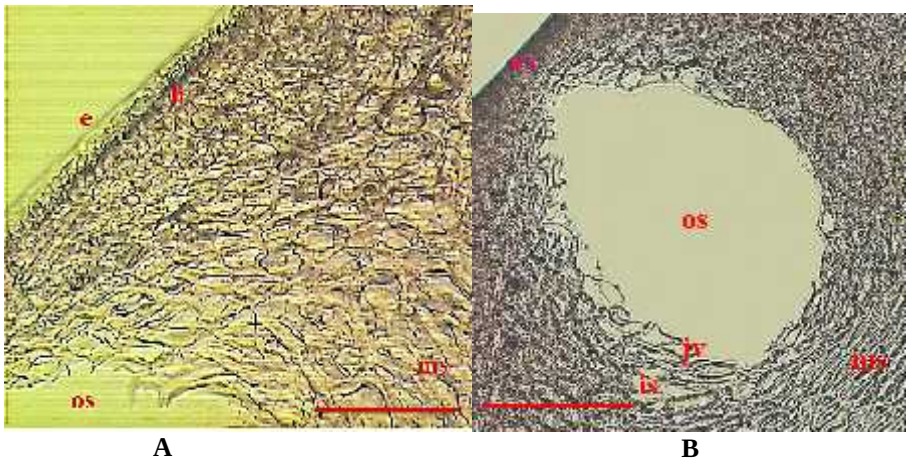
The exocarp color, the secretory cavities length and width, number of carpels and juicee vesicles size of the studied speciesfruits

Species	No. of fruct	The exocarp color	The secretory cavities sizes length and width (µm)		No. of carpels	The 20 cells length of an endocarp carpel (mm)	
			L	l		first row	second row
Citrus limon	1.	yellow	343.54	242.90	8	3-4	5-6
	2.	yellow	247.75	199.17	10	4-6	6-8
	3.	yellow	276.90	218.61	9	4-5	6-8
	4.	yellow	267.19	218.61	8	3-5	5-7
	5.	yellow	412.93	281.76	9	3-5	6-8
	6.	yellow	340.06	242.90	10	4-6	6-8
	7.	yellow	281.16	228.32	10	4-6	6-8
	8.	yellow	388.64	242.90	8	4-5	5-7
	9.	yellow	301.19	252.61	8	3-4	5-6
	10.	yellow	342.85	240.00	9	4-5	6-8
Citrus maxima	1	yellowish-green	17.72	130.30	13	6-8	8-10
	2	yellowish-green	151.51	145.45	14	5-7	8-12
	3	yellowish-green	169.69	136.36	12	5-7	8-10
	4	yellowish-green	166.66	12121	15	6-8	9-12
	5	yellowish-green	145.45	115.15	15	6-8	9-12
	6	yellowish-green	169.69	115.14	14	5-7	8-12
	7	yellowish-green	169.69	127.26	12	5-7	8-10
	8	yellowish-green	151.50	115.14	13	6-8	8-10
	9	yellowish-green	157.56	133.32	14	6-8	9-12
	10	yellowish-green	175.74	127.26	12	5-7	8-10
Citrus ×paradisii	1	yellow-red	281.25	225.00	13	6-8	9-12
	2	yellow-red	281.23	212.50	12	6-8	8-10
	3	yellow-red	287.50	250.00	13	7-8	8-11
	4	yellow-red	281.25	243.75	14	6-9	10-12
	5	yellow-red	243.75	215.62	14	6-8	8-11
	6	yellow-red	225.00	171.87	12	5-7	7-9
	7	yellow-red	231.20	193.75	13	5-8	8-12
	8	yellow-red	265.62	212.50	14	6-8	9-12
	9	yellow-red	187.50	181.25	12	5-8	8-10
	10	yellow-red	203.12	193.75	13	5-7	8-12

II. Anatomical aspects. All studied species fruit is a hesperidium with a rind comprising several distinct tissues. Externally, in cross-section, it consists of exocarp (flavedo) and mesocarp (albedo). The exocarp consists of epidermis, formed by a single continuous layer of more or less conical cells for *Citruslimon*, slightly radially elongated for *C. maxima* and tabular for *C.* × *paradisii*, covered on the outer periclinal wall by a hydrophilic cuticle. Such asMatas et al (2010) reported for *C. clementina*, the cuticle intrudes part way between the anticlinal walls of cells in our findings for *C. limon* and *C. maxima*. The epidermis is interrupted by the presence of stomata. Just below the epidermis a many-layered spongy tissue, with hypodermal value (albedo), is present: 6-7 layers of cells for *C. limon*, 8-12 layers of cells for *C. maxima* and 7-8 layers of cells for *C.*×*paradisii*(Fig. 1,A; 2, A,C).Within this parenchymatous tissue occur crystal idioblasts and several secretory cavities, appearing as a large hallow space, surrounded by flattened essential oil gland cells (Fig. 1, B, 2, B, D). The whitespongy of albedo is rich in pectin.

The development of the secretory cavities of *Citrus* species remains controversial and as well the relation between the development of secretory cavities and the essential oil product which is also unknown. Some authors consider that the secretory cavities develop by lysingor gelling cell walls (Bavaru and Bercu, 2002; Fahn (1935); Metcalfe and Chalk, 1950; Tarnavschi*et al*., 1974). Recent studies of Turner *et al*., (1998) and She-Jiang Liang et al. (2006) show for *C. limon* and *Citrus medica* L. var. *sarcodactylis*that the secretory cavities developed schizogenously and their epithelial remain living long after maturation and this can be extended to other *Citrus* species.

The secretory cavities of *C. limon*and *C.* ×*paradisii*have a circular shape whereas *Citrusmaxima*isoval-shaped. All secretory cavities are coated with a layer of secretory cells with thin tangentially elongated cellulose walls, penetrating the mesocarp (Fig. 1, B; Fig. 2, B, D). Their sizes are between 247.75- 412.93 µm length and 199.17- 281.76 µm width for *C. limon*, 145.42 – 175.74 µm length and 115.14 – 145. 25 width for*C. maxima*. The lengthof *Citrus* ×*paradisii*secretory cavities is 187.50 – 287.50 µm and 143.75 – 250.00 µmwidth (Table 2). They are numerous in *C. limon* and *C.* × *paradisii*flavedo and and smaller in *C. maxima*.Flavedo cells consists carotenoids with chromoplasts, which give the characteristic color of the mature fruit yellow for *C. limonreticulata,* yellowish-green for *C. maxima* and yellow red for *C.* ×*paradisii* (Table 2).



A **B**

Fig. 1. Cross secton of exocarp and mesocarp with oil sacs of *Citruslimon* (A, B): e- epidermis, ex- exocarp, h- hypodermis, is- intercellular space,jv- juice vesicle, ms- mesocarp, os- oil sac. Scale bar 150 mµ.

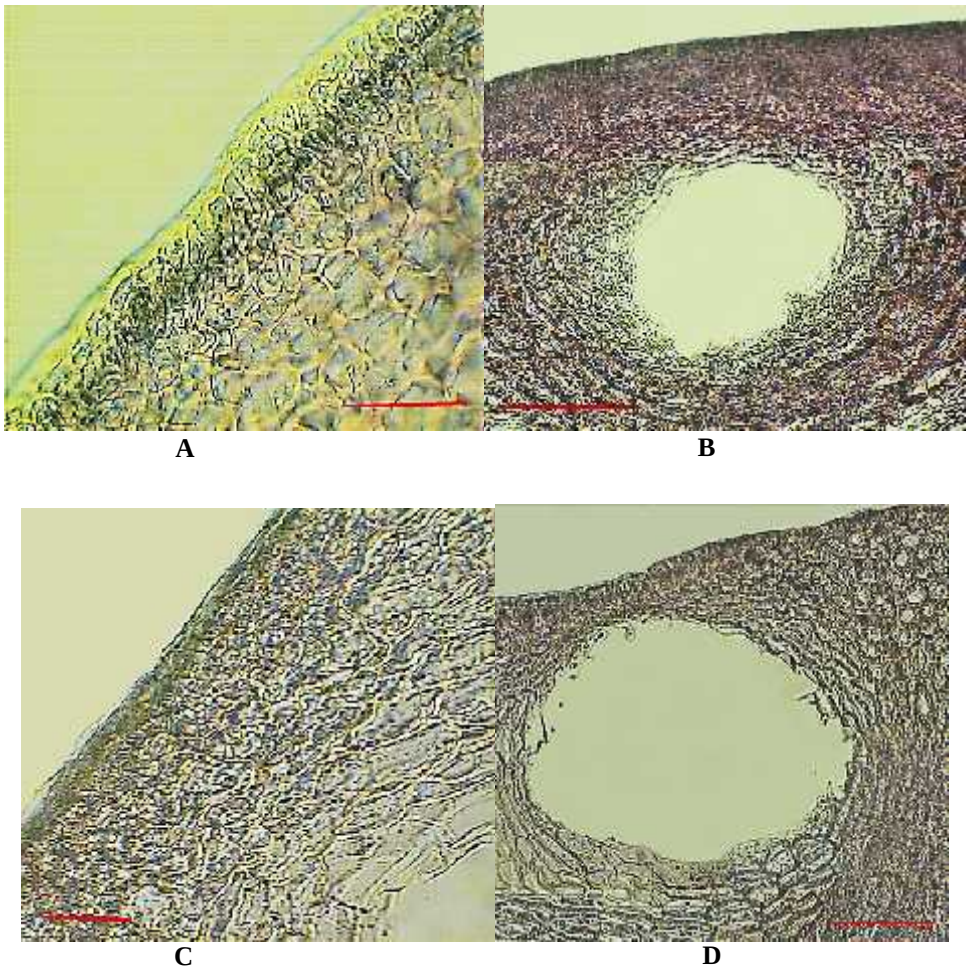


Fig. 2. Cross section of exocarp and mesocarp and oil sacs of *Citrusmaxima* (A, B) and*Citrus*×*paradisii*(C, D). Scale bar A- 150; B-D-100 mμ.

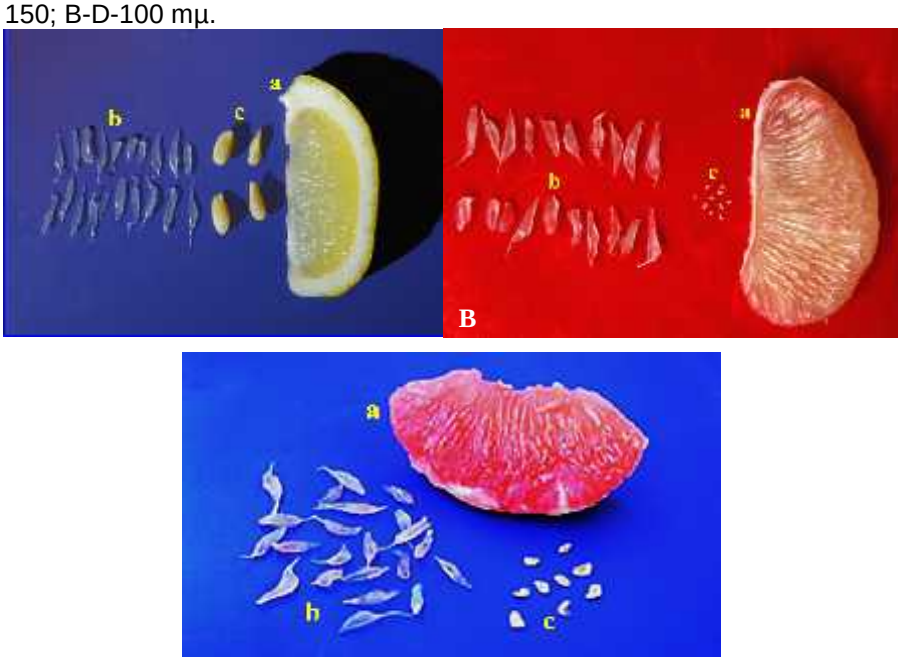


Fig. 3. Natural view of a carpel (a) with 20 juice vesicles (b) and seeds (c) of *Citrus limon* (A), *Citrus maxima* (B) and *Citrus*× *paradisii* (C).

Endocarp (or pulp) is the membranous content of the fruit's and appear segmented (divided) into a different number of carpels: 8-10 carpels for *Citruslimon*fruits, 12-15 for *C. maxima* and 12-14 carpels for *C.* ×*paradisii*(Table 2). Each carpel is composed of juice

vesicles (juice sacs) - secreting spindle like cells with thin membranes, containing essential oil. According to K. Esau (1960), the juice sacs originate as multicellular hairs in which the interior of the enlarged distal part breaks down and fills with liquid.The juice vesical length is 5-6 mm for *C. limon*, 4-12 mm for *C. maxima* and 5-10 mm for *C. ×paradisii* fruits (Fig. 3; Table 2). Such asBrent et al. (1990) and Cameron et al. (1964) reported, the color of the pulp is variable, depending on the species and the ripening stage. Usually, it has the color of the outer peel.

CONCLUSIONS

Concerning the morphometric aspects of the studied species fruits, they have distinctive features in terms of length, width, area and volume. The larger fruits in length and width are those of*Citrus maxima*, followed by *C. ×paradisii*and *C. limon.* The largest area and volume have the fruits of *Citrus maxima,* followed by*Citrus ×paradisii*and *C. limon*.

Anatomically, the investigated species fruits present constant anatomical characters, such as the epidermis which consists of a single-layered cells covered bya thick cuticle, the presence of stomata and mesocarp which has large parenchyma cells with airspaces, the presence of the secretory cavities, extended from the exocarp to mesocarp. The juice vesicles are filled with flavored essential oil. The exocarp of all studied *Citrus* species fruits, contain pigments that give the distinctive color of each fruit.

Differences appear concerning the epidermal cells conformation, the cuticle thickness, (thicker for*C. maxima* in comparison with the rest of *Citrus* species),the number of hypodermal layers, which are more numerous in*C. maxima*, followed by *Citrus × paradisii*and*C. limon.*Paradoxically, the larger fruit of *C. maxima* have a smaller number and size of secretory cavities than the rest of species. Concerning the number of carpels and the length of the endocarp juice vesicals, *Citrus maxima* and *C. ×paradisii* are numerous and longer than those of *C. limon.*

BIBLIOGRAPHY

1.**Andrews A.C**., 1961 -*Acclimatization of citrus fruits in the Mediterranean region, Agricultural History*,35(1): 35-46.
2.**Bacchi O.**, 1944 -*Observacões citológicas em citrus: VI. Resultados preliminores do efeito da colchicina sôbre sementes em germinacão, Bragântia*, 4: 679-91.
3.**Batanouny K.H**, 1992 - A Text Book of Botany/Plant Anatomy, 4thedition, Cairo University Press, Cairo.
4.**Bailey L.H., Bailey E.Z.,** 1976 -*Hortus Third: A concise dictionary of plants cultivated in the United States and Canada, McMillian, New York.*
5.**Bain M.J.**, 1958 -*Morphological, anatomical, and physiological changes in the developing fruit of the Valencia orange*, *Citrussinensis*Osbeck,*Austral. Jour. Bot.*6(l): 1-24.
6.**Banerji I.**,1954 -*Morphological and cytological studies on Citrus grandisOsbeck,Phytomorphology*, 4: 390-396.
7.**Bavaru A., Bercu R.,** 2002 -*Morfologia si anatomiaplantelor, Edit. Ex Ponto, Constanta*.
8.**Bercu R.,Jianu L.D.,** 2003 -*Practicum de morfologia si anatomiaplantelor, Edit. Ex Ponto, Constanta*.
9.**Brent T., Jones D.,Galletta D P**.,1990 -*Juice Vesicle Populations in Citrus Fruit,Botanical Gazette*, 151(1): 9.
10.**Buia Al., PéterfiŞt.**,1965.*Botanicaagricolă, Edit. Agro-Silvică, Bucureşti*.
11.Calabrese, F. 2002. Origin and history. In: G. Dugo, Di Giacomo (eds.), Citrus: The genus Citrus,pp. 1–15, Taylor & Francis, London, New York.
12.**Cameron J.W.,Soost R.K.**, **Olson. E.O.**, 1964 -*Chimeral basis for color in pink and red grapefruit, Jour. Hered*.,55: 23-28.

13.**Chen T.Y.**, 1944 -*Cytological observations on twenty-two citrus fruits, Jour. Agr. Assoc. China,*177: 1-8.
14.**Davis, W**. **B.**, 1932 -*Deposits of oil in the juice sacs of citrus fruits, Amer. Jour. Bot*.,19: 101-105.
15.**DianxiangZ., Hartley T.G., Mabberley, D.J.**, 2008 -*Flora of China, Vol. 11,* pp. 51, 90–96, 98http://flora.huh.harvard.edu/china/pdf/PDF11/Citrus.pdf
16.**El-TomiA.L**., 1954 -*Effect of cross-pollination on fruit setting in Washington navel orange, Citrus Indus*, 35: 5-6.
17.**Esau K**., 1960 -*Anatomy of Seed Plants, John Wiley & Sons Ltd, New York; Chapman and Hall Ltd., London*.
18.**Esau K.**, 1965*. Plant Anatomy, John Wiley & Sons,* 2nd edition, *New York*, *London, Sydney*.
19.**Fahn M.**, 1935 - *ZurEntstehung und Weiterbildung der Exkreträume von Citrus medica L. and Eucalyptus globulus, Lab. Oesterr. Bot. Zeitschr*., 84: 198-209.
20.**Furusato, K.,** 1951 -*Genetics and breeding in Citrus, Ann. Rept. Natl. Inst.Genet (Japan)*, 2: 41-42.
21.**Gmitter F., Hu, Xulan**, 1990 -*The possible role of Yunnan, China, in the origin of contemporary Citrus species (Rutaceae),Economic Botany*,44(2): 267–277.
21**. Gogoi M., SinghB., Rethy P., Mishra A.K.**, 2005 -*Cytological studies in some Citrus species of Arunachal Pradesh, The Indian Journal of Genetics and Plant Breeding*, 65(1): 70-72.
22**. Gurgel J.T.A**., **Sobrinho J. S**., 1951 -*Analise de poliembrionia em Citrus, máxime em toranjas, Anais Esc. Super. Agr. "Luis de Queiroz," Univ. Saõ Paulo*, 8:727-46.
23**. Johri, B.M.,Ahuja M.R**., 1956 -*Development of endosperm and nucellarpolyembryony in Aegle marmelos,Corrêa, Curr*. Sci., 25:162-64.
24. **Khan, M.A.**, 2013 -*The Anatomy of Citrus Bark: Variations in the Structure and Development of Component Tissues in Various Species, Lambert Academic Publishing, Germany*.
25**. Koltunow M.A.**, **Hidaka T., Robinson P.S.**, 1996 -*Polyembryony in Citrus, Plant Physiol*., 110: 599-609.
26**. Liu Y., Heying E., Tanumihardjo S.**, 2012 -*History, Global Distribution, and Nutritional Importance of Citrus Fruits, Comprehensive Reviews in Food Science and Food Safety*, 11: 6.
27**. Matas A., Agusti J., Tadeo F.R., Talón M., Jocelyn R.**, 2010 -*Tissue specific transcriptome profiling of the citrus fruit epidermis and subepidermis using laser capture microdissection, J. Exp. Bot.(Lancaster, UK),*61: 3321-3330.
28**. Metcalfe C.R., Chalk**, **L**., 1950, *Anatomy of the Dicotyledons,* vol2,*ClarendonPress*, *Oxford*.
29**. MortonJ**. 1987 -*Pummelo. Citrus maxima. p. 147–151. In: Fruits of warm climates, published by Julia F. Morton (Purdue University), Miami*, FL.
30**. Nakamura M.,** 1942 -*Cytological studies in the genus Citrus. III. Further data on chromosome numbers, Jour. Hort. Assoc. (Japan),*13:30-40.
31**. Nicolosi E., Deng Z.N., Gentile A., La Malfa S., Continell G., TribulatoE**., 2000,*Citrus phylogeny and genetic origin of important species as investigated bymolecular markers, Theoretical and Applied Genetics*, 100(8): 1155-1166.
32. **Niculescu M.,** 2009 -*Morfología şi anatomía plantelor*,vol. I, *Edit.Sitech, Craiova*.
33. **Niculescu, Mariana,** 2009 - *Metode de cercetare şi prezentare a florei,* Ed. Sitech, Craiova, 2009, 119 p., ISBN 978 606-530-322-5
34**. Pieringer A.P**., **Edwards J.G.,** 1965 -*Identification of nucellar and zygotic Citrus seedlings by infrared spectroscopy, Proc. Amer. Soc. Hort. Sci*., 86: 226-34.

35**. Rao A.R., Khan M.D., Hameed M., MahmoodT.**, 1992 -*Polyploidy in Citrus species and biotypes in Punjab, Proc. Ist. Int. Sem. Pak*., pp. 89-102.
36**. Randhawa G.S.,Choudhury S.C.**, 1960 -*Studies on cytology of lemon (Citrus limonBurm.), Hort. Adv. (Saharanpur)*, 4: 68-71.
37**. Reforgiato R., RussoG.,Recupero S**., 2005 -*New promising Citrus triploid hybrids selected from crosses between monoembryonic diploid female and tetraploid male parents, Hort. Science*., 40: 516-520.
38**. Rainer W**. **S.**, 1975 -*On the history and origin of citrus, Bulletin of the Torrey Botanical Club,*102(6): 369–375.
39**. Sharma A.K.,Bal A.K.**, 1957 -*Chromosome studies in Citrus* L., *Agron. Lusit.,*19: 101-26.
40**. She-Jiang Liang, Hong Wu, Xuan Lun, Dong-Wen Lu**, 2006 -*Secretory CavityDevelopment and Its Relationship with the Accumulation of Essential Oil in Fruits of Citrus medica L. var. Sarcodactylis (Noot.) Swingle, J.Integrat. Plant Biol.*, 48(5): 573-583.
41**. Tarnavschi I.T., Şerbănescu-Jiatru G., Rădulescu-Mitroiu N., Rădulescu D.**,1974 -*Practicum de Morfologie şi anatomie vegetală, Edit. Universităţii Bucureşti*.
42**. Turner G. W., Berry M.A., Gifford M.E**., 1998 -*Schisogenous secretory cavities of Citrus limon (L.) Burm.f. and a reevaluation of the lysigenous gland concept, J.Plant Sci.*, 159(1): 75-88.
43**. vanWyk**, **B. E**., 2005 - "*Citrus maxima." Food Plants of the World: An Illustrated Guide, Timber Press, Portland*, OR.
44**. Yarnell S.H.,** 1940 -*Citrus cytological investigations, Texas Agr. Expt. Sta. Ann. Rept*.: 53:22.