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Ecophysiological study on the salt tolerance of a pannonian endemism (*Lepidium crassifolium* (W. et K.)) in inland saline area

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ABSTRACT In the inland saline area two structurally different sands of Lepidio-Puccinellietum limosae community can be distinguised: open stand with low plant cover (mostly by *Lepidium crassifolium*) and closed stand with dense plant cover (mostly by *Puccinellia limosa*). The open habitat can be characterised by higher salinity degree. The leaf area of *L. crassifolium* is significantly lower on the open stand. The high water content per unit leaf area indicates the succulent character of the species and is involved in the avoidance of high salt (Na^+) concentrations in the most saline habitat. There was remarkable accumulation of proline in leaves that can act as an osmotically active compound in the citoplasm. The osmotic potential of the tissue sap follows the changes of the proline concentrations, both diurnally and with the differences of habitats. Significant midday depression of Fv/Fm was found in the open habitat due to the unfavourable soil conditions and other additional abiotic factors such as higher irradiance and temperature. **Acta Biol Szeged 46(3-4):249-250 (2002)**

KEY WORDS

salt tolerance
Lepidium crassifolium
sodium
proline
osmotic potential

Halophytes are plants that survive high concentrations of electrolytes in their environments (Flowers et al. 1977). For osmotic adaptation to salinity many halophytes accumulate salt which are compartmentalised into cell vacuoles to protect the cytoplasm from toxic effects. To prevent dehydration of the cytosol, its osmotic potential must be adjusted to the level of the vacuole. This osmotic adjustment requires an accumulation of compatible organic solutes (Flowers et al. 1977; Aspinall and Paleg 1981). Proline accumulation has been shown to be an adaptive response in plant tissue under salt stress, however it is yet not clear whether the primary role is one of the storage (of reduced carbon or nitrogen) or in the osmotic balance of the cell as a whole (Greenway and Munns 1980; Aziz et al 1999).

Inland saline areas with varied microtopographic conditions and different soil conditions offer an excellent possibility to investigate the adapting strategy of plants to abiotic stresses. The aim of this study was to reveal some aspects of osmotic adjustment and adaptation capacity to the soil salt content and the temporal water stress of the pannonian endemic species, *Lepidium crassifolium* (W. et K.) in two different habitats.

Materials and Methods

The experimental site is located in an inland saline area in the Kiskunság region of Hungary. Based on differences in the spatial diversity of the natural plant association Lepidio-Puccinellietum limosae in the research site, two different habitats could be distinguished with the subassociation lepidietosum (open habitat with low plant cover (mostly *Lepidium crassifolium* (W. et K.) and with the subassiociation puccinellietosum (covered habitat with large plant cover (mostly *Puccinellia limosa* (Schur) Holmgb.). The dominant species of this association is the pannonic endemism, *Lepidium crassifolium* (W. et K). Changes in leaf area, leaf water relations (leaf water content (%), specific leaf weight (dry weight per unit leaf area g dm^{-2}), succulence parameter (water content per unit leaf area (g dm^{-2}) were measured. The Na^+ accumulation was measured from acidic digestion of ash obtained after burning with ICP-AES. Leaf proline content was measured according to Lea and Blackwell (1993), osmotic potential of leaf sap (obtained by centrifugation from frozen tissue (in liquid N_2) was determined by Dew Point Mikrovoltmeter (WESCOR, USA). In situ measurements of maximal photochemical activity (F_v/F_m) was made by PAM 2000 Fluorometer (Waltz GMBH).

Table 1. Differences in soil conditions and leaf water relations of *L. crassifolium* on the two different habitats. (mean of three replicates ±S.E.)

habitates	soil moisture (%)	EC (mS/cm)	pH	leaves of *L. crassifolium* water content of leaves (%)	water content(g) /leaf area (dm^2)	SLw (DW (g)/dm^2)
open	17,64 ± 0,22	5,35 ± 0,20	10,21 ±0,01	81,6 ± 0,5	4,97 ±0,51	1,05 ± 0,11
covered	22,38 ± 1,09	3,23 ± 0,10	9,95 ± 0,03	84,4 ± 1,0	4,13± 0,31	0,81 ± 0,06

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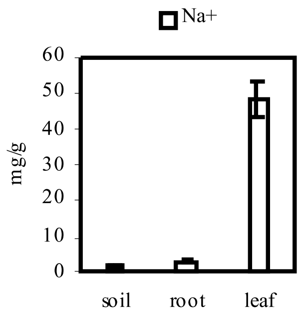

Figure 1. Na^+-concentration of the soil (mg g^{-1}), root and leaves of *L. crassifolium* (mg/g DW) in the two different habitats.

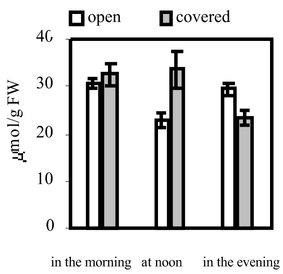

Figure 2. Daily changes of proline content (mmol g^{-1} f.w.) of leaves of *L. crassifolium* in the two different habitats.

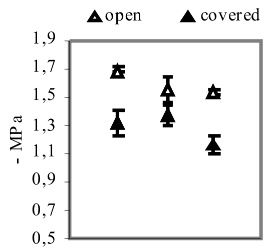

Figure 3. Daily changes of osmotic potentials of the tissue sap of *L. crassifolium* in the two different habitats.

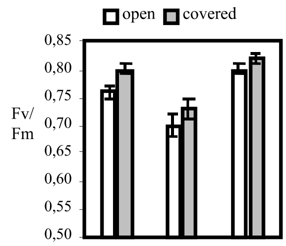

Figure 4. Daily changes of maximal photochemical activity (F_v/F_m) of *L. crassifolium* in the two different habitats.

Soil samples were collected in three replicates from depth of 0-20 cm and actual moisture content, available Na^+ content, electric conductivity and pH were determined.

Results and Discussion

The two habitats have differences in their soil condition. Every measured soil parameter shows, that the open habitat (*lepidietosum* subassociation with mostly *L. crassifolium* cover) can be characterised by higher salinity degree. Under such circumstances only typical halophytes can survive. The morphological appearance of *L. crassifolium* was different in the two habitats. The leaf area was significantly lower on the open habitat but leaves contain more dry weight per unit leaf area therefore less water (%). The higher water content per unit leaf area indicates increased succulent character which may dilute the accumulated salts in the cell sap (Hagemeyer 1997). Since *L. crassifolium* accumulates large quantities of Na^+ into leaves, succulence may be a mechanism to avoid high salt concentrations in plant organs in the most saline habitat. As halophytes in saline environments tend to accumulate considerable amounts of inorganic ions for osmotic adaptation, part of the dry weight increase will be due to inorganic material. In leaves with high vacuolar anion concentration, the osmotic adjustment of the citoplasm requires accumulation of compatible organic solutes which may significantly contribute to the dry weight and SL_w. In leaves of *L. crassifolium* a remarkable proline accumulation capacity was observed that seems to function as osmotically active compound in the citoplasm. The osmotic potential of the leaf sap was in correlation with changes of proline concentrations, both diurnally and with habitats. There were differences in the midday depression of maximal photochemical activity (Fv/Fm) of *L. crassifolium* in the two habitats, it amounted to a larger extent in the open habitat. This can be due to the most unfavourable soil conditions as well as additional factors such as higher irradiance and temperature as superimposed stress (Jimenez et al 1997). In the covered habitat, however, the protected leaves of *L. crassifolium* under the shadow of higher grasses (*P. limosa*) exhibited larger maximal photochemical activity and slighter diurnal changes.

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