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ROOT, STEM AND LEAF ANATOMY OF *ABUTILON THEOPHRASTII* MEDIK. (*MALVACEAE*)

AYŞEGÜL GÜVENÇ, AYŞE MİNE ÖZKAN, CEYDA SİBEL ERDURAK AND MAKSÜT COŞKUN

Department of Pharmaceutical Botany,
Faculty of Pharmacy, Ankara University, 06100, Tandoğan, Ankara, Turkey

Abstract

Abutilon theophrastii Medik., used in folk medicine in Turkey has been investigated anatomically. Examinations were done on transverse sections of leaf, stem and root.

Introduction

Abutilon theophrastii Medik., is the only species of the genus *Abutilon* Gaertn., growing in Turkey (Davis, 1966). The genus with nearly 100 species is widely distributed generally in tropical regions. It is called as "Sarı Hatmi" in Turkey. The plant is traditionally used as a protecting agent in irritation and inflamation of respiratory and gastrointestinal systems, like the other members of the family (Baytop, 1999).

Abutilon theophrastii is an annual herb. Stems tough, rugose, tomentose, branched; leaves ovate, cordate, acuminate, crenate, adpressed-stellate-tomentose, palmately nerved. Sepals oblong-ovate, obtuse. Petals yellow. Carpels pilose, biaristate, dehiscing dorsally, much exceeding the persistent calyx (Davis, 1966).

Jain *et al.*, (1996) investigated antibacterial, antifungal and antiviral effects of a new steroidal cholestan derivative isolated from the aerial parts of *A. bidentatum* having strong fungicidal activity. In another study, Dennis *et al.*, (1984) determined the structure of fixed oil of the root of the same species with analgesic effect.

Abutilon species are used as antirheumatic, demulcent, emollient and diuretic in folk medicine (Ahmet *et al.*, 1990). They also isolated a new triterpene from *A. pakistanicum*. Johri *et al.*, (1991) confirmed the high antiestrogenic effect of methanolic extract of *A. indicum*. The essential oil composition of *A. indicum* was determined by Geda & Gupta (1983) using GLC/TLC methods. Estevei-Nieto & Torras (1980) investigated antitumor activities of stem, leaf and flowers of *A. hirsutum*. They showed that the leaf and flower extracts have strong inhibition effect on Sarcoma 37 and 180 (85 and 72.3 % respectively). In addition, Gaind & Chopra (1976) investigated *A. indicum* phytochemically.

There does not appear to be any report on the anatomical study on *Abutilon theophrastii*, only a brief general description about the genus is given in Anatomy of Dicotyledons (Metcalfe & Chalk, 1965).

The present report describes the microscopic characteristics of the root, stem and the leaf of *Abutilon theophrastii* which is used in folk medicine.

Material and Method

Abutilon theophrastii was collected on 31 July, 1998 by A. Güvera on Samsun and Bafra road. Voucher specimen is deposited in the Herbarium of the Faculty of Pharmacy, Ankara University (AEF 22960). The microscopical studies were carried on preserved

material (in 70% alcohol). Free hand sections were taken, stained and mounted in Sartur Reagent (Çelebioğlu & Baytop, 1949) and chloral hydrate solution. Anatomical diagrams of transversal and superficial sections were sketched in Leitz Wetzlar sketching prism attached to the microscope. The photographs taken by Olympus BX50 camera attached to the microscope, were used to determine anatomical characteristics.

Results

a. Leaf

The leaf is bifacial. The transverse section of the leaf exhibits the following characters:

1. Lamina

i) Epidermis: The upper epidermis consists of a single layer of rectangular cells with a fairly thin, smooth cuticle. Numerous hairs and glandular hairs of different types cover it. The covering hairs are generally tufted with straight walls and acute apices. Glandular hairs can be differentiated in two types: the long ones, with a unicellular stalk and a multicellular glandular head; the short ones with multicellular stalk and glandular head. The former have a globe-like head composed of 10-12 layers of cells. The latter with two celled stalk and 2-3 celled head are similar to the ones of the leaf of *Althaea* and *Malva* species.

Stomatal number is approximately same on both epidermises. Since stomata couldn't be observed clearly on the photographs taken from the transverse sections of the leaf, superficial sections were used for sketching the details: wavy-walled, small epidermal cells and 2-4 subsidiary cells around the stomata were observed (Fig.1 & 2).

ii) Mesophyll: The mesophyll is clearly differentiated into palisade and spongy parenchyma. Under upper epidermis, the mesophyll contains 2 layers of palisade which is composed of compactly arranged long cylindrical cells. The spongy mesophyll, being thinner than the palisade layer, is formed of thin walled, isodiametric paranchymatous cells with few intercellular spaces. Mucilaginous cells are observed generally in the palisade and occasionally in the spongy parenchyma structure. Numerous cluster crystals are scattered in the mesophyll (palisade has mostly the bigger crystals) and they are the most characteristic elements of the mesophyll (Fig.1).

2. Midrib

The upper and lower epidermis of the midrib is similar to that of lamina except that the cells are smaller. Trichomes and glandular hairs are also densely observed on the midrib. Under the upper epidermis a projecting prominent part, consisting of 7-8 layers of collenchymatic cells, is observed as the most striking characteristic of the leaf. Under this part, palisade parenchyma is suddenly interrupted. Between this prominence and the vascular bundle, parenchymatous cells and a big mucilaginous cell can be observed.

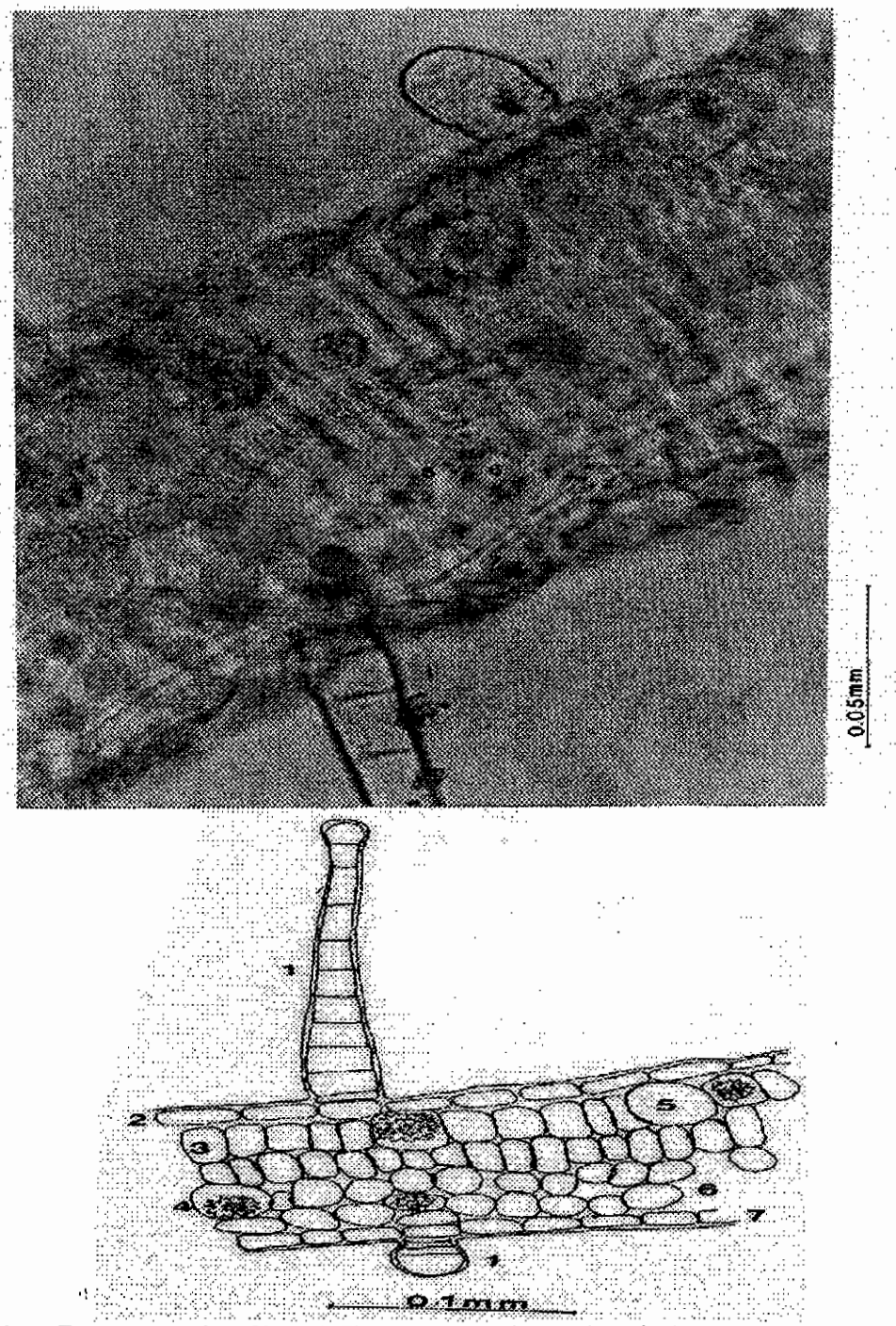

Fig. 1. Transverse section of leaf; 1) Glandular hair 2) Upper epidermis 3) Palisade parenchyma 4) Cluster crystals 5) Mucilaginous cell 6) Spongy parenchyma 7) Lower epidermis.

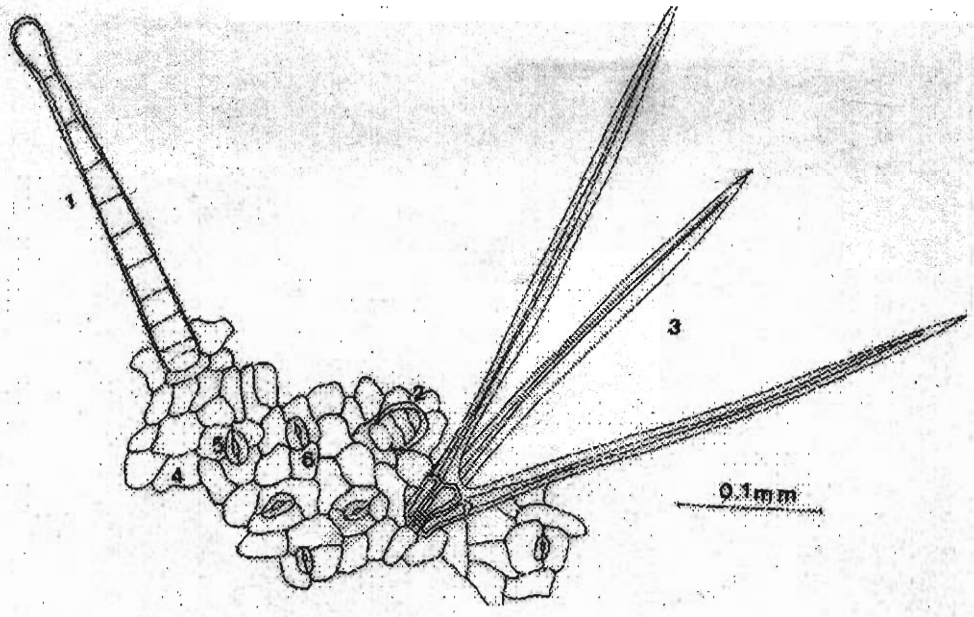

Fig. 2. Surface view of leaf; 1) Multicellular-long glandular hair 2) Short glandular hair 3) Multicellular tufted hair 4) Epidermis 5) Stomata 6) Subsidiary cell.

A crescent-shaped vascular bundle is present in the center of midrib. The vascular bundle contains 2-4 layers of lignified radiating xylem with an arch of phloem consisting of thin walled, compactly arranged, small cells. The rest of the midrib, composed of parenchymatous cells, contains starch grains, cluster crystals with rare mucilage. Under the midrib, close to lower epidermis groups of corner-collenchyma cells are also observed (Fig. 3).

b. Stem

A transverse section of the stem is somewhat rounded and exhibits the following characters:

i) Epidermis: Epidermis is composed of a single layer of isodiametric cells with convex outer and inner walls. Cuticle is thin and smooth. Glandular hairs are similar to those of the leaf with respect to form and abundance. Cluster crystals, generally scattered all over are occasionally found under the epidermis as uniseriate lines. Epidermis of stem also contains many of glandular and covering hairs. Eglandular hairs are generally observed as unicellular and simple, or bicellular and clustered. Number of multicellular tufted hairs is less than monocellular and bicellular ones (Fig. 4).

ii) Cortex: Adjacent to the epidermis, the cortex contains a thick layer of collenchyma cells. The remainder of cortex is composed of 5-6 layers of parenchyma cells of different sizes. Cortical parenchyma, a thinner layer than collenchyma, contains cluster crystals in the cells or in the cortex (Fig. 4).

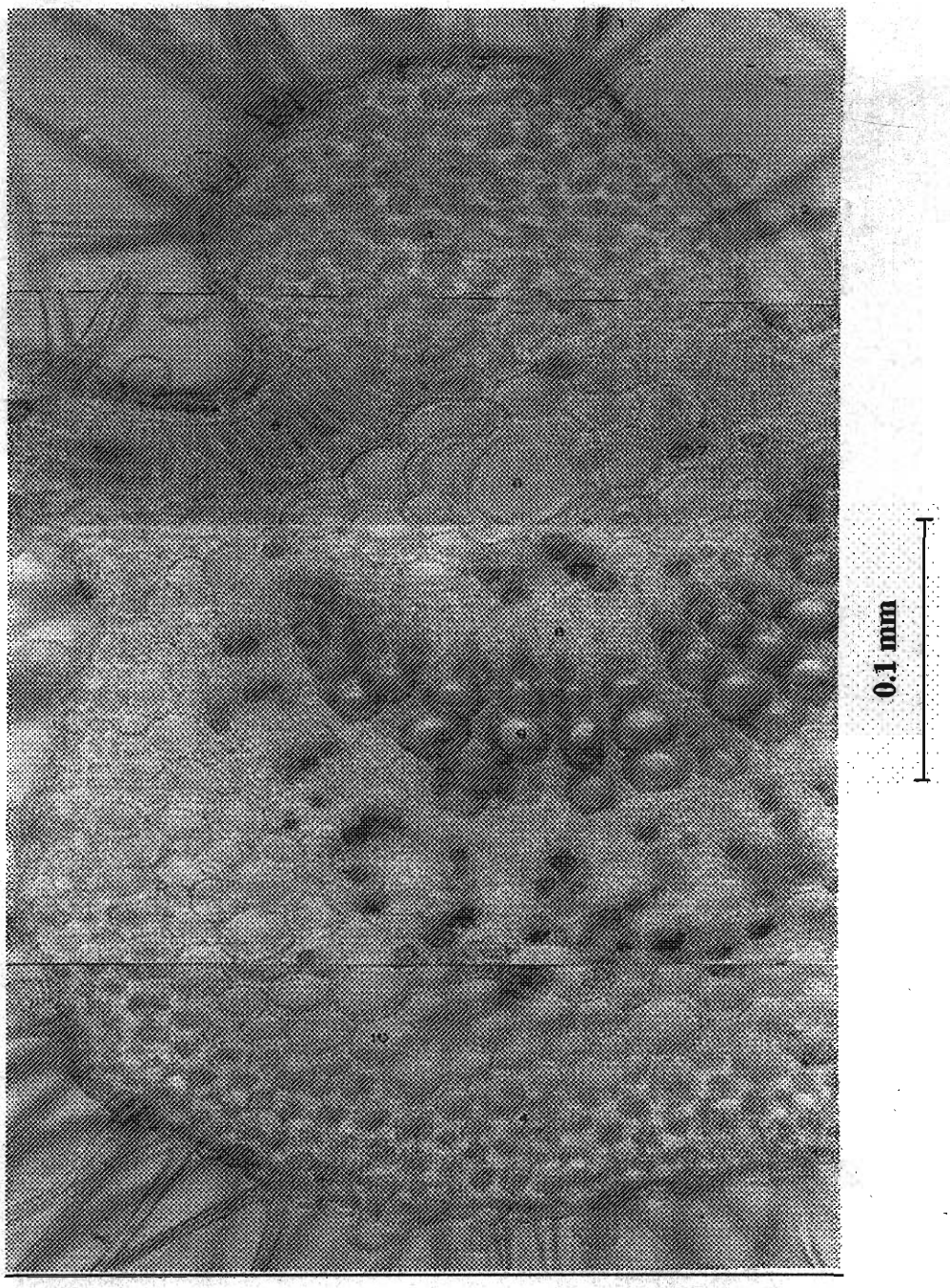

Fig. 3. Transverse section of lamina through mid-rib; 1) Covering hair 2) Glandular hair 3) Epidermis 4) Collenchyma 5) Palisade parenchyma 6) Mucilaginous cell 7) Cluster crystal 8) Phloem 9) Xylem 10) Parenchyma.

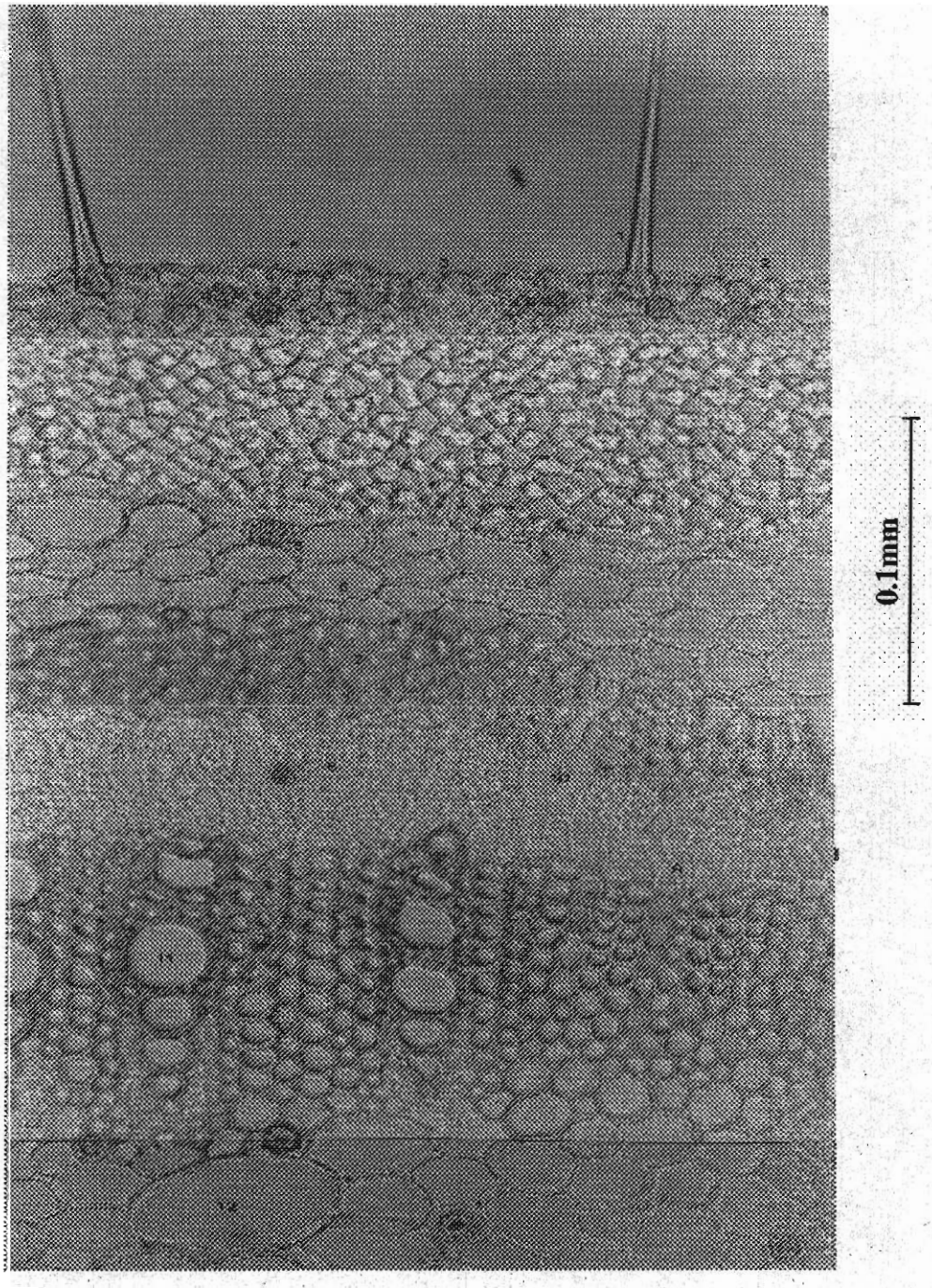

Fig. 4. Transverse section of stem; 1) Covering hair 2) Glandular hair 3) Epidermis 4) Collenchyma 5) Cluster crystal 6) Cortex parenchyma 7) Phloem sclerenchyma 8)Phloem 9) Cambium 10) Medullary ray 11) Xylem 12) Pith.

iii) Vascular cylinder: Underneath the cortical parenchyma, 6-7 layers of phloem sclerenchyma, consisting of more or less a complete ring of fibres, which are sometimes interrupted by the rays are present. The phloem is composed of crushed, irregular cells. Between the phloem and xylem layers, cambium with 5-6 layers of thin-walled, crushed, rectangular cells are clearly observed.

Xylem contains a continuous ring of 11-12 layers of cells. Tracheae with large central spaces are few, but tracheids with small central spaces are in compact groups of cells. Medullary rays are either uniseriate or biseriate.

The pith is composed of thin walled and large, rounded parenchyma cells. Some of these cells are transformed into mucilaginous cells. Some big cluster crystals are scattered also in pith. Mucilaginous cells are less and small in cortical parenchyma but numerous and big in pith parenchyma (Fig. 4).

c. Root

The root is composed of unicellular, rectangular, suberized, sometimes deformed epidermal cells. Some simple and 2-4 celled tufted hairs are observed. Under this, 2-3 layers of hypodermis are seen. A thick layer of cortical parenchyma, consisting of thin walled, rectangular cells of different sizes is observed. The cells contain starch grains and cluster crystals. In the cortex, phloem sclerenchyma makes a ring of triangle towers which is sometimes interrupted by phloem parenchyma.

Under these characteristic sclerenchymatous structures, phloem is observed with little and crushed cell groups. Adjacent to phloem, cambium is well marked by 7-8 layers of cells. Medullary rays are forwarded into the cortical parenchyma forming triangles. The cells contain either a few starch grains or none.

Xylem consists of radially arranged vessels which nearly cover all of the inner part of the root. Tracheae with big central spaces are few. The smaller tracheids are abundant. The rays are composed of 2-3 layers of starch-containing cells and they divide the vascular cylinder into 3-4 cell-width parts. Pith is not very broad and consists of rounded parenchymatous cells containing starch grains and clustered crystals. Mucilaginous cells are also present among the pith cells. But the number of the mucilaginous cells are fewer with respect to those found in leaf and stem because of the restricted area of the pith (Fig. 5).

Discussion

In this study, the anatomical structures of the root, stem and leaf of *Abutilon theophrastii*, the only species of *Abutilon* growing in Turkey, were investigated for the first time.

Leaf anatomy is very similar to that of *Malva sylvestris*; another member of the *Malvaceae* family (Yazgan *et al.*, 1986). But it can be differentiated from *Malva sylvestris* by its 2-layered palisade parenchyma with big clustered crystals, mucilaginous cells and multicellular, long glandular hairs. Neither the leaf of *Altheae* nor *Malva* have these kinds of glandular cells (Baytop, 1981). However, the characteristic elements of *Malvaceae*, such as short, multicellular glandular hairs, simple unicellular and multicellular tufted eglandular hairs, tufted crystals and mucilaginous cells are observed in this species.

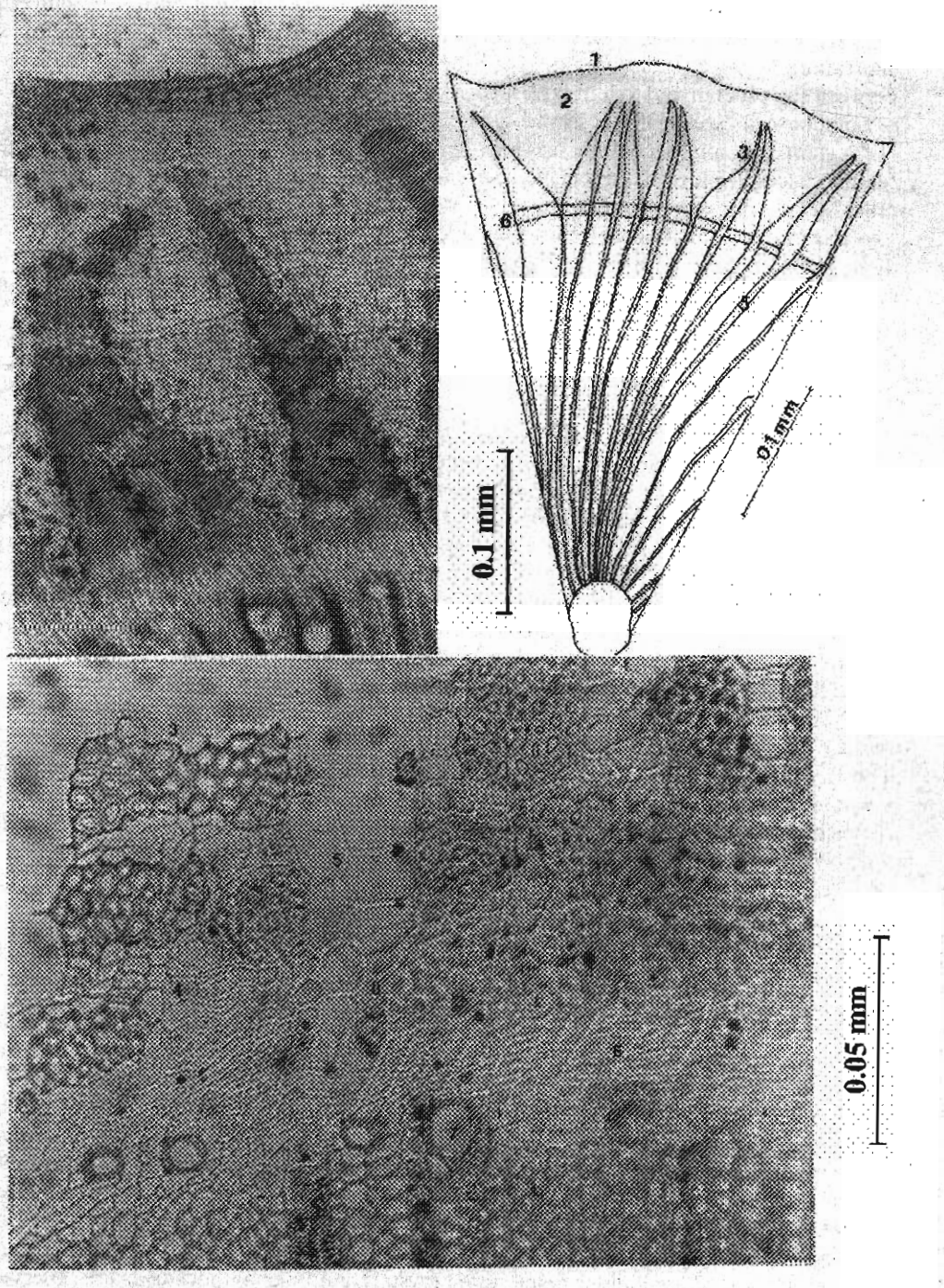

Fig. 5. Transverse section of root; 1) Epidermis 2) Cortex parenchyma 3) Phloem sclerenchyma 4) Phloem 5) Medullary ray 6) Cambium 7) Xylem 8) Cluster crystal.

Root anatomy has the characteristic layers of the dicotyledeneous plants, the most characteristic feature being phloem sclerenchyma in cortex. Parenchymatous cells of cortex and the pith are rich in starch grains and clustered crystals like the elements of the root of *Altheae* species. Moreover, 1-2 mucilaginous cells are present in the pith.

Clustered crystals and simple and clustered eglandular hairs are observed in all of the studied organs of the plant. Multicellular and long eglandular hairs of leaf and the stem are interesting. The towers of phloem sclerenchyma in the root are the characteristic elements of the plant.

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