Changes in Rubulose-1, 5-Bisphosphate Carboxylase/Oxygenase Turnover is the Key to Photosynthetic Acclimation to Elevated CO_2 in Rice(Frontiers in Rice Science -from Gene to Field-,The 100^<th> Anniversary of Tohoku University, International Symposium)

著者	Seneweera Saman, Makino Amane, Conroy Jann, Suzuki Yuji, Mae Tadahiko
journal or publication title	Tohoku journal of agricultural research
volume	57
number	3/4
page range	22
year	2007-03
URL	http://hdl.handle.net/10097/40414

Changes in Rubulose-1,5-Bisphosphate Carboxylase/Oxygenase Turnover is the Key to Photosynthetic Acclimation to Elevated CO_2 in Rice

Saman Seneweera[1], Amane Makino[2], Jann Conroy[1], Yuji Suzuki[2] and Tadahiko Mae[2]

[a]Centre for Plant and Food Sci, Univ of Western Sydney, Locked Bag 1797, Penrith South DC 1797, Australia; [b] Depart of Applied Plant Sci, Graduate School of Agric Sci. Tohoku University, Tsutsumidori-Amamiyamachi, Sendai 981-8555, Japan.

Rice is grown in many different agro-ecological zones and it assimilates CO_2 directly through C_3 photosynthesis. At present atmospheric CO_2 concentration, rice is not photosynthetically saturated, but as the CO_2 concentration rises in the atmosphere, photosynthetic rates will be accelerated but cannot be sustained during prolonged exposure and this process is termed "acclimation". The primary factor associated with acclimation response is a reduction in the amount of ribulose-1-5-bisphospate carboxylase/oxygenase (Rubisco) which is a rate limiting enzyme for C_3 photosynthesis. The mechanism of reduction of Rubisco content at elevated CO_2 is still not well understood. The amount of Rubisco in the leaves is mainly determined by both synthesis and degradation and is regulated by internal and external signals. The most accepted hypothesis is that the decline in the Rubisco content at elevated CO_2 is through accumulation of soluble sugars thereby suppressing the expression of genes for the large subunit of ribulose-1-5-bisphospate carboxylase/oxygenase (*rbc*L) and small subunit of ribulose-1-5-bisphospate carboxylase/oxygenase (*rbc*S). However, a negative relationship between Rubisco and soluble sugar has not always been reported. We tested the hypothesis that acclimation of leaf photosynthesis to elevated CO_2 is associated with factors other than accumulation of carbohydrates, plants were grown until maturity with a luxurious N supply, in an outdoor glass house at either ambient (390 μmol CO_2 mol) or elevated CO_2 (1000 μmol CO_2 mol). Immediately after emergence of flag leaf blade, plants were labelled with ^{15}N tracer. Gas exchange measurements were carried out to estimate in *vivo* maximum carboxylation ($V_{c.max}$) and maximum electron transport capacity (J_{max}) during leaf development. Simultaneously, leaf blades were sampled for Rubisco, chlorophyll, total N, sucrose and hexose. Isolation of Rubisco and it's ^{15}N measurements was carried out to calculate Rubisco synthesis and degradation. The changes in mRNA for *rbc*S and *rbc*L were also determined. In response to short-tem CO_2 enrichment, photosynthetic rates were increased by 40 per cent in leaf blades immediately after full expansion. Initial stimulation of photosynthesis was reduced during long-term exposure and reduction were associated with reduced amounts of Rubisco content and its maximum potential activity (V_{cmax}). However, acclamatory responses varied during leaf development and were more pronounced during the leaf senescence phase. This was largely due to changes in synthesis and degradation Rubisco. The level of *rbc*S and *rbc*L mRNAs, and amount of Rubisco synthesis were suppressed by elevated CO_2 but not well correlated with soluble sugar. Rubisco degradation was also accelerated by elevated CO_2 but the mechanism is still not well understood. This data suggests that acclimation of photosynthesis to elevated CO_2 is partially due to reduced synthesis and rapid degradation of Rubisco.