ANATOMICAL ADAPTIONS OF *SUEDA SALSA* (L.) Pall. (CHENOPODIACEAE) TO THE HARSH HALOPHYTIC HABITAT OF TECHIRGHIOL LAKE

ADAPTĂRI ANATOMICE ALE SPECIEI *SUEDA SALSA* (L.) PALL. (CHENOPODIACEAE) LA MEDIUL HALOFITIC AL LACULUI TECHIGHIOL

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Abstract. *The article comprises the investigation of the root, stem and leaf anatomy of a species which frequently grows on the bank arround Thechirghiol Lacke near Constantza county,* Sueda salsa *(L.) Pall. The anatomical characteristics of* Sueda salsa *vegetative organs has been described and discussed. The mature root possesses a typical secondary structure. The stem has a primary structure surrounded by the cortex differentiated into a chlorencymatic and parenchymatic tissue. The stem vascular sysem, composed of xylem and phloem, forms a circular ring around the stem. Remarkable is the presence of the inner phloem due to the proliferation of the xylem vessels into the parenchymatous tissue. The stem and blade epidermis is covered by a thick cuticle supplimented by wax. It continuity is interruptured by the presence of paracytic stomata. The homogenous blade has no slat glands or salt bladders, thus, this plant must compartmentalize the toxic excess of* Na^+, K^+ *şi* Ca^2 *in the leaf cells vacuoles, increassing the vacuoles concentration, withstanding to the harsh salting condition of its habit.*

Rezumat*. Lucrarea înfăţişează unele aspecte anatomice ale rădăcinii, tulpinii şi frunzei speciei halofite care creşte frecvent pe malul lacului Techirghiol, lângă oraşul Constanţa* Sueda salsa *(L.) Pall. Organele vegetative ale plantei* Sueda salsa *prezintă atât caractere anatomice generale întâlnite la Chenopodiaceae dar şi care justifică natura sa halofită. Rădăcina acestei specii prezintă o structură secundară. Tulpina este acoperită, la exterior, de o epidermă unistratificată, protejată de o cuticulă groasă, suplimentată cu ceară vegetală. Cortexul, pluristratificat este diferenţia în colenchim angular (1, 2 straturi de celule) şi o zonă internă de natură parenchimatică, redusă. Cilindrul central are o structură intermediară intre cea primară şi cea secundară datorată activităţii zonei cambiale. Astfel, cambiul generează mai multe elemente de lemn şi extrem de puţine liber iar intre fasciculele vasculare se găsesc raze medulare interfasciculare sclerenchimatice. Stelul este reprezentat prin numeroase elemente de xilem generate de cambiul intrafascicular. Se remarcă prezenţa floemului intern extrem de redus prin proliferarea vaselor de xilem în masa de parenchim celulozic. Frunza, cu structură omogenă, prezintă un mezofil cu celule mari parenchimatice. Demn de remarcat este faptul ca, deşi această plantă traieşte într-o zonă sărăturoasă, pe suprafaţa limbului nu se observă prezenţa glandelor sau a veziculelor saline. Din acest motiv, ca adapatre la acumularea mare de ioni de* Na^+, K^+ şi Ca^2, *celule mezofilului au capacitatea printr-un sistem propriu de a mări concentraţia sucului vacuolar pentru a rezista condiţiilor halofite ale mediului în care habitează. Se remarcă, pe secţiunile tangenţiale efectuate prin frunză, prezenţa stomatelor de tip paracitic.*

Key words: *anatomy, leaf, root, stem, Sueda salsa*
Cuvinte cheie**:** *anatomie, limb, rădăcină, tulpină, Sueda salsa*

INTRODUCTION

Sueda salsa (L.) Pall. is an annual plant growing to 10-15 cm. The plant is green but it may often turns in reed. It is in flower from July to October. The stem is branched from the base. It has liniar halfcilintrical leaves. However, on the stem tip the leaves become short and eliptic in shape. The flowers are hermaphrodite (have both male and female organs). The plant is self-fertile. The plant grows on the lakes (e.g. Techirghiol) and pools moist saline sands. it grows also in the Danube Delta (Sf. Gheorghe) (CIOCÂRLAN, 2000; SĂVULESCU, 1952). It requires moist soil and cannot grow in the shade. In the literature a study into the anatomy of the species almost lack. Our purposes were to show that the root, stem and leaves of this plant, exhibit certain features of anatomical interest, in accordance with its rough halophytic habit.

MATERIAL AND METHODS

The plants were collected form the Techirghiol Lake area. Small pieces of the material were fixed in FAA (formalin:glaciar acetic acid:alcohol 5:5:90). Cross sections of the root, stem and leaf were performed using a rotary microtome. The sections were stained with alum-carmine and iodine green (BERCU & JIANU, 2003). The tangent sections were stained with saphranin 1%. The samples were embedded in Canada balsam. Histological observations and micrographs were performed with a BIOROM –T bright field microscope, equipped with a TOPICA 6001A video camera. The microphotographs were obtained from the video camera through a computer.

RESULTS AND DISCUSSIONS

During the period of vegetation the root gets an early secondary structure (Fig. 1, A). The outermost layer of compactly arranged thin-walled cells – epidermis – sporadically has been ruptured and replaced by cork, placed just bellow the epidermis, followed by phellogen – a single layer of thin-walled cells flattened in shape and compactly arranged - and phelloderm (secondary cortex). The slightly suberized cork cells are compactly packed, without intercellular spaces. The phelloderm consists of parenchyma cells. Some intercellular spaces are found between them (Fig. 1, B).

Similarly to other dicots roots (ANDREI 1978, BATANOUNY 1992, BAVARU & BERCU 2002, ESSAU 1988), the circular ring of cambium produces more secondary xylem towards inner side and secondary phloem on the outer side (Fig. 1A). The secondary phloem comprises few sieve elements, companion cells, phloem parenchyma. Similarly to other species of Chenopodiaceae (ZANOVSCHI & TOMA 1985), the centrally located secondary xylem elements, found in the root of *Sueda salsa*, consist of radially packed layers of xylem vessels, placed into a sclerenchymatous parenchyma and sporadically into a cellulosic one (Fig. 1, A).

The stem of *Sueda salsa* as BERCU et al. (2003), ESSAU (1988) and ZANOVSCHI & TOMA (1985) reported to other Chenopodiaceae annual and bianual species (*Kochia scoparia*, *Salsola kali* subsp. *ruthenica*, *Spinacia oleracea*), gets a specific structure of anatomical interest. It presents a sinuous shape with crests and slopes (Fig. 2, A). Epidermis is covered by a thick cuticle supplemented with wax as BARTHLOTT et al. (1998) reported for this species. The cortex can be roughly divided into an outer and inner region. The outer region is represented by a collenchymatous tissue (1-2 layers of cells), placed mosstly in between crests and slopes whereas the inner one is extremely reduced possessing parenchymatous cells. The inner layers are composed of loosely arranged large cells. Endodermis is composed of one layer of parenchyma cells followed by pericycle. Pericycle is well developed and lies beneath the endodermis cells (Fig. 2A, B).

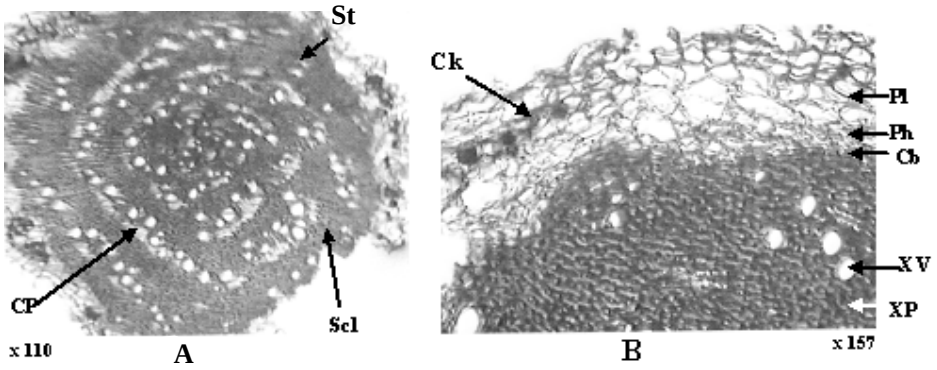

Fig. 1. Cross section of the root. General view (A). Portion with cork, cambium and xylem elements: Cb- cambium; Ck- cork; CP- cellulosic parenchyma; Pl- phellogen; Ph- phloem; St. stele; SclP- sclerenchymatic parenchyma; XP- xylem parenchyma; XV- secondary vessel (orig.).

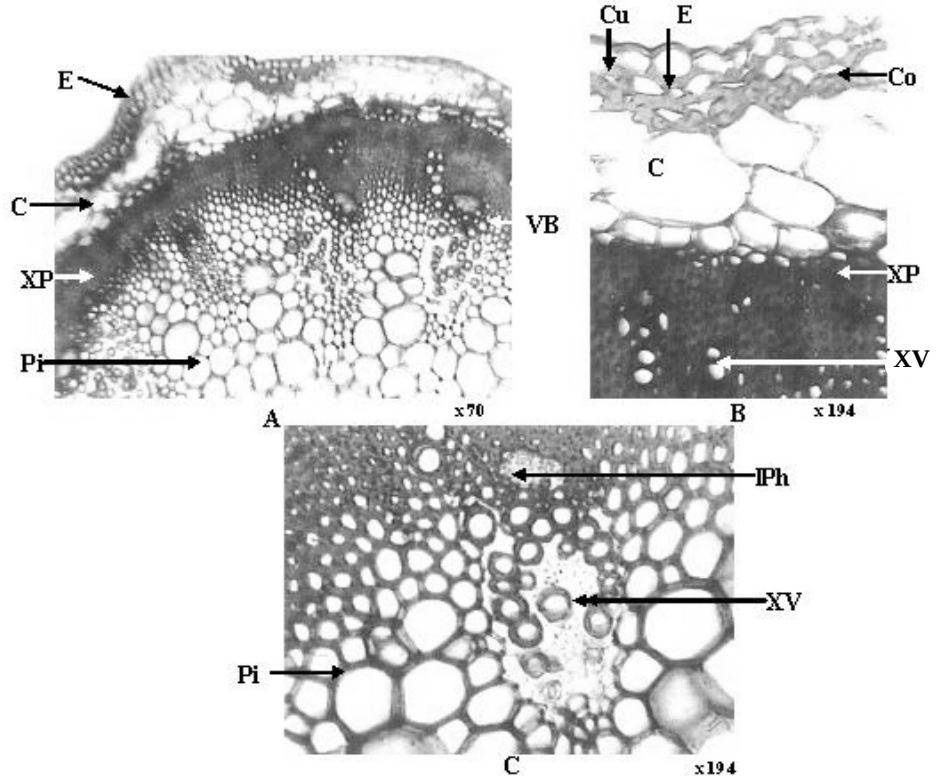

Fig. 2. Cross section of the stem. Portions with epidermis, cortex and stele (A). Portion with epidermis and cortex (B). The inner phloem of the vascular bundle (C): C- cortex; Co- collenchyma; Cu- cuticle; E- epidermis; IPh- inner phloem; Pi- pith; VB- vascular bundle; XP- parenchyma xylema; XV-xylem vessel (orig.).

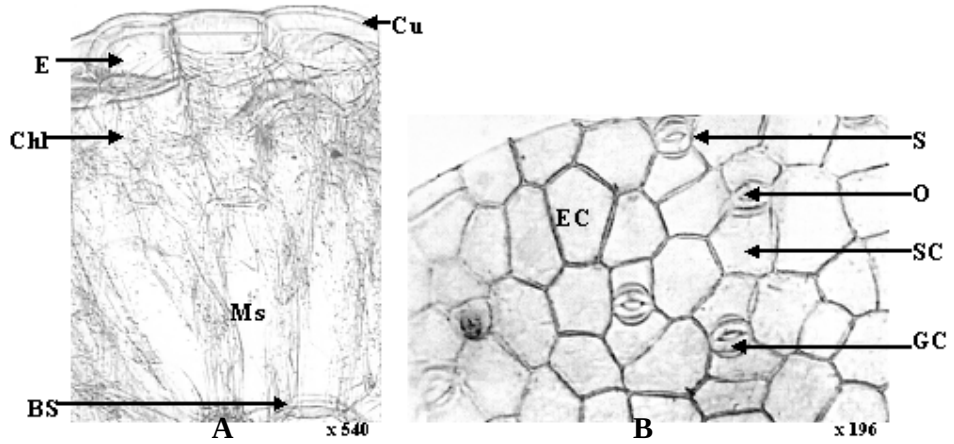

Fig. 3. Portion of a cross section of the leaf with epidermis and mesophyll (A). Tangent section of the blade (B): BS- bundle sheath; Chl- chloroplasts; Cu- cuticle; E- epidermis; EC- epidermal cell; GC- guard cell; Ms- mesophyll; O- ostiole; S- stoma; SC- subsidiary cell (orig.).

The vascular elements (xylem and phloem) form compact and conjoined tissues (Fig. 2, A). The xylem vessels are embedded in a sclerenchymatous parenchyma the later with thick-walled cells. The pith rays are also sclerenchymatous in nature. The phloem is poorly represented by few elements forming an inner phloem due to the proliferation of some xylem vessels into the parenchyma. The pith is made up of large number of rounded cells, which are loosely arranged, enclosing intercellular spaces (Fig. 2, C).

Transversal section of the sessil elliptically-shaped leaf exhibits the epidermis consisting one layer of cells covered, externally, by a thick cuticle and wax. The homogenous mesophyll is represented by large parenchimatous cells. The first two layers of cells are smaller than the others and contain a number of chloroplasts (Fig. 3, A). The vascular system is represented by small collateral bundles towards the center, composed by few xylem and phloem elements, surrounded by a parenchymatous sheath. The epidermis continuity is broken by the presence of paracytic stomata, characteristic to a great number of Chenopodiaceae species (BERCU & BAVARU 2004, DILCHER 1974, DELIU 1993) (Fig. 3, B).

In contrast to some other halophytic plants, *Sued salsa* does not have salt glands or salt bladders on its leaves. Thus, this plant must compartmentalize the toxic Na^+ in the cells vacuoles. Therefore, membrane-bound transport systems regulating cytosolic ion homeostasis (Na^+, K^+ and Ca^{2+}) and ion accumulation in the vacuoles can be considered of crucial importance for adaptation to saline conditions (SERRANO et al. 1999, HASEGAWA et al. 2000). The absence of salt glands or bladders on *Sueda salsa* blade has been reported by FLOWERS et al. (1986) and POLJAKOFF-MAYBER (1975), their role being carried out by the mesophyll cells , increassing the vacuoles concentration allawing the accumulation and elimination expecially of of sodium, which may be toxic for the plant.

CONCLUSIONS

Results reveal dicots and halophytic features of *Sueda salsa* vegetative organs, such as the typical secondary structure of the mature root.

Cross sections of the stem revealed that the cortex is roughly divided into a chlorenchyma tissue, with assimilatory function, and parenchyma tissue, the later to the inner region.

The stem vascular system (xylem and phloem) forms compact and conjoint tissues, possessing an inner phloem.

The mechanical tissue is poorly developed, represented by some collenchyma cells found in the stem and by the conductive tissue in the root and stem.

The homogenous leaf has a well-developed mesophyll composed of large parenchyma cells. The stem and leaf epidermis is covered with a thick layer of cuticle and wex.

Remarkable is that *Sueda salsa* does not have salt glands or salt bladders on its leaves, thus, this plant must compartmentalize the toxic Na^+, K^+ şi Ca^2 ions into the leaf cells, increassing the vacuoles concentration.

This is considered of crucial importance for *Sueda salsa* adaptation to harsh saline conditions found on Tekirghiol shore, it grows on.

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