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Phytoglobin-NO cycle and AOX pathway play a role in anaerobic germination and growth of deepwater rice

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Abstract:

An important and interesting feature of rice is that it can germinate under anoxic conditions. Though several biochemical adaptive mechanisms play an important role in the anaerobic germination of rice but the role of phytoglobin-nitric oxide cycle and alternative oxidase pathway is not known, therefore in this study we investigated the role of these pathways in anaerobic germination. Under anoxic conditions, deepwater rice germinated much higher and rapidly than aerobic condition and the anaerobic germination and growth were much higher in the presence of nitrite. The addition of nitrite stimulated NR activity and NO production. Important components of phytoglobin-NO cycle such as methaemoglobin reductase activity, expression of Phytoglobin1, NIA1 were elevated under anaerobic conditions in the presence of nitrite. The operation of phytoglobin-NO cycle also enhanced anaerobic ATP generation, LDH, ADH activities and in parallel ethylene levels were also enhanced. Interestingly nitrite suppressed the ROS production and lipid peroxidation. The reduction of ROS was accompanied by enhanced expression of mitochondrial alternative oxidase protein and its capacity. Application of AOX inhibitor SHAM inhibited the anoxic growth mediated by nitrite. In addition, nitrite improved the submergence tolerance of seedlings. Our study revealed that nitrite driven phytoglobin-NO cycle and AOX are crucial players in anaerobic germination and growth of deepwater rice.

Keywords: alternative oxidase, nitric oxide, nitrite, phytoglobin, reactive oxygen species, redox