Tropentag, September 14-16, 2010, Zurich

"World Food System —
A Contribution from Europe"

Role of Antioxidants in Developing Rice Varieties Tolerant to Iron Toxicity

Michael Frei, Katrin Engel, Mathias Becker

University of Bonn, Institute of Crop Science and Resource Conservation (INRES) - Plant Nutrition, Germany

Abstract

Iron toxicity is among the most prevalent mineral disorders in highly reduced paddy soils and leads to substantial yield losses in lowland rice production in Africa and Asia. Elevated concentrations of reduced Fe^{2+} in the soil solution result in the excessive uptake of Fe^{2+} ions that are transported to the leaves via the transpiration stream. In the leaf symplast Fe^{2+} catalyzes the excessive formation of reactive oxygen species (ROS). This oxidative stress becomes visible as bronzing symptoms and can cause the death of entire leaves or plants. Based on previous experiments three different adaptation strategies of tolerant genotypes had been distinguished: (i) exclusion of Fe^{2+} by oxidation at the root surface, (ii) immobilisation in the stem tissues or retention in the apoplast to prevent Fe^{2+} from entering the symplast, and (iii) detoxification of ROS to prevent the formation of stress symptoms despite high tissue Fe^{2+} concentrations (= tissue tolerance). In this study factors conferring tissue tolerance were determined by biochemical analyses of a range of contrasting genotypes including landraces, high yielding varieties, parents of a QTL mapping population and a gene knockout mutant that was deficient in tissue ascorbic acid concentration. Plants were stressed with 1000 ppm $FeSO_4$*$7H_2O$ in hydroponic culture for five days. Biochemical analyses included substrates and enzymes involved in the ascorbate-glutathione cycle, and further enzymatic and non-enzymatic antioxidants such as superoxide dismutase, catalase, peroxidise and phenolics. These results will be discussed with an emphasis on their possible application in the breeding of tolerant rice varieties, and compared with factors of oxidative stress tolerance under different environmental stresses such as zinc deficiency or high ozone concentration.

Keywords: Antioxidants, iron toxicity, *Oryza sativa* L., QTL, reactive oxygen species, tissue tolerance

Contact Address: Michael Frei, University of Bonn, Institute of Crop Science and Resource Conservation (INRES) - Plant Nutrition, Karlrobert-Kreiten Strasse 13, 53115 Bonn, Germany, e-mail: mfrei@uni-bonn.de