Anatomical studies of *Reseda lutea* (*Resedaceae*)

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Abstract. *Reseda lutea*, with a wide distribution area in Turkey, is used as a natural dye in the dyeing industry. The aim of this study is to determine the anatomical characteristics of the root, stem and leaf of *R. lutea* in cross sections. As a result of the study, it was identified that the anatomical characteristics of the species resemble other members of the *Resedaceae* family to which this species belongs. The most distinguishing characteristic of the species in the anatomical structure is the presence of myrosin cells, which are also present in the root, stem and leaf of other members of the family. It is interesting that the leaves of the species do not have secretory trichomes, but they are seen in cross sections taken from the stem.

Key words: anatomy, medicinal and useful plant, *Reseda lutea*

Introduction

The *Resedaceae* family is represented by six genera in the world. Among them, only genus *Reseda* L. is naturally distributed in Turkey. Genus *Reseda* contains approximately sixty species throughout the world. In Turkey, the genus is represented by 15 species, including *R. lutea* L., with one subspecies and seven other varieties (Davis 1965; Davis & al. 1988; Özhatay & al. 1994).

Reseda lutea is generally distributed in the temperate zones of the world, as follows: from the South, West and Central Europe to Finland, Norway and Sweden, Great Britain; the Mediterranean basin and Anatolia; Southwest Asia and the former Soviet Union countries, Afghanistan, Chile, USA, Australia, New Zealand, and South and North Africa (Dogan 2001). The species is naturally distributed on open rocky slopes and in wet areas, and in changing environments as a result of the anthropogenic activities such as roadsides, railroad embankments, garbage dump areas, around agricultural areas, in artificial ditches and graveyards, etc. Our study sample of *R. lutea* is distributed densely in Turkey as a ruderal plant.

For centuries, this species has been widely used by the local people as a source of natural dye in the carpet and rug industries in the country (Anonymous 1991; Dogan 2001). Therefore, in some places in Turkey the species has a special standing in the economic life of the local people. Although it is not common nowadays, according to Bonnier (1934), this species has been used by locals due to its diuretic, sedative and sudorific characteristics.

We can summarize the economic importance of *R. lutea* in the light of related literature:

- as medicinal plant (Bonnier 1934);
- in everyday life, the young leaves of the plant are used in salads and eaten raw as an edible plant (Kirk 1975; Kunkel 1984);
- in the carpet and rug industry, as a source of natural dye (Uğur 1988; Anonymous 1991; Öztürk & Özçelik 1991);
- in animal husbandry, as a grazing plant and stock food source (Moghaddam 1977; Heap & al. 1995);

• in honey production, due to its high nectar secretion (Jablonski & al. 1992);

• in combating erosion, as a primary succession plant (Bruns & Jochimsen 1989; Jochimsen & Janzen 1991; Heap & al. 1995).

On the other hand, the species is regarded as a weed in some parts of the world, especially in cultivated areas (Abdallah & Dewitt 1978; Harris & al. 1995; Heap & al. 1995; Dogan & al. 2002).

In this study, due to its economic importance and wide distribution in Turkey, the aim was to investigate the anatomical characteristics of *R. lutea* by using the samples collected from the western part of Anatolia.

Material and methods

Plant samples of *R. lutea* for our study material were collected from five different West Anatolian cities and at altitudes from 25 m to 1500 m. The localities are as follows:

Canakkale: A1 Ecebat, between Alcitepe-Eceabat, near a field, 50 m; Balikesir: B1 Savastepe, Sogucak Village, near a field, 400 m; Izmir: B1 Konak, in a park; Denizli: C2 Honaz Mountain, Kocapinar Village, near a field, 1500 m; Kutahya: B2 Gediz, Abideler Village, 625 m.

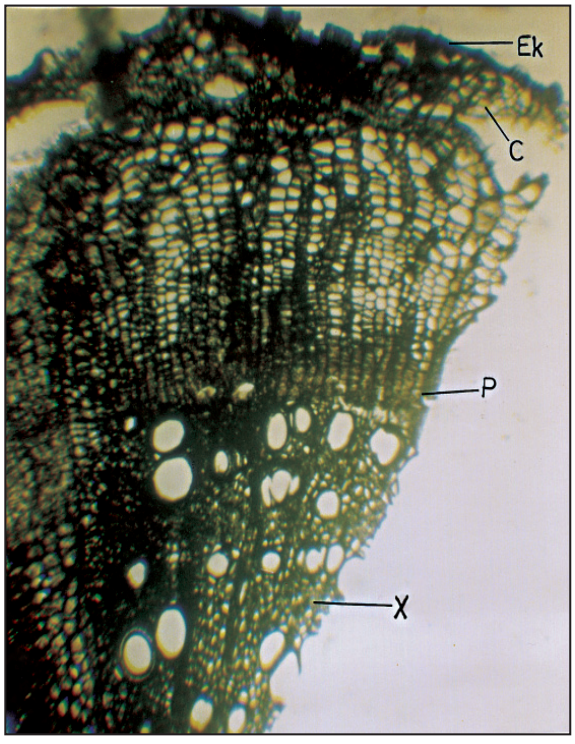

Fig. 1. Root of *Reseda lutea* (cross section):
Ek – exodermis; **C** – cortex; **P** – phloem; **X** – xylem (×20).

The collected plant samples were identified taxonomically according to the *Flora of Turkey and the East Aegean Islands* (Davis 1965) and *The Biology of Australian Weeds* (Heap & al. 1995).

After identification, the plant materials were put into a 70 % alcohol-water solution to store for later anatomical investigation. Anatomical sections of the material were taken from root, stem and leaves. The sections were put into a Sartur reactive and Milon reagent. Photographs of the sections were taken with a light microscope, by using a microphotography apparatus (Figs 1-8).

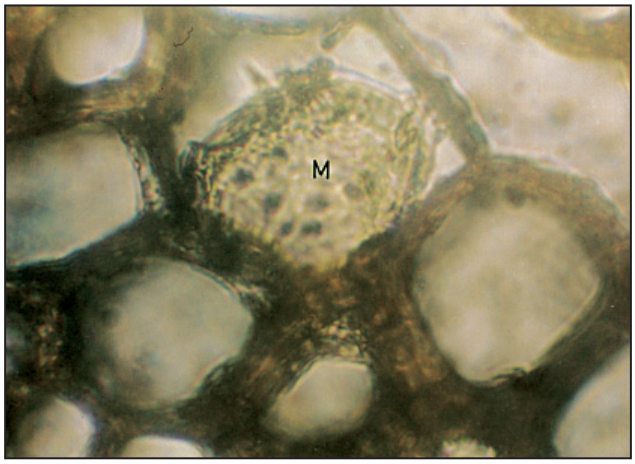

Fig. 2. Central part of root (cross section):
M – myrosin cell (×250).

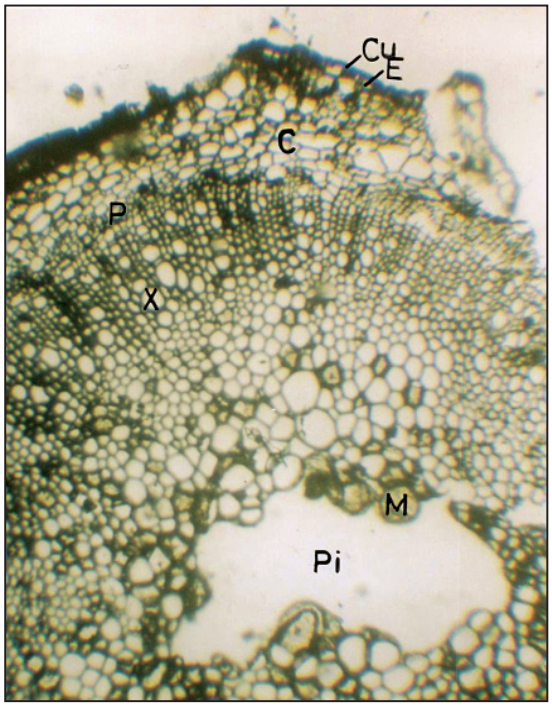

Fig. 3. General appearance of the stem (cross section):
Cu – cuticle; **E** – epidermis; **C** – cortex; **P** – phloem;
X – xylem; **M** – myrosin cell; **Pi** – pith (×20).

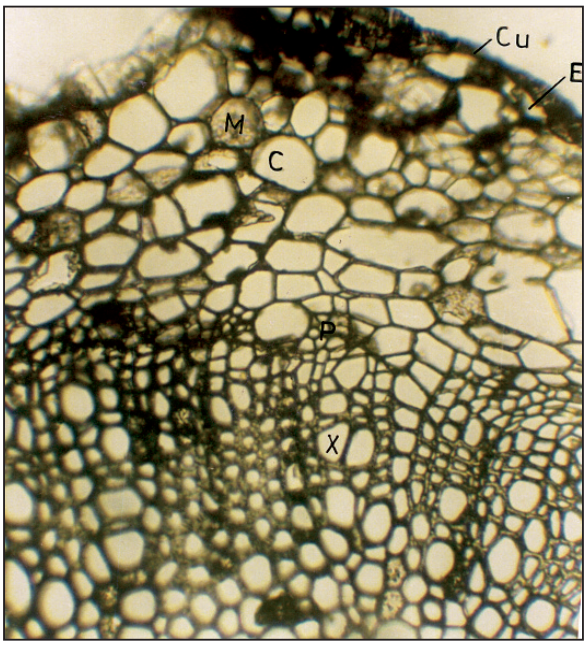

Fig. 4. Detailed appearance of the stem:
Cu – cuticle; **E** – epidermis; **C** – cortex; **P** – phloem; **X** – xylem; **M** – myrosin cell (×63).

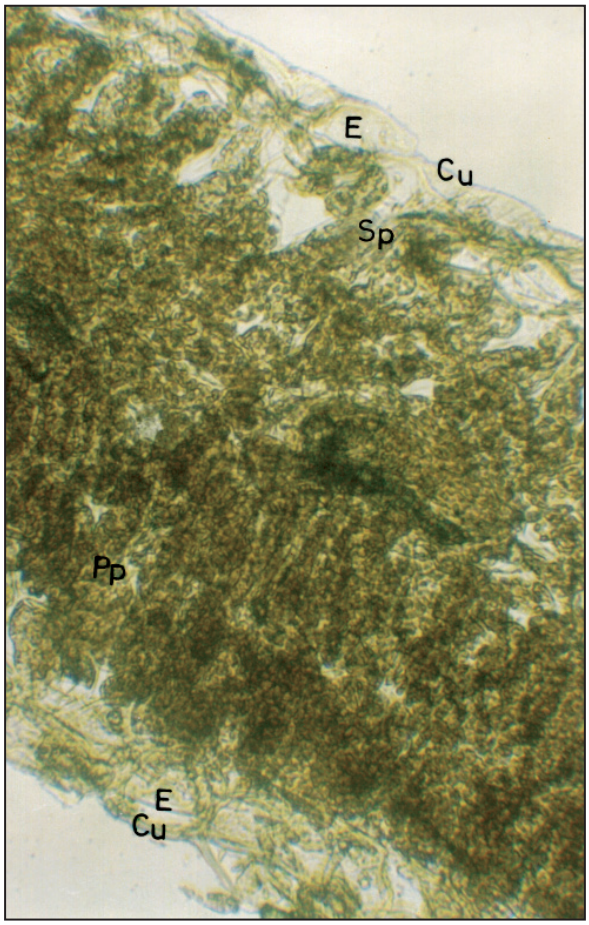

Fig. 6. Leaf of *R. lutea* (cross section):
Cu – cuticle; **E** – epidermis; **Pp** – palisade parenchyma; **Sp** – spongy parenchyma (×63).

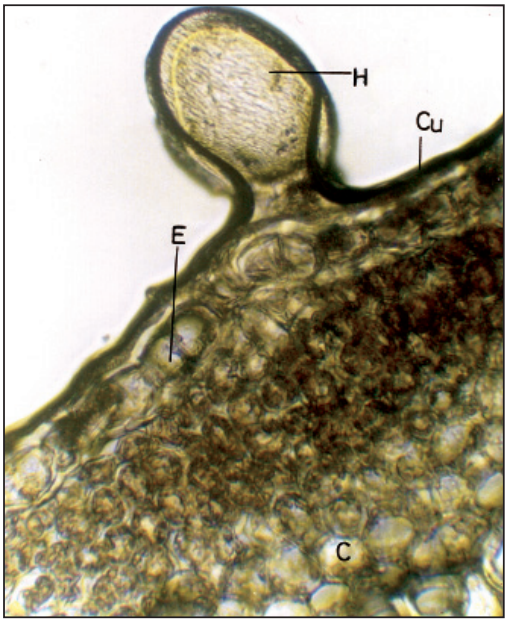

Fig. 5. Stem of *R. lutea* (cross section):
Cu – cuticle; **H** – hair; **E** – epidermis; **C** – cortex (×63).

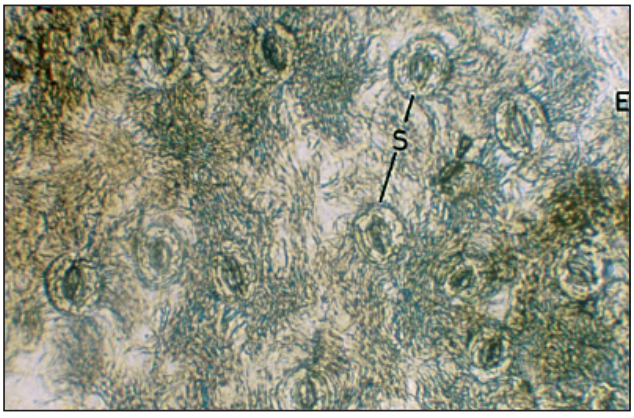

Fig. 7. Upper epidermis of leaf with stomata (transverse section):
E – epidermis; **S** – stoma (×63).

Fig. 8. Leaf of *R. lutea* (cross section):
Cu – cuticle; **E** – epidermis; **S** – stoma; **Me** – mesophyll (×25).

Results and discussion

The investigated anatomical structure of the cross section of the secondary root of *R. lutea* showed a lignified and broken exodermis on the outer surface, and indistinct epidermis cells. The parenchymatous cortex in structure was squeezed narrow, and the vascular region covered a large area. The phloem tissue covered a very narrow strip and was indistinct. On the other hand, the xylem tissue covered a very large strip and extended to the pith. Endodermis and pericycle were obscure and, therefore, cannot be distinguished. In the cortex and pith fragments of the root there were secretion cells (myrosin cells).

The cross section of the stem of *R. lutea* showed an epidermal layer with cuticle formed by smaller cells with thickened walls on the outer surface of the stem. Secretory trichomes showed occasionally in the epidermis layer in the primary structure of the stem. Just below the epidermis layer was the cortex layer formed of non-homogenous cellsace. The cortex tissue contained a high amount of myrosin cells. The phloem tissue, squeezed between the cortex and xylem tissues, covered a very narrow strip in the stem. On the other hand, the xylem tissue covered a very large area in the form of a well-arranged circle. Similarly to the cortex region, an ample number of myrosin cells were identified among the cells close to the pith.

In the cross section of the leaves of *R. lutea*, abaxial and adaxial epidermis of the leaf are covered by a cuticle and epidermis is formed by one-layer of bigger cells. Cell walls of abaxial and adaxial epidermis are thickened. The structure of the leaf is typical dorsoventral. It was very difficult to distinguish the cells of palisade and spongy parenchyma from each other in the mesophyll structure. While the cells of spongy parenchyma covered a small strip, the cells of palisade parenchyma occupied a wider space in the mesophyll. Superficial sections taken from the leaf to investigate the structure of the stomata have shown that the stomata were of the Ranunculaceous (anomocytic) type. The stomata were visible on both sides (amphistomatic type) of the leaf. They were mesophytic in character in the cross sections of the leaf. In other words, the stomata cells and the epidermal cells were on the same level. As in the root and stem cross sections, myrosin cells were presented in the leaf mesophyll tissue. No crystal structure was visible in the leaf cross sections.

There was no detailed study of the anatomical structure of *R. lutea* in our literature review. Only Metcalfe & Chalk (1957) reported the general structure of *Resedaceae* and some of *Reseda* species other than *R. lutea*. Bonnier (1934), Metcalfe & Chalk (1957), Fahn (1967), Gibbs (1974), and Jorgensen (1995) pointed out that the presence of myrosin cells in the members of *Resedaceae* is typical, like in the members of *Caricaceae*, *Capparaceae* and *Brassicaceae*. The present study has shown that myrosin cells are present in the anatomical cross sections of *R. lutea* in the root cortex and pith regions, in the stem cortex and pith regions, and in the leaf mesophyll tissues. The dorsoventral structure of the leaf identified in this study was not mentioned by Metcalfe & Chalk (1957). They only reported that the cells of the palisade and spongy parenchyma cannot be distinguished clearly from each other. Our other findings about the anatomical structure of the root, stem and leaf of *R. lutea* investigated in the cross sections are parallel to the findings of Metcalfe & Chalk (1957) studied at the family level.

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