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Efficiency of Adaptation Mechanisms of Rice to Diverse Conditions of Iron Toxicity

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Abstract

Iron toxicity is a nutrional disorder that differentially affects lowland rice as a function of plant development stage and the intensity and duration of the stress. After its uptake and translocation in aboveground plant parts, the physiologically active Fe(II) catalyzes reactive oxygen species which destroy cell membranes and structural components. Tolerant cultivars are considered the most effective approach to cope with diverse iron toxic conditions. Tolerance mechanisms may comprise **(1)** exclusion of Fe(II) from the root by oxygen release of the aerenchyma, or from the leaf symplast by apoplastic oxidation, **(2)** retention and immobilisation in physiologically less active tissues and **(3)** detoxification of reactive oxygen species in leaf tissues. Ten rice genotypes of different origins (*O. sativa* indica/ japonica, *O. glaberrima*, interspecific NERICA) and with known sensitivity or tolerance to Fe(II) were comparatively evaluated in hydroponic culture regarding the effectiveness of the prevailing adaptation mechanism under diverse toxicity conditions. Increasing Fe(II) stress intensities (0, 500, 1000, 1500 ppm Fe(II)) were applied for variable durations (2–6 days) at the seedling, vegetative and early reproductive growth stages (4, 6 and 8–10 weeks old plants). Leaf symptom scoring was combined with Fe partitioning (root plaque, Fe content in root, stem and leaf tissue) and Fe speciation (total Fe(III) by AAS; active Fe(II) by 2,2- dipyridyl colouration). Within a given cultivar, both the stress tolerance level and the type and effectiveness of the involved adaptation mechanisms changed with developmental stage. Genotype selection must consider the intensity, the duration, and the timing of the iron stress occurrence to effectively counteract iron toxicity stress.

Keywords: Rice, iron toxicity, *Oryza sativa*, stress tolerance

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