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Does Corticular Photosynthesis Contribute to Carbon Gain in Green Stem-Succulent Plants?

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Abstract

The African baobab (*Adansonia digitata* L.) and castor bean (*Ricinus communis* L.) are drought resistant green-stemmed succulent plants which grow in the arid and semi-arid regions of Africa. A common characteristic of stem-succulent plants is the presence of a green layer underneath the stem bark which contains chlorophyll and is capable of re-fixing CO₂ produced by stem respiration in the presence of light. Photosynthesis in the stems of green-stemmed plants is known to contribute to plant carbon gain especially during leafless periods. The contribution of corticular photosynthesis to plant carbon gain has, however, never been measured in stem succulent species. The aim of the study was to investigate the contribution of corticular photosynthesis to carbon gain in these stem succulent plants, and how this process is affected by drought, which is common in their natural habitats. The height and stem diameter of baobab and castor bean plants grown in the greenhouse were measured. The plants were completely defoliated and subjected to different treatments: watered with uncovered stems (WU), watered and stems covered with aluminium foil (WC) to achieve 100% light exclusion, drought and uncovered (DU) and drought and covered (DC). The plants were allowed to grow for 3 weeks, while buds produced were harvested weekly. After three weeks, the dry weight of buds produced, the height and stem diameter and the ¹³C composition of the buds and outer stem bark was measured. Stem coverage with aluminium foil resulted in a higher stem and larger stem diameter for drought exposed baobab seedlings with similar trends seen in castor bean. Light exclusion also resulted in a reduction in the stem chlorophyll content in both species. Light exclusion resulted in a significantly lower bud dry weight production and enrichment in ¹³C in bud dry matter, demonstrating that corticular photosynthesis contributes to whole plant carbon gain in both species. Bud biomass production in drought stress plants was significantly lower compared to watered plants, showing that drought stress have negative impacts on growth. These findings confirm that the green stems of stem-succulent plants contribute to overall plant carbon gain.

Keywords: Bud development, corticular photosynthesis, defoliation, stem coverage, stem succulent