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Morphoanatomical features of artemisia fragrans species

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Abstract
As a result of the conducted morphoanatomical studies, a number of characteristic signs of the species *A.fragrans* Willd. was determined. One of such characteristic signs is the very early transition of the root to the second structure. Roots are consisted of a single-layered rhizoderm. Beneath the rhizoderm, there is a single-layered exoderm, cortex parenchyma, single-layered endoderm and pericycle. The diameter of the central cylinder is equal to 150 μm. The root base of the old plant is visibly particulated as the parenchyma surrounding the wood becomes corky and breaks down over time. The stem is composed of one and two axis trichome epidermis. Below the epidermis, there are hypoderm, collenchyma, endoderm and pericycle cells. There is primary conducting bundles in the central cylinder. At the base of the primary shoots of a plant, dilatation of radical rays and parenchymatization of transition zones of annual layers occur, which in turn leads to particulation of individual parts of the stem. The leaves are covered with uniaxial, long and biaxial short trichomes. Epidermis is composed of single-layered cells. Cell walls are concave and convex. The number of cells on the adaxial surface of the stomata is greater than on the abaxial surface. Mesophile is a isolateral-palisade. The main and lateral vessels are located on the central, transverse surface of the leaf and are surrounded by water-bearing cells. Leaf stalk has a partially wing-like protrusion that is clearly visible in cross-section. Three collateral bundles pass through the leaf stalk. The main vessel is significantly sclerificated. Chlorenchyma developed from the edges of the stalk only in certain parts. As a result of the conducted research, it was determined that the shape and nature of the structural features in *Artemisia* species is predominantly adaptive.

Keywords: artemisia fragrans, root, stem, leaf, morphoanatomical study

Introduction

The genus *Artemisia* L. is the biggest genus of the *Anthemideae* tribe and generally Asteraceae Bercht.& J. Presl family. Various authors [Korobkov, 1981., Konowalik *et al*., 2011.] [11] note that it consists of 200-400 (500) species. The numerous, more than 150 species of the *Artemisia* genus are perennial herbs or semi-shrubs and are mainly distributed in the northern hemisphere, in the temperate climate zone of Asia and Europe. 40 species and 2 variations of *Artemisia* genus, which is a polymorphic species, are distributed in Azerbaijan [Alasgarova *et al*., 2015] [1]. The species that make up the genus are distributed mainly in arid areas and dry valleys in Azerbaijan [Hajiyev *et al*., 1999.] [4]**.**

For the convenience of grouping and classification of species, the genus is divided into four groups (DeKandol): *Dracunculus* - with bare receptacle and non-fertile marginal flowers; *Seriphidium* - with bare receptacle and all flowers bisexual and fertile; *Abrotanum* - with bare receptacle and fertile marginal flowers; *Absinthium* - (in Greek. Απίνθιον) hairy receptacle and fertile flowers.

The species *A.fraqrans* we studied can be attributed to the *Absinthum* group due to its botanical suitability.

Molecular phylogeny of Artemisia species was studied based on the internal transcribed spacers (ITS) of nuclear ribosomal DNA [Torrell *et al*., 2002.] and the separation of the main lineage of the subtribe into three clades (*Arctanthemum, Dendranthema* and *Artemisia* clades) was determined. Polish researcher [Konowalik, 2010.] [9] studied karyological and cytogenetic characteristics of *A. Absinthium var. calcigena* of the wormwood species *A. Absinthium*, which is endemic for Poland and noted there is no difference in their genome. As can be seen, Artemisia species attract the attention of scientists in various fields.

In general, the genus *Artemisia* is very polymorphic, so its taxonomic status has not been fully determined [Korobkov, 1981., Sagaleev, 2002.] [11, 14]. The species that are mainly distributed in the territory of Azerbaijan are called differently in the international system. For example, *A. fraqrans – A. lerchiana* and etc. However, despite all this, the species representing the genus are morphologically very close and plastically change quickly due to the influence of environmental factors. In representatives of this genus, the amplitude of ecological variability and diagnostic signs is very wide. All this has led to the widespread and adaptation of wormwood species.

One of the more widespread species in Azerbaijan is *A. fraqrans*, the species has morphological and anatomical features worth studying. This species is mainly distributed in arid zones mixed with other Artemisia species and has mainly xerophytic structural features. Taking all these into account, we set ourselves the goal of morphoanatomical study of A. fragrans species.

Research Methodology

The performed anatomical studies were conducted in accordance with the generally accepted methodology. Research materials (leaf, stem, root) were taken in all morpho-physiological development phases. The studied materials were placed in 70% alcohol, hand sections were made for research in the laboratory, the sections were dyed, temporary and permanent preparations were made.

The morphological structure of leaves, stems, roots and other parts was studied with a binocular magnifying glass. Anatomical and morphological images were taken by hand with the help of "PA-4", "PA-6" (Abbe system) apparatus. Photographs were taken with the help of a digital microscope with a monitor, brand XSP 91-06-DN.

In *Artemisia* L. species, the taxonomic role of epidermis and stomata has been determined by a number of scientists [Humbatov *et al*., 2010]. Description of structural features of the species [Humbatov, 2017., Humbatov *et al*., 2015., Tutayug, 1967., Barykina *et al*., 2004.] [7, 8, 18, 2] is given according to accepted terminology.

During the study, living material was dusted with heavy metals, then placed in the vacuum post of an electron SCAN (Jeol JSM-35C) microscope and photographed with digital technology [Humbatov *et al*., 2015.] [8].

Experiments and Discussions

The studied species *Artemisia fragrans* Willd. - a cosmopolitan species belonging to the Asteraceae family. It is a perennial plant with a height of 25-45 cm. It has a branching underground rhizome stem. From the root collar, many above-ground shoots develop, at the top of which fragrant flowers are formed. The leaves in the lower part of the shoot are bipinnate, those in the middle part are simple-pinnated, and those at the top are three-pinnated. The entire aerial part of this plant (except the flowers) is gray. Flowers are arranged in a panicle. The plant that blooms in July-August has a unique fragrance. In Azerbaijan, this species is mainly distributed in the Kura-Araz plain. The root develops in the vertical direction. Every year, after drying the upper part and the formation of bushes, new vegetative stems form from the root collar. At the initial stage of development, the leaves and shoots are whitish-hairy. In the full development phase, hairs decrease and dry. The dried hairs impart additional protective properties on the leaves and shoots.

The roots of the studied species consisted of a single-layered rhizoderm, with a thickness of 50 µm. Below the rhizoderm there is a single-layered exoderm, 4-5 rows of cortex parenchyma (170 µm), single-layered endoderm and a pericycle. The diameter of the central cylinder is equal to 150 µm. Primary conducting system is diarch, consisted of 10-12 proto- and metaxylem tubes, maximum diameter is 25-28 µm. At the end of the first year, before the plant goes into summer dormancy, the diameter of the root base is 1.4-1.8 mm, the thickness of the cortex is 240-618 µm, the diameter of the wood is 575-940 µm, and the diameter of the large veins is 19-26 µm. In the second year, dilatation of radial rays occurs in the central cylinder, which causes particulation. As the age of the plant increases, parenchymatization of the root base becomes stronger, the root base of the 5-6 years plant is visibly particulated as the parenchyma surrounding the wood becomes corky and breaks down over time (Figure 1).

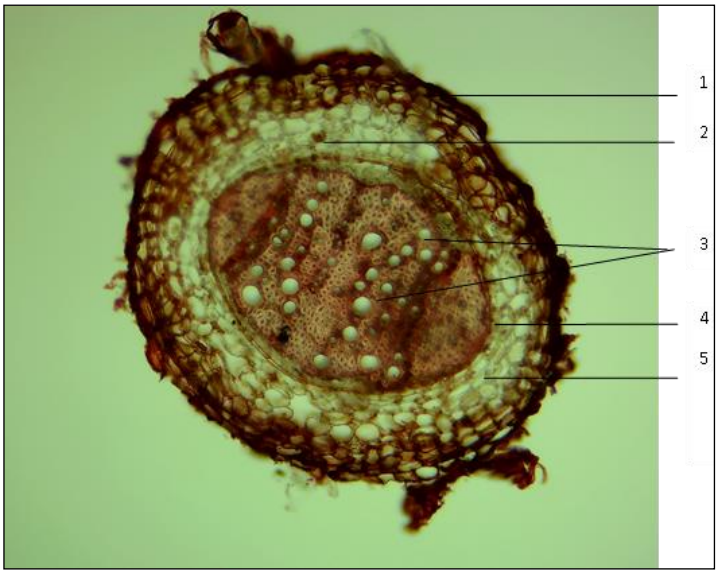

Fig 1: Cross-section of the root of A. fragrans species

1- periderm, 2- phytomelanin derivative, 3- cambium pericyclic derivatives, 4- casparian strip, 5-cortex

The stem of juvenile plants is composed of one- and two-axis trichome epidermis forming a tight bend. Primary cortex is 270-320 µm thick. Below the epidermis, there is 1 row of hypoderm, 1-2 and sometimes 3-4 rows of collenchyma, 1 row of endoderm and pericycle cells. There are 7 primary conducting bundles in the central cylinder. In juvenile plants, ring-shaped cambium and cylindrical wood with a diameter of 208 to 460 µm are formed. Secondary xylem tubes are small (18-22 µm). Under natural conditions, the annual growth of wood is not very large (150-200 µm). At the base of the primary shoots of the 2-3 year plant, the dilatation of the radical

rays and the parenchymatization of the transition zones of the annual layers take place, which in turn leads to the particulation of individual parts of the stem. Annual shoots are covered with primary cortex. At the base of the stem, it is represented by a single layer of hyperdermis, 3-5 layers of collenchyma and 5-6 layers of cortex parenchyma. Large groups of pericyclic fibers are formed in the opposite direction of each leading bundle along the length of the shoot, which gives the stem a slightly ribbed shape. Palisade parenchyma parts with chlorophyll are located in the pores between the ribs. Seven conducting bundles pass through the central cylinder of the primary structure. By the budding phase, the formation of the wood ring is completed. At the end of the first year, before the plant goes into summer dormancy, the diameter of the stem is 1.6-2.0 μm, the thickness of the secondary cortex is 270-720 μm, the diameter of the wood is 208-460 μm, the diameter of the core is 146-170 μm, and the diameter of its cells is equal to 25-29 μm. In the second year of development, the growth of wood continues, dilatation of radial rays occurs (Fig. 2).

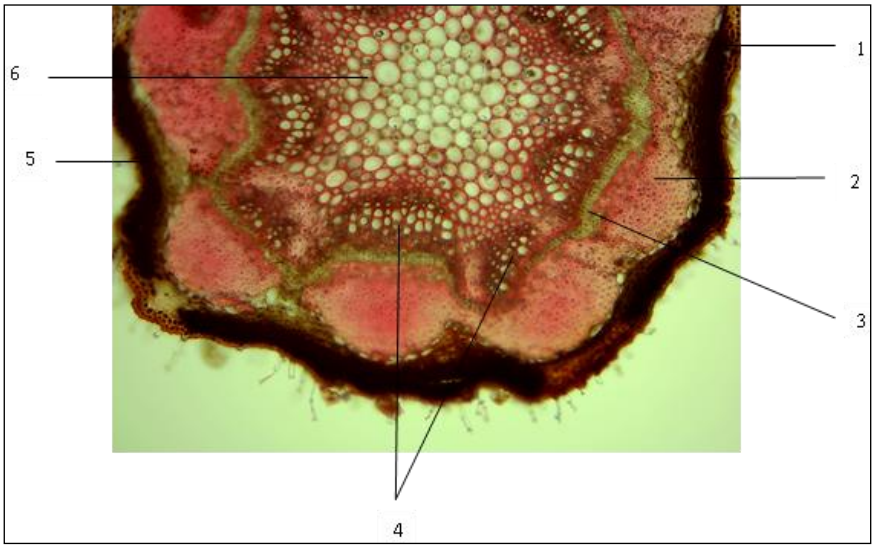

Fig 2: Anatomical structure of the stem of *Artemisia fragrans* species
1. Periderm 2 Xylem. 3 Cambium. 4. Phloem 5 Cortex parenchyma. 6. Core

Leaves of annual shoots are covered with uniaxial, long and biaxial short trichomes. The epidermis is single-layered and consists of cells with a height of 14-21 μm. Epidermal cells here are 5-8 times smaller than in seed leaves. Cell walls are concave and convex. The stomata is anomasitic and do not form depressions. The number of cells on the adaxial surface of the stomata is greater than on the abaxial surface. All indicators of the epidermis are quite variable depending on the age of the plant and environmental conditions. Mesophile is a isolateral-palisade. The main and lateral vessels are located on the central, transverse surface of the leaf and are surrounded by water-bearing cells 20-25 μm high. The tubes of the main vessel are small (4-10 μm), few (10-12), and the number of side vessels is 1-2. The level of vascular sclerotization depends on the age of the plant and the environment it lives in.

Leaf stalk has a partially wing-like protrusion that is clearly visible in cross-section. Three collateral bundles pass through the leaf stalk. The main vessel is significantly sclerificated. Chlorenchyma developed from the edges of the stalk only in certain parts (figure 3).

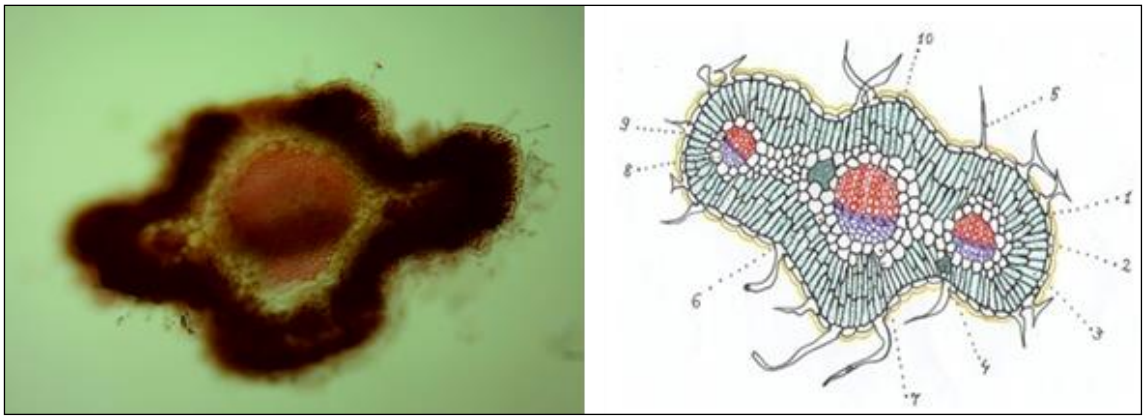

Fig 3: Anatomical structure of the leaf of *Artemisia fragrans* species
1. *cuticle 2. epidermis 3. parenchyma 4. schizogen intercellular area.5. hair. 6. sponge parenchyma 7. covering cells 8. phloem 9. cambium 10. Xylem*

The seed leaves of fragrant wormwood have a single layer of epidermis and are composed of large cells 95-130 µm high. Cell walls are concave and convex. Stomata are not depressed, anomostic, numerous (100-150 per 1 mm^2 on the adaxial surface and 88-120 per 1 mm^2 on the abaxial surface) and large, almost the same height on both sides. The mesophyll tissue is dorsiventral, palisade parenchyma is 2-3 row, cells are 95-100 µm high. The sponge has 5-6 rows, and its cells are 140-150 µm in diameter. The central vessels are few, 6-7. Veining is a loop-shaped.

Result

- Based on the results obtained from the conducted morphoanatomical studies, it was possible to distinguish the main characteristics of the A. fragrans plant. So, the flowers of the studied species have a small and mesamorous structure. Artemisia fragrans is a typical subshrub and is a xeromorphic plant. The leaves of wormwood growing in sandy soil are larger in size, have fewer stomata, taller epidermal cells, smaller diameter of the main vessel, longer and thicker shoots, and smaller radius of the wood compared to individuals growing in clay soil. These characteristics can be explained by the fact that wormwood plants in sandy soil can absorb more moisture, but are more strongly affected by halofactors and, as a result, acquire halosucculent characteristics (epidermis with taller cells, thicker primary cortex).
- The seed leaves are developed in dorsiventral mesophyll structure, the cortex layer covering the central cylinder is thickened. Diarch location and small number of primary conducting elements are also characteristic of the representatives of the species.
- The leaves are heterophyllous. Primary leaves are simple, others are splitted. The leaves are xeromorphic, isolateral-palysade, with sclerification of the main vessel. The sizes of all the tissues presenting in the leaves vary depending on the age of the plant.
- Annual shoots are significantly sclerified, root collar and root became parenchymal.

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