THE WATER SHUTTLING HYPOTHESIS IN *LITHOPS*

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Xerophytic plants are adapted to life in arid environments thanks to the development of several survival strategies. The most common adaptation is the loss of leaves and a long-term investment on succulent stems, as in the family Cactaceae in which photosynthesis depends on the stem. In the family Aizoaceae, instead, leaves are the water storage organs and the genus *Lithops* represents the more extreme adaptation. The genus *Lithops* consists of a pair of succulent leaves inserted on an extremely short stem; the apical meristem produces a new pair of leaves each growing season, and the new leaves develop inside the mature ones (Albanese *et al*., 1989). This genus avoids drought stress and this strategy allows to perform a complete growth cycle even if there is no external water supply. This is possible by maintaining a high water content inside the plants, isolating them from the environment and using the water stored in the leaves. Water shuttling describes the water redistribution from old to young leaves that allows the plant to grow even without external inputs of water (Rabas & Martin, 2003); recycling water between vegetative organs is, in fact, one of the possible adaptation strategies of plants under stress, and, although repeatedly mentioned by many authors (Herrera *et al*., 2000), it had never been demonstrated experimentally in *Lithops*. The methodology used to verify the existence of water redistribution from old leaf to young leaf, was fluorescence microscopy that involves the use of fluorescent tracers to obtain information on water pathway. We used two fluorescent tracers to verify the water pathway inside the plant: the apoplastic tracer Sulforodamin G (SRG) (Canny, 1988) and the symplastic tracer Carboxyfluoroscein diacetate (CFDA) (Wang *et al*., 1994). The experiments were conducted on 70 plants of *Lithops hallii* (De Boer) and *Lithops julii* (Dinter & Schwanter) N. E. Br.

The results showed that:

- water shuttling occurs in *Lithops*: young leaves take up water from the old ones;
- water can follow both a symplastic and an apoplastic pathway; in fact, although our data reveal a higher percentage of apoplastic than symplastic transport (74.2% *vs* 59.2%) this difference was not statistically significant. Water shuttling is therefore one of the adaptive responses of these plants.

The genus *Lithops* invests in leaves: old leaf - young leaf water recycling allows these plants to grow without rainfall, so that they always have at least one pair of leaves in full photosynthetic efficiency, even during prolonged unfavorable periods.

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