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Influence of *Bacillus* spp. on Iron Plaque Formation at the Root Surface of Lowland Rice

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Abstract

Under iron toxic conditions, roots of lowland rice take up excess amounts of ferrous iron, which is translocated via the xylem with the transpiration stream to the leaves. There high concentrations of iron result in the formation of free radicals, damaging cell components, particularly membranes. The rice plant has developed several mechanisms to prevent this nutritional disorder, such as iron storage in different forms and tissues, partitioning among roots, leaves and stems and exclusion at the root surface by oxidising Fe(II) into a root surface plaque of Fe(III) compounds. Albeit the oxygen diffusing through the aerenchyma to the roots is responsible for the oxidation, some bacteria endemic to rice may positively affect the oxidation power of the roots. The aims of this research were to study the effect of 4 root-associated strains of bacillus (*B. megaterium*, *B. pumilus*, and two un-identified isolates of *Bacillus*) on the iron uptake by the plant and on Fe(III) deposition at the root surface.

Seedlings of the iron toxicity-sensitive cultivar I Kong Pao were hydroponically grown for 6 weeks. The root tips of the seedlings were cut (vs. a non-cut control), inoculated with bacteria and subjected to two iron treatments (0 and 1000 mg l^{-1} Fe(II)). Nitrogen gas was infiltrated to the cultural solution to maintain reduced conditions. Toxicity symptoms were scored visually; Fe uptake and partitioning within plant organs, and iron plaque formation were determined by chemical analysis.

All four strains improved plant height in plants with intact roots whereas iron plaque formation was more pronounced when the roots were cut. The increased formation of iron plaque could have been due to improved bacterial penetration, facilitated by the cutting of the roots. *B. megaterium* reduced both Fe uptake and leaf symptoms and affected iron partitioning among organs, increasing the share of iron stored in the roots. The results imply that *B. megaterium* is a promising candidate for ameliorating the performance of rice under conditions of iron toxicity. Possible mechanisms of bacterial action related to iron toxicity will be discussed.

Keywords: Fe(II)/Fe(III), iron toxicity, *Oryza sativa*

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