# Photosynthetic carbon metabolism, respiration and starch degradation in leaves of Arabidopsis under high temperature stress

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Raising the temperature of Arabidopsis leaves above 40°C an abrupt increase in the rate of respiration was detected, both in the dark and in the light. To elucidate the mechanisms of this phenomenon the effects of temperature on the conversion of primary and stored photosynthates, the potential substrates of respiration, were studied. For this purpose the rates of photosynthesis, respiration and degradation of pulse-labeled starch and soluble photosynthates were measured in parallel in the dark and in the light under different temperatures.

In the dark the substrates of respiration were derived mainly from starch accumulated in leaves during previous light period. In the light degradation of starch was blocked and reversed to its additional synthesis from cytosolic soluble photosynthates, the substrates of respiration were derived exclusively from primary and soluble stored photosynthates, mainly from sucrose. In the light breakdown of starch took place only in conditions where photosynthetic $CO_2$ assimilation was suppressed (in $CO_2$-free air and/or under supraoptimal temperatures).

In the dark the rates of respiration and degradation of starch increased with temperature, most abruptly at temperatures higher than 40°C. In illuminated leaves increase in leaf temperature above 25°C resulted in a progressive decrease in the rate of photosynthesis leading to its full suppression at 43°C. In the light at moderate temperatures (20-40°) the rate of decarboxylation of soluble stored photosynthates did not depend on temperature, the rise in total respiration was due to the temperature-mediated increase in respiratory decarboxylation of primary photosynthates. Under these conditions degradation of starch was blocked. The block was removed at temperatures higher than 40°C where an extensive degradation of starch and respiratory decarboxylation of stored photosynthates were followed also in the light. The acceleration of starch degradation at supraoptimal temperatures was accompanied by accumulation of maltose, sucrose and alanine, both in the light and in the dark.

Thus, the abrupt rise in respiration under high temperature stress could be explained by the increased availability of substrates derived from degradation of starch.