The rate of nitrite reduction in leaves as indicated by O_2 and CO_2 exchange during photosynthesis

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Photosynthetically reduced ferredoxin (Fd^-) in leaf chloroplasts is used for the reduction of NO_2^- to NH_4^+ and 1.5 O_2 are evolved. This offers a possibility for the *in vivo* measurement of NO_2^- reduction in intact leaves as the surplus of O_2 evolution over CO_2 fixation. Light response (at 300 ppm CO_2 and 10 - 50 ppm O_2 in N_2) and CO_2 response curves (at absorbed photon fluence rate, PAD of 550 µmol m^{-2} s^{-1}) of O_2 evolution and CO_2 uptake were measured in leaves of different species. Tobacco (*Nicotiana tabacum* L.) leaves were grown on NO_3^- and NH_4^+ as N source. Potato (*Solanum tuberosum* L.), sorghum (*Sorghum bicolor* L. Moench) and amaranth (*Amaranthus cruentus* L.) leaves were grown on NH_4NO_3 nutrient. The surplus of photosynthetic O_2 evolution in excess of the photosynthetic CO_2 uptake was measured with the help of a zirconium cell O_2 and an infrared absorption CO_2 analyzers and interpreted to be the rate of electron flow to acceptors alternative to CO_2, mainly to NO_2^-, SO_4^{2-} and oxaloacetate. In the NO_3^- -nutritioned tobacco, as well as in sorghum and amaranth and young potato, the photosynthetic O_2 - CO_2 flux difference increased at very low light intensities (PAD) to the value of about 0.5 - 1 µmol m^{-2} s^{-1} and the rate saturated already at PAD of 50 µmol quanta m^{-2} s^{-1}. At higher PADs another component of the O_2 - CO_2 excess was observed, which increased about proportionally with the photosynthetic rate to the maximum of about 1 µmol m^{-2} s^{-1}. In the NH_4^+ -fed tobacco, as well as in potato during tuber filling, the low-PAD component of the surplus O_2 evolution was virtually missing. The results show that the photoreduction of NO_2^- and CO_2 reduction compete for one and the same pool of Fd^- with rather similar affinities. NO_2^- reduction saturates at a low light intensity at rate of about 9% of the maximum O_2 evolution rate. The measured nitrite reduction rate is in agreement with leaf N/C molar ratio. At higher PADs oxaloacetate reduction is superimposed on the NO_2^- reduction. The NH_4^+ “toxicity” and role of NO_2^- and oxaloacetate reduction in regulation of ATP/NADPH balance are discussed.