Nat. Volatiles & Essent. Oils, 2021; 8(4): 13863-13874

NVEO
Natural Volatiles &
Essential Oils

Structural Features Of The Leaf Of Magnolia Soulangeana Soul Sheet. Bod. (Family Magnoliaceae Juss.) Growing In The Sunny And Shadow Conditions OfThe Tashkent Botanical Garden

Duschanova G.M

Tashkent State University named after Nizami, Uzbekistan, Tashkent

Annotation. A comparative study of the anatomical structure of the leaf of Magnolia soulangeana in sunny and shadow conditions of the Tashkent Botanical Garden was carried out and a different combination of xeromorphic and mesomorphic features was determined, which ensures adaptation to habitat conditions. Mesomorphic features: the outlines of epidermal cells are more sinuous;large, few epidermal cells with thin outer walls; large cell spongy parenchyma; non- submerged stomata; large vessels in conductive bundlespredominate in sunny and shadow habitats. Xeromorphic signs: small, numerous epidermal cells with thick outer walls; small cell spongy parenchyma; high palisade index; small vessels in conductive bundlespredominate in sunny and shadow habitats. In sunny and shadow conditions, mesomorphic characters are more prevalent in Magnolia soulangeana than xeromorphic ones, which indicates more adaptability to mesophytic habitat conditions.

Key words: Magnolia soulangeana, leaf, adaptation, light, shadow, anatomy,morphology.

Introduction

Most of the park ecosystems in the region are evergreen sanatorium parks of continuous flowering. The favorable climate makes it possible to make the main component of the floral decoration of local parks woody plants, relatively low shrubs and bushy trees, which are unique for park construction in Uzbekistan. Among the plants of this group, which bloom in all seasons, the most decorative and exotic are deciduous bushy magnolias (Karpun, 1985). Their decorative effect is due both to large flowers with an attractive color, and to the fact that flowering occurs at the very beginning of the appearance of leaves, when bright flowers are especially noticeable. At the same time, the cultivation of these spectacular plants is underdeveloped and is associated with well-known difficulties of a bioecological nature (Istratova, 1964; Misnik, 1976; Garbuzova, 2002).

Among the deciduous shrub magnolias in the region, Magnolia liliaeflora Desr. and hybrids with her participation: M. x soulangeana Soul.-Bod. nM x lennei Van Houtte is almost a quarter of the available taxa (Karpun, 2003, 2010a, 20106). It was these species that were chosen as the main objects of research, which were carried out throughout the entire region. This group of magnolias is represented mainly by garden forms of seed origin; therefore, the study of their form diversity ishighly relevant (Pilipenko, 1978).

The change in the structural and functional properties of plants along ecological gradients is the result of the influence of evolutionary and ecological factors and reflects the change in the importance of adaptive mechanisms at different levels of plant organization (Diaz et al., 1998; Wright et al., 2004). Quantitative changes occurring within a species, as well as in the community as a whole, make itpossible to assess the contribution of various parameters to the adaptation of individual plant species to environmental factors. The well-known conservatism of the structure of integumentary tissues and the conducting system, which are successfully used for global systematic and phylogenetic studies (Vasilevskaya, 1954; Esau, 1969; Gamaley, 2004), makes it impossible to use them in the study of adaptation to local environmental conditions. The most environmentally plastic structure of the leaf mesophyll. Thus, the type of mesophyll structure reflects the growing conditions of the species: the homogeneous type is more common in shade-loving plants, while the dorsoventral type is characteristic of light-loving mesophytes, and the isopalisad type is characteristic of xerophytes (Esau, 1969; Vasilevskaya and Butnik, 1982).

We have studied a comparative analysis of the anatomical and morphological features of the leaf blade of Liriodendron tulipifera under conditions of high and low illumination and, accordingly, extremely high and moderate temperatures, showed that leaves from open well-lit habitats exhibit xeromorphic characters, and mesomorphic ones in the shade (Akinshina, Duschanova, Azizov et al, 2020).

The study of intraspecific variability, the identification of adaptive mechanisms under the influence of unfavorable environmental stress factors is the most important stage in comprehensive studies of the ecological biological characteristics of deciduous bush magnolias. Such studies are necessary for the subsequent rational use of deciduous bushy magnolias in landscaping objects of landscape architecture for various purposes.

Purpose of the research: comparative study of the anatomical structure of the leaf of Magnolia soulangeana in sunny and shadow conditions of the Tashkent Botanical Garden, to identify diagnostic signs and adaptive features of this species.

Materials and methods

The object of study was the sulange magnolia (Magnolia soulangeana Soul.- Bod.) - a species of flowering plants from the genus Magnolia of the Magnoliaceae family. The studies were carried out under conditions of introduction at the North American exposition of the Tashkent Botanical Garden named after acad. N.F. Rusanov at the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan. For anatomical studies, a sheet was fixed in 70% ethanol. The epidermis was studied on paradermal and cross sections. Cross-sections of the leaf - made through the middle. Descriptions of major tissues and cells are given in accordance with classical methods (Esau, 1969; Zakharevich, 1954; Evert, 2006; Cutler, Botha, and Stevenson, 2007). Anatomical measurements were taken with a micrometer eyepiece attached to the microscope. The number of stomata and epidermal cells was counted per 1 mm2 of surface area. Various anatomical features of the leaf: adaxial and abaxial sides of the leaf epidermis; mesophyll structure; the height of the epidermal cells; cuticle thickness; parenchyma cell diameter; diameter and number of vessels; stomata length / width; submerged stomata; the number of layers of mesophyll cells; diameter and number of layers of spongy cells, height, width and number of layers of palisade parenchyma; the diameter and number of layers of collenchymal cells were measured with a micrometer under a microscope. The measurement was carried out depending on the organ, tissues and cells in 30-fold repetition with an eyepiece micrometer with subsequent conversion to microns. Hand-prepared preparations were stained with methylene blue, followed by gluing in glycerin-gelatin (Barykina, Veselova, Devyatov et al., 2004). Micrographs were taken with a computer microphoto attachment with a Canon A123 digital camera under a Motic B1-220A-3 microscope. Statistical processing of quantitative data was carried out according to generally accepted criteria (Zaitsev, 1991) using a personal computer (MS-Excel program). The results of the statistical analysis are shown in the table.

Magnolia soulangeana leaves are lyre-shaped, in most cases consisting of four lobes, with an obverse-heart-shaped, notched apex. The size of the leaves varies between conditions (sun and shade).

Anatomical structure of the leaf of Magnolia soulangeana in sunny conditions. On the paradermal section, the outlines of epidermal cells are sinuous, the projection is polygonal and chlorophyll-bearing. However, the upper epidermis is somewhat different from the lower epidermis. The cells of the upper epidermis are larger than those of the lower. In the cell membranes of the epidermis, the nucleoli are clearly visible on both sides of the leaf. The adaxial and abaxial epidermis is covered with unicellular trichomes. The leaves are hypostomatic - the stomata are located on the abaxial (lower) side of the epidermis of the leaf blade and are located transversely to the longitudinal axis of the leaf. All this leads to a reduction in water loss from the leaf surface. The stomata are oval, 23.7 ± 0.2 µm long, 13.2 ± 0.09 µm wide, not submerged. Stomatal guard cells on both sides of the leaf are almost the same length. The

stomata are of the paracytic and hemiparacitic types, the hemiparacitic type of stomata predominates more (Picture 1, 2; Table 1).

Leaf mesophyll on a cross section of the dorsiventral type, which is represented by palisade cells located under the upper epidermis of the leaf mesophyll, spongy cells - above the lower epidermis of the leaf mesophyll. The epidermis is represented

by one row of cells with a thick-walled cuticle layer. The cells of the adaxial epidermis are larger than those of the abaxial epidermis.

Assimilation tissue, consisting of palisade and spongy cells, is located between the adaxial and abaxial epidermis. A single-row palisade parenchyma is located under the adaxial epidermis. The palisade parenchyma is chlorophyll-bearing, elongated, consists of two rows of cells and is located between the adaxial epidermis and the spongy parenchyma of the leaf. The height of the palisade parenchyma cellsis 28.6 ± 0.3 μm, the width is 9.5 ± 0.09 μm. The palisade index is high - 3. The spongy chlorophyll-bearing parenchyma consists of 6-7 rows and is located betweenthe palisade parenchyma and the abaxial epidermis. The spongy parenchyma is round, small-celled with large cavities. Numerous lateral conductive bundleswith 3-4 small vessels are located between palisade and spongy cells (Picture 3, 4; Table 1).

The main vein of the leaf protrudes on the abaxial side. Lamellar 2-3-row collenchyma is located under the adaxial and abaxial epidermis in the leaf ribs. The rest of the vein is occupied by the main parenchyma, into which 6 conductive bundlesare immersed, the parenchyma cells are thick-walled and multifaceted, among which there are hydrocytic cells. The conducting bundles are closed collateral, consist of 4 large and 2 small bundles. Large and small conducting beamsalternate with each other. The conductive bundles are sclerified due to the presenceof mechanical tissues (sclerenchyma) in them. The xylem vessels are thick-walled, elongated with a diameter of 36.1 ± 0.3 μm (Picture 3, 4).

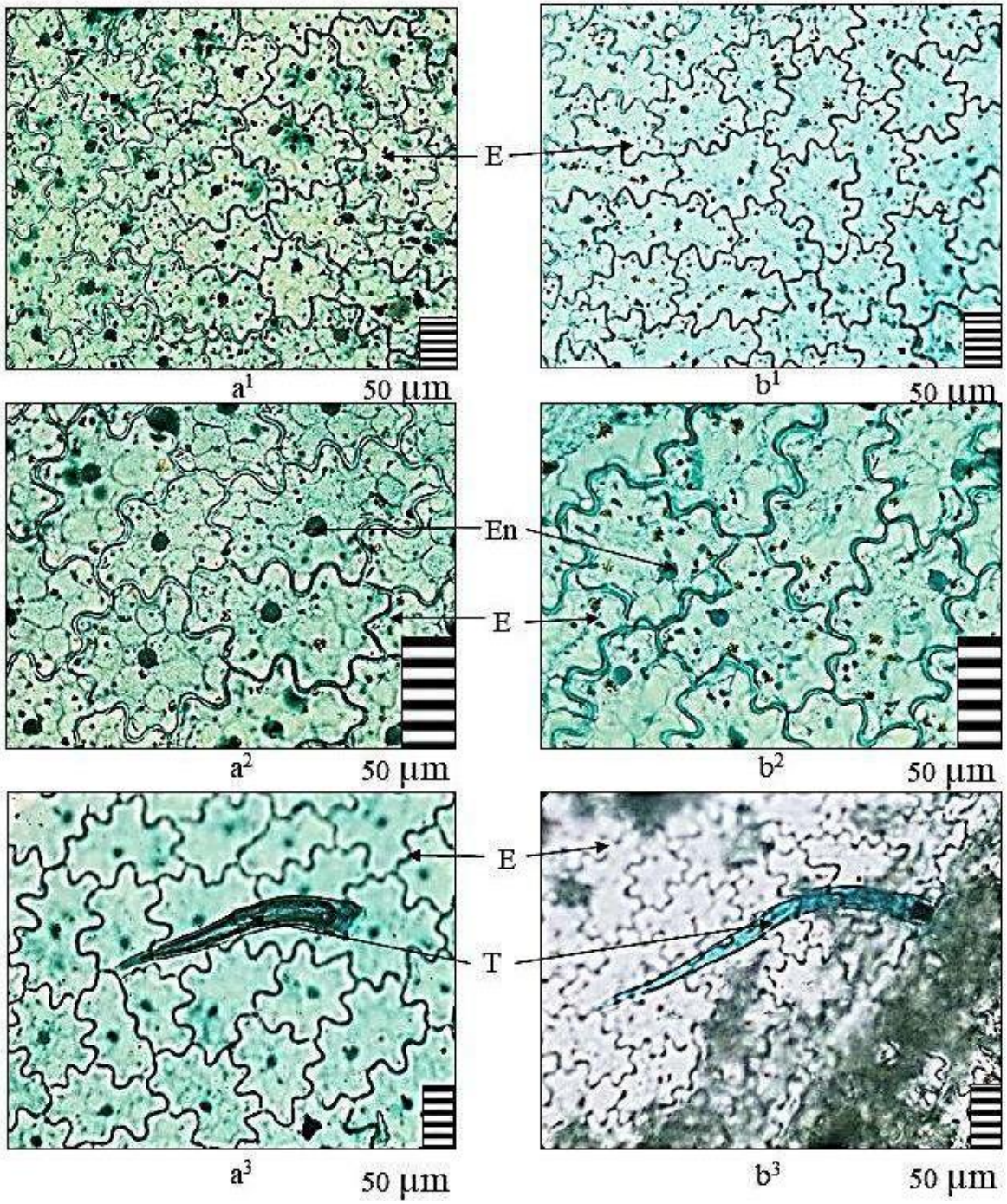
Anatomical structure of the leaf of Magnolia soulangeana in shadow conditions. On the paradermal section, the outlines of epidermal cells are highly sinuous, the projection is polygonal and chlorophyll-bearing. However, the upper epidermis is somewhat different from the lower epidermis. The cells of the upper epidermis are larger than those of the lower. In the cell membranes of the epidermis,the nucleoli are clearly visible on both sides of the leaf. The adaxial and abaxial epidermis is covered with unicellular trichomes.

The leaves are hypostomatic - the stomata are located on the abaxial (lower) side of the epidermis of the leaf blade and are located transversely to the longitudinal axis of the leaf. All this leads to a reduction in water loss from the leaf surface. The stomata are oval, 34.2 ± 0.3 μm long, 15.8 ± 0.08 μm wide, not

submerged. Stomatal guard cells on both sides of the leaf are almost the same length. The stomata are of the paracytic and hemiparacitic types, the hemiparacitic type of stomatapredominates more (Picture 1, 2; Table 1).

Leaf mesophyll on a cross section of the dorsiventral type, which is represented by palisade cells located under the upper epidermis of the leaf mesophyll, spongy cells - above the lower epidermis of the leaf mesophyll. The epidermis is represented by one row of cells with a thin-walled cuticle layer. The cells of the adaxial epidermis are larger than those of the abaxial epidermis. Palisade and spongy parenchyma is located between adaxial and abaxial epidermis. The palisade parenchyma is located under the adaxial epidermis. The palisade parenchyma is chlorophyll-bearing, small and short, which consists of two rows of cells and is located between the adaxial epidermis and the spongy parenchyma of the leaf. The height of the palisade parenchyma cells is 25.3 ± 0.22 μm, the width is 12.5 ± 0.1 μm. The palisade index is low - 2. The spongy parenchyma is chlorophyll-bearing, consists of 7-8 rows and is located between the palisade parenchyma and the abaxialepidermis. The spongy parenchyma is round, small-celled with large cavities.Numerous lateral conducting bundles are located between palisade and spongy cells(Picture 3, 4; Table 1).

The main vein of the leaf protrudes on the abaxial side. Lamellar 1-2-row collenchyma is located under the adaxial and abaxial epidermis in the leaf ribs. The rest of the vein is occupied by the main parenchyma, into which 6 conductive bundlesare immersed; the parenchyma cells are thick-walled, rounded-oval, amongwhich there are also hydrocytic cells. The conducting bundles are closed collateral, consist of 4 large and 2 small bundles. Large and small conducting beams alternate with each other. Conductive bundles are sclerified due to the presence of mechanicaltissues (sclerenchyma) in them. The xylem vessels are thick-walled, elongated, with a diameter of 54.2 ± 0.44 microns. Their walls are thickened in the form of spirals or rings (Picture 3, 4; Table 1).



Picture - 1. Anatomical structure of the adaxial epidermis of the leaf of Magnolia soulangeana in sunny (a^1-a^3) and shadow (b^1-b^4) habitat conditions: a^1-a^2 - b^1-b^2 - adaxial epidermis; a^3-b^3 - trichomes.

Legend: T - trichome, E - epidermis, En - epidermal nucleus.

Picture - 2. Anatomical structure of the abaxial epidermis of the leaf of Magnolia soulangeana in sunny (a^1-a^3) and shadow (b^1-b^4) habitat conditions: a^1-a^2 - b^1-b^2 - adaxial epidermis; a^3-b^3 - trichomes.

Legend: T - trichome, U - stomata, E - epidermis, En - epidermal nucleus.

Figure –3. Anatomical structure of the main vein leaf of M. soulangeana in sunny (a^1-a^5) and shadow (b^1-b^5) habitat conditions:

a^1-b^1 - general view; a^2-a^3-b^2-b^3 - lamellar collenchymal cells; a^4-b^4 - conducting bundles; a^4-b^4 - parenchyma. **Legend:** HD - hydrocytic cells, CL - collenchyma,Xy - xylem, PP - conducting bundle, Px - parenchymal cells, SC - sclerenchyma, T - trichome, F - phloem, E - epidermis.

Figure - 4. Anatomical structure of the mesophyll leaf of Magnolia

soulangeana in sunny (a^1-a^3) and shadow (b^1-b^4) habitat conditions:

a^1-b^1 - general view; a^2-b^2 - detail; a^3-b^3 - non-submerged stomata and spongyparenchyma. Legend:

GP - spongy parenchyma,

P - palisade parenchyma, C - cavity, S - stomata, E - epidermis.

Table Quantitative indicators of the leaf of Magnolia soulangeana in two differentenvironmental conditions (n = 30)

Indicators		in sunny conditions	in shadow conditions
Epidermis: **outer wall thickness, µm**		3,9±0,02	2,2±0,01
cell height, µm		23,8±0,2	25,7±0,22
number on 1 мм^2	adaxial	389,2±3,8	406,4±4,5
	abaxial	446,5±5,1	505,6±5,8
Stoma: length, µm		23,7±0,2	34,2±0,3
Width, µm		13,2±0,09	15,8±0,08
Immersion, µm		–	–
number on 1 мм^2	adaxial	–	–
	abaxial	196,5±1,8	210,8±2,1
Spongy parenchyma: cell diameter**,** µm		19,2±0,09	21,9±0,2
number of rows		6-7	7-8
Palisade parenchyma: length**,** µm		28,6±0,3	25,3±0,22
width, µm		9,5±0,09	12,5±0,1
number of rows		2	2
palisade index		3	2
The number of rows of collenchymal cells		2-3	1-2
Collenchymal cell diameter, µm		27,5±0,24	16,7±0,09
Parenchymal cell diameter, µm		55,3±0,6	67,5±0,7
The number of conducting bundles in the main vein of the leaf		6	6
Xylem diameter in conducting beams, µm		36,1±0,3	54,2±0,44

On the basis of biometric analysis of quantitative indicators of the Magnolia soulangeana leaf in sunny and shadow conditions, mesomorphic characters prevail than xeromorphic ones (Picture 1, 2, 3, 4; Table 1).

Mesomorphic features: the outlines of epidermal cells are more sinuous; large, few epidermal cells with thin outer walls; large cell spongy parenchyma; non- submerged stomata; large vessels in conductive bundlespredominate in sunny and shadow habitats.

Xeromorphic signs: small, numerous epidermal cells with thick outer walls; small cell spongy parenchyma; high palisade index; small vessels in conductive bundlespredominate in sunny and shadow habitats.

Thus, based on the results obtained for a comparative study of the anatomical structure of the leaf of Magnolia soulangeana in different conditions (sun and shade), a different combination of xeromorphic and mesomorphic characters was determined, which ensures adaptation to habitat conditions. In sunny and shadow conditions, mesomorphic characters are more prevalent in Magnolia soulangeana than xeromorphic ones, which indicates more adaptability to mesophytic habitat conditions.

Used literature

1. Karpun Yu.N. The principles of organizing a garden of continuous flowering in the conditions of the Black Sea coast of the Caucasus // Forest recreation and introduction in the North Caucasus. - M .: VNIILM. - 19856. - Issue.18. - P. 83-90.

2. Istratova O.T. Seasonal development of introduced trees and shrubs in Sochi // Tr. Op. - NILOS. 1964. - Issue. 6. - P. 72-81.

3. Misnik G.E. Timing and nature of flowering trees and shrubs. - Kiev: Naukova Dumka. 1976 . - 384 p.

4. Garbuzova L.A. Phenological observations in the "Arboretum" in 2001 // Proceedings of the conference dedicated to the 110th anniversary of the Sochi arboretum. - 2002 . - P. 42-45.

5. Karpun Yu.N. Catalog of cultivated woody plants of the North Caucasus. -Sochi, 2003 . - 100 p.

6. Karpun Yu.N. Cultivated woody plants. Taxonomic Dictionary. - SPb: VVM, - 2010 a. - 114 p.

7. Karpun Yu.N. Subtropical decorative dendrology. - SPb: publishing house"VVM", - 2010 6. - 580 p.

8. Pilipenko F.S. Foreign trees and shrubs on the Black Sea coast of the Caucasus. - L .: Nauka, - 1978 . - 293 p.

9. Esau K. Plant Anatomy. - Moscow: Publishing house. Mir, 1969 . - P. 138-

416.

10. Vasilevskaya V.K., Butnik A.A. Types of anatomical structure of dicotyledonous leaves (to the method of anatomical description) // Botan. zhurn. 1982. Vol. 67, No. 7. – pp. 876–890.

11. Vasilevskaya V.K. Formation of a leaf of drought-resistant plants. Ashgabat: AN Turkmen. SSR, 1954. 182 p.

12. Gamaley Yu.V. Transport system of vascular plants. SPb .: Publishing house of St. Petersburg. University, 2004 . - 424 p.

13. Akinshina N.G., Duschanova G.M., Azizov A.A., Khalmurzaeva A.I., Toderich K.N. Xeromorphic traits of Liriodendron tulipifera L. (Magnoliaceae) leaves in the arid climate of Central Asia // VESTN. ISKCON. UN-TA. CEP. 16. BIOLOGY. 2020.Vol. 75. No. 4. - P. 251–257.

14. Diaz S., Cabido M. Plant Functional Types and Ecosystem Function in Relation To Global Change // Journal of Vegetation Science, 1997. - Vol. 8. - P. 463-474.

15. Wright I. J., Reich P. B., Westoby M. et al. The Worldwide Leaf Economics Spectrum // Nature, 2004. - Vol. 428. - P. 821-827.

16. Zakharevich S.F. On the method of describing the epidermis of the leaf // Bulletin of Leningrad State University. - Leningrad, 1954. - No. 4. - S. 65-75.

17. Evert R.F. Esau's Plant Anatomy, Meristems, Cells, and Tissues of the Plant Body: their Structure, Function, and Development. 3rd edn. 2006. New Jersey:John Wiley & Sons, Inc. 601 p.

18. Cutler D.F., Botha C.E.J., and Stevenson D.W. Plant anatomy. An appliedapproach. Blackwell Publishing Ltd. - Oxford. UK. 2007 . - 302 p.

19. Barykina RP, Veselova TD, Devyatov AG et al., Handbook of botanical microtechnology (fundamentals and methods). - Moscow: Publishing house. Moscow State University. 2004 . - P. 6-68.

20. Zaitsev G.N. Mathematics in Experimental Botany. - Moscow: Nauka, 1991 . - 296 p.