Hierarchical cluster analysis as a tool to compare diel time cycles in CAM research

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Crassulacean acid metabolism (CAM) is an important photosynthetic specialization with optimised water-use efficiency (WUE) by sequestering CO2 predominantly at night when evapotranspiration rates are low. An important hallmark of CAM plants is the integration of circadian and metabolite control over nocturnal C4 and daytime C3 carboxylation processes, hereby providing plasticity for optimizing carbon gain by extending or curtailing the period of net CO2 uptake over any 24-h period depending on environmental conditions. Inherent to its 'diel origin' the statistical processing of CAM-data is challenging and often limited to comparisons of nocturnal/diurnal accumulations/decreases. As such, specific information in the data might be overlooked, especially when large datasets are considered. To address this issue, 6 months old vegetative Phalaenopsis 'Edessa' were sampled over the diel cycle every 2 hours under a light regime of 12h/12h at 28°C and 75% RV (n=5). Besides conventional measurements of malate, soluble sugars and starch, a range of additional metabolites (such as different phosphorylated sugar intermediates, organic acids, polyols, trehalose and trehalose-6-phosphate) were analysed in addition by LC/MS-Q3. These analyses were further complemented by registering diel gas exchange patterns using a LCi Portable Photosynthesis System. As such, a unique CAM dataset arose, consisting of about 2500 data points and representing 38 diel patterns with each diel cycle composed of 13 sampled time points (n=5). In order to maximise data interpretation, an hierarchical agglomerative cluster method was applied after normalization of the data. Clusters will be presented and the physiological and biochemical relevance will be discussed.