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A Study to Detect CAM Plants in Mongolia

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Abstract

In order to discover CAM plants from the Mongolian flora, four species, *Orostachys spinosa* (L.) C. A. Mey., *O. malacophylla* (Pall.) Fisch., *O. thyrsiflora* Fisch. and *Sedum aizoon* L. of *Crassulaceae* D.C. family were examined in terms of their leaf anatomy, photosynthesis and transpiration intensity for a 24-hour cycle. Photosynthesis by these plants has been studied using isotope-discriminate analysis ($\delta^{13}C$) and a special method for CAM. Transpiration was measured by the weight-method and leaf anatomy and stomatal movement by microscopy. $^{13}C/^{12}C$ value of *Orostachys spinosa*, *O. thyrsiflora* C_4-like (-13.44‰,-18.10‰), *O. malacophylla*, *Sedum aizoon* C_3-like (-25.03‰,-26.32‰). CAM plant characters are clearly discovered in two species *Orostachys spinosa* and *O. malacophylla.* Although differences in the acidity value cycle of *Sedum aizoon* in terms of a 24-hour cycle was similar to the previous two plants, stomatal movement was commonly closed during night and day showing that we need to conduct more future studies for this species. *Orostachys thyrsiflora* does not have CAM photosynthetic response.

Key words: leaf anatomy, CAM, photosynthesis, transpiration intensity, stomatal movement

Introduction

During the past several years drought occurrence has increased in Mongolia, and drastic changes have taken place in climate, there has been a significant increase detected in desertification and degradation has occurred in pasturelands. For this reason, there is an essential need to study the eco-physiology of succulent and CAM (Crassulaceaen Acid Metabolism) plants, which have the ability to keep the water in their cells, can endure dry, hot conditions and grow in desert areas. These plants are poorly studied in Mongolia.

CAM plants open their stomata at night and close them during the daytime to survive hot and dry conditions. CAM metabolism was first investigated in members of the family C*rassulaceae* D.C. and called Crassulaceaen Acid Metabolism. The *Crassulaceae* Family has 40 genus, 15,000 species and CAM has been recorded in 25 genus: *Adromischus, Aeonium, Bryophyllum, Cotyledon, Crassula, Cremnophila, Diamorpha, Dudleya, Echeveria, Graptopetalum, Greenovia, Hasseanthus, Hylotelephium, Kalanchoe, Lenophyllum, Monanthes, Nananthus, Pachyphytum, Parvisedum, Rochea, Sedum, Sempervivum, Tylecodon, Umbilicus, Villadia* (″http://biodiversity.uno.edu/delta).

Nowadays, an estimated 15-20,000 CAM species are known in 33 families in terrestrial and also in aquatic plants (Black & Osmond, 2003). From those, 14 families grow in the Mongolian flora including *Asteraceae*, *Chenopodiaceae*, *Caryophyllaceae* which are the largest families in Mongolia's flora.

In crassulacean acid metabolism (CAM), the reactions of photosynthesis and CO_2 uptake are temporally separated; CO_2 uptake and fixation take place at night, and decarboxylation and refixation of the internally released CO_2 occur during the day. CAM is an adaptation primarily to minimize the quantity of water that is lost when stomata are opened to permit the entry of CO_2. In CAM plants, the stomata are opened in the cool of the night. CO_2 is fixed as malic acid, which is stored in the vacuole. As malic acid accumulates, the leaf vacuoles acidify in the dark. Upon illumination, the stomata close, and the leaf deacidifies. The malic acid is recovered from the vacuole and undergoes decarboxylation. The CO_2 that is released is prevented from escaping by stomatal closure and is assimilated via the Calvin cycle using photochemically generated ATP and NADPH (Hatch & Boardman, 1981).