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Physiological and biochemical aspects of iron nutrition and interactions in plants

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Tutrient imbalances in plants are a world-wide problem for crop production. Diagnosis of nutritional disorders is traditionally based on visible symptoms. Iron (Fe) is one of the most important and most problematic of all the micronutrients used by living organisms. Fe takes part in a wide variety of biological processes; however its bioavailability is very limited in well-aerated and calcareous soils. It functions in both heme and non-heme forms in many enzymatic reactions. Photosynthetic CO₂ fixation rates were enhanced by 96% by Fe application within the first 10 days of treatment per unit leaf area. In legumes, Fe deficiency inhibits symbiotic nitrogen fixation by affecting growth and survival of -(brady)rhizobia, Rhizobium phaseoli, other rhizobial species, nodule formation, nodule function or through effects on the growth of host plants. Introduction of nitrogen fixing nodules through iron and zinc fertilization in non-nodule forming French beans (Phaseolus vulgaris L.) revealed a significant role of Fe in host-rhizobium association. Different crop plants, characterized by distinct Fe acquisition strategies, could similarly affect the rhizosphere microbial community through the release of root exudates. Iron-zinc, iron-nitrogen; iron-boron-zinc and iron-zinc-vanadium interactions studied in certain agricultural crops provided immense insight regarding physiological functions of Fe in plant. Chlorosis results by severe Fe-deficiency with several folds decline in nitrate reduction to ammonia. Chloroplasts and mitochondria have large Fe requirements to carry out the various metabolic processes that occur within. In mitochondria, Fe is required for synthesis of iron-sulfur (Fe-S) clusters and for proper function of the respiratory electron transport chain. However, transporters involved in plant organellar Fe transport have only recently begun to be uncovered elucidating roles of transport proteins in plant Fe homeostasis. MAs transporter gene will be sufficient to compensate even the low amount of secreted MAs in crops like rice, sorghum. Elucidation of the molecular mechanism of phytosiderophore (PS) release will be an important final step in the full characterization of the Strategy II Feuptake mechanism.

Last but not the least, the overall research by our own and by world scientists enrich our knowledge in one of the most relevant fields of the physiological and biochemical aspects of iron nutrition and interactions in plants applicable for the development of sustainable agricultural practices aiming at facing this nutritional stress, which is one of the major constrains for the limited agricultural productivity as well as pharmaceutical products. Of course this is a long research journey with plant iron nutrition.

Recent Publications

01. Garg, O.K., A. Hemantaranjan and C. Ramesh. 1986. Effect(s) of iron and zinc fertilization with special reference to senescence in French bean (*Phaseolus vulgaris* L.). J. Plant Nutrition, 9: 257–266 (U.S.A.).

02. Hemantaranjan, A. and O.K. Garg. 1986. Introduction of nitrogen fixing nodules through iron and zinc fertilization in non-nodule forming French beans (*Phaseolus vulgaris* L.). *J. Plant Nutrition*, 9: 281–288 (U.S.A.).

03. Hemantaranjan, A. 1988. Effect of iron and zinc fertilization on grain quality of Triticum aestivum L. J. Plant Nutrition, 11: 1438-1450 (U.S.A.).

04. Hemantaranjan, A. 1988. Iron fertilization in relation to nodulation and nitrogen fixation in Phaseolus vulgaris L. J. Plant Nutrition, 11: 829-842 (U.S.A.).

Biography

A Hemantaranjan has his expertise in physiology of abiotic stresses and micronutrients. His significantly established doses of salicylic acid, zinc, brassinolide and paclobutrazol in stress mitigation are commendable. He has published over 135 of his research papers and review articles in journals of international repute including proceedings of international/national symposia, recurrently cited world over especially in international journals, biological reviews including Annual Review of Plant Physiology and Books. He is the member of Editorial Boards and reviewer of 16 international journals; delivering Guest Lectures/Keynote Address.

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