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Green barks of trees from drought deciduous forests ("bosque seco") in northern Peru/southern Ecuador do not perform CAM

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With 14 figures

Abstract: Trees from drought deciduous forests ("bosque seco") in northern Peru and southern Ecuador regularly shed their leaves at the onset of seven months-long periods without rain. This way they very effectively reduce the bulk water consumption by leaf transpiration, still loosing small amounts of water through their bark, but at the risk of too little or no carbon gain when leaf-less. Seven species studied here have good developed green cortex tissue on stems and axes, as especially evident for the "bottle tree" *Ceiba trischistandra* (A. Gray) Bakhuisen (Bombacaceae). In several leaf-less tree species at the end of summer drought, when xylem sap flows are very low, indications of higher xylem flows at night as compared to day-time were found, which led to the question of whether the trees are capable of performing CAM in their axes. However, although quite low in some cases, the pH of the cortex tissues did not fluctuate diurnally. In addition, no night-time carbon uptake could be observed. Although no net carbon gain was measured in *C. trischistandra* and *Erythrina smithiana* Krukoff (Fabaceae) photosynthetic activity of the green cortex was sufficient to re-assimilate between 50% to 60% of the carbon released by mitochondrial respiration. In contrast, the obligate CAM plant *Cereus diffusus* (Britton & Rose) Werdermann (Cactaceae), which was studied as a reference in the same environment, showed both diurnal pH-fluctuations in its green tissue with lowest values before sun rise, and net carbon fixation at night.

Keywords: Green stem cortex tissue, CAM, *Cereus diffusus*, C3-photosynthesis, *Ceiba trischistandra*, summer deciduous trees, seasonal dry forest

Introduction

Drought deciduous forests (so-called "bosque seco") are found in southern Ecuador and northern Peru approximately between 4° and 5° S (Walter & Breckle 2004, Lauerer et al. 2008). They are the evolutionary result of the long-lasting effects of the cold Humboldt current at the Pacific coast nearby, but sheltered off by a low coastal range in the west, and the strong lee-side effect of the Andes shielding off the normally predominant moist air flows from the Amazon Basin in the east. As a consequence of this situation, summers with air temperatures up to 40°C last regularly seven months without any rain, followed by about 3 months of little and 2 months of sufficient rain, in total allowing for the very slow growth of an open forest up to 25 m in height. Trees regularly shed their leaves in summer giving the forest a physiognomic impression of being dead – for the dominating brown and black colours – if it were not for some flowering trees. When rainfall increases, the forest completely turns into green, but for no longer than 2–3 months. Trees appear to permanently face the dilemma of either dying from water stress – when maintaining leaves too long in their canopies during the dry period – or dying from too little carbon gain when in the leaf-less mode, for not being able to support the permanently respiring, non-green plant parts with assimilates from photosynthesis.

However, photosynthesis in tissues other than leaves is well known (e.g. Horna & Zimmermann 2002, Küppers 1989,

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