Rubisco *in planta* k_{cat} is regulated in balance with photosynthetic electron transport

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Site turnover rate (k_{cat}) of Rubisco was measured in intact leaves of different plants. Potato (*Solanum tuberosum* L.) and birch (*Betula pendula* Roth.) leaves were taken from field-growing plants. Sunflower (*Helianthus annuus* L.), wild type (wt), Rubisco-deficient (-RBC), FNR-deficient (-FNR) and Cyt b_6f deficient (-CBF) transgenic tobacco (*Nicotiana tabacum* L.) were grown in a growth chamber. Rubisco protein was measured with quantitative SDS-PAGEand FNR protein content with quantitative immunoblotting. Cyt b_6f level was measured *in planta* by maximum electron transport rate and Photosystem I (PSI) content was assessed by titration with far-red light. The CO_2 response of Rubisco was measured *in planta* with a fast-response gas exchange system at maximum ribulose 1,5-bisphosphate concentration. Reaction site k_{cat} was calculated from V_m and Rubisco content. Biological variation of k_{cat} was significant, ranging from 1.5 to 4 s^{-1} in wt, but was >6 s^{-1} at 23 ºC in –RBC leaves. The lowest k_{cat} of 0.5 s^{-1} was measured in –FNR and –CBF plants containing sufficient Rubisco but having slow electron transport rates. Plotting k_{cat} against PSI per Rubisco site resulted in a hyperbolic relationship where wt. plants are on the initial slope. A model is suggested in which Rubisco Activase is converted into an active ATP-form on thylakoid membranes with the help of a factor related to electron transport. The activation of Rubisco is accompanied by the conversion of the ATP-form into an inactive ADP-form. The ATP and ADP forms of Activase shuttle between thylakoid membranes and stromally-located Rubisco. In normal wt plants the electron transport-related activation of Activase is rate-limiting, maintaining 50-70% Rubisco sites in the inactive state.