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ARTICLE

Root respiration in whole *Haberlea rhodopensis* Friv. plants during desiccation and rehydration

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ABSTRACT The current study investigated changes in root respiration connection with root relative water content in whole *Haberlea rhodopensis* Friv. plant during desiccation and recovery phases. Whole plant was examined during full hydrated, 72 h dehydration and 96 h rehydration period every 6 and 24 hours continuously. Root respiration rates decreased during water stress while it has exceeded the starting values after rehydration. There was a linear relationship between relative water content and root respiration. *H. rhodopensis* whole plants were able to maintain root respiration for the whole desiccation period. The root respiration rate was linearly related to root tissue relative water content. **Acta Biol Szeged 52(1):115-117 (2008)**

KEY WORDS

desiccation tolerance,
root respiration,
relative water content

Desiccation-tolerant (DT) plants such as *Haberlea rhodopensis* Friv. can survive a shorter or longer period in the desiccated state, they revive and resume normal metabolism when they are remoistened (Tuba et al. 1998). In the past mainly the ecophysiology of cryptogamic DT plants were studied, while until 1980's works on ecophysiology of vascular/flower DT plants were done only exceptionally (Vassiljev 1931; Magdefrau 1935; Hartel 1940; Abel 1956) and see the reviews of Kappen and Valladeres 1999 and Proctor and Tuba 2002). Much of the current literature discusses the DT plants mainly as a means of explaining basic mechanisms of DTce (Bewley and Krochko 1982; Oliver and Bewley 1997; Hartung et al. 1998; Scott 2000; Black and Pritchard 2002; Bartels 2005; Moore et al. 2007) instead of exploring their anatomy, function and ecology (Kappen and Valladares 1999; Proctor and Tuba 2002). Desiccation-tolerant plants are important constituents in many ecosystems where these plants dominate under unfavourable climate conditions, where the normal homoiohydric plants maintain much of their biomass below the soil surface, succumb to stresses and/or are unable to establish themselves (Tuba et al. 1998). Large pools of nutrients and carbon occur in the poikilohydric DT plants of these extreme ecosystems, and therefore significant aspects of ecosystem function depend on their ecophysiological response, production and turnover pattern. Especially important to know how these plants maintain a net positive carbon gain and what their functional role is in their own ecosystems. Respirations (shoot and root respiration) is an essential component of the plant carbon gain. It is known, that the length of the desiccation period ranges from few hours in cryptogamic HDT plants to 24 h in vascular HDT plants (Tuba et al. 1995; 1996). However, there is almost no information about the root respiration responses of DT plants under different water conditions. The main aim of this study was to investigate the effect of desiccation and the recovery processes on root respiration of *Haberlea rhodopensis* Friv. whole plants.

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Materials and Methods

Haberlea rhodopensis Friv. is a perennial herbaceous rock poikilohydric plant, nowadays it can be found only in the Balkan Mountains (Georgieva et al. 2005). It is considered as a homoiochlorophyllous DT plant (Tuba et al. 1994). Root respiration was measured in the laboratory of Szent István University, Gödöllő. The fully hydrated plant roots were desiccated slowly over 3 days in an own constructed special chamber (at 20°C, at 50% relative humidity, at a PPFD of 50 µmol m^2 s^{-1}). Root respiration was measured by using a LI-6400 (Li-Cor, Lincoln, NE, USA) IRGA connected with soil a respiration chamber. Following desiccation the dried roots were rehydrated by air humidify and direct spraying on roots in a closed glass chamber for 4 days.

Root relative water contents were measured by thermogravimetric method as described by Tuba (1987).

Results and Discussion

Relative water content of fully hydrated plant roots began to decline gradually after suspending of water supply to the roots. The decline in relative root water content was linear with root respiration values and after 72 hours the roots reached the completely desiccated stage. Minimum value of root respiration was 0.393 µmol CO_2 kg^{-1} dry weight after 54 hours of dehydration (Fig. 1). After 96 hours of rehydration,

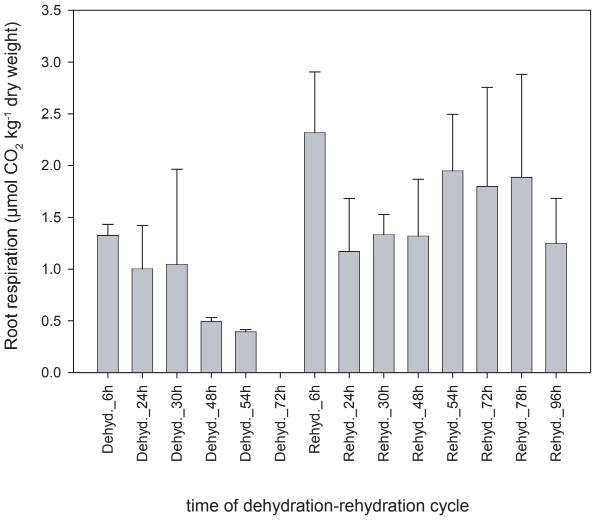

Figure 1. Root respiration of *Haberlea rhodopensis* Friv. during dehydration-rehydration cycle. Means ± standard deviations are presented (n= 5, p<0.05).

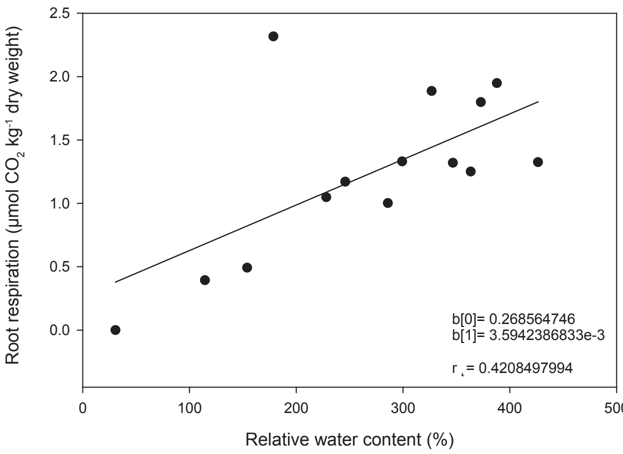

Figure 2. Relationship between root respiration and relative water content in *Haberlea rhodopensis* Friv. during dehydration-rehydration cycle. First value was measured after 6 hours of dehydration and last one after 96 hours of rehydration (n= 65, p<0.05).

the relative water content of the previously desiccated root was restored and regained the approximate control roots' values.

Figure 2. shows relationship between the relative water content and root respiration (r^2= 0.420849). At lower water contents the increase of the root respiration values was more rapid than in fully hydrated states. Recovery of root respiration rate was similar to the rate of fully hydrated plants after 1 day of the rehydration. Maximum value of root respiration was 2.3 μmol CO_2 kg^{-1} dry weight after 6 hours of rehydration (Fig. 1).

Root respiration change during dehydration-rehydration cycle has shown dynamic connection with changes in root relative water contents. Results concluded that the HDT *Haberlea rhodopensis* Friv. root has the ability to survive the desiccation just as leaves (Péli et al. 2005). Variation in plant relative water content causes changes not only in the root respiration of the whole *H. rhodopensis* Friv. plants, but in their photosynthetic activity (data not shown) too. It's seems to be that *Haberlea rhodopensis* Friv. whole plants has an extremely high ability to adapt to longer drying/wetting periods. *H. rhodopensis* Friv. whole plants were able to maintain root respiration for the whole desiccation period. This response in *H. rhodopensis* Friv. is similar to respiration response of *X. scabrida* (Tuba et al. 1996) and it is suggested to maintain energy supply allowing metabolic activity during desiccation.

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