

## **Participant Report on International Workshop on New Concepts of Plant Nutrient Acquisition**

**T. P. Rao (School of Agricultural Sciences, Nagoya University)**

This workshop was held between 24-27 March 1998 at Tsukuba Inc., Tsukuba, Ibaraki, Japan. It was organised by the national agro-environmental sciences and ministry of agriculture, forestry and fisheries, Japan with the following organizing committee; Noriharu Ae, Joji Arihara and Kensuke Okada.

The aim of this international workshop was to summarize the newly developing concepts on the mechanisms of plants to acquire soil nutrients and to apply them to practical agriculture. This workshop was very well organized with the participation of many scientists from across the world and their findings were presented in the following sessions under the chairmanship of eminent scientists in that particular area of research.

1. Introduction: global concerns and historical review
2. Role of root exudates in nutrient acquisition and metal tolerance
3. Role of cell apoplast in nutrient acquisition and metal tolerance
4. Control of soil microorganisms and soil fauna
5. Direct incorporation of micro and macro organic molecules
6. Practical implications

In the first session P.C. Smithson (ICRAF, Kenya) referred about the difficulties for sustainable agricultural development in context with African continent, where the problems were associated with depletion of inherent soil fertility through decades of cropping with few external inputs. He opined that the replenishment of inorganic P and N should strive to better utilize and manage existing organic resources, with an appropriate improvements in existing indigenous system like incorporation of leguminous trees in follow systems to recapitulate the leaching out nutrients. H. Okajima (Hokkaido university, Japan) presented an excellent review on decades of plant nutrition research and signified its role in sustainable agriculture.

In the second session, T. Otani (NIAES, Japan) indicated that some selected crop species have an ability to acquire Al- and Fe-bound sparingly soluble form of P. The ability was found to be not related with their root development, microorganism association, rhizosphere pH, uptake kinetic characteristics ( $I_{max}$ ,  $K_m$  and  $C_{min}$ ) or  $Fe^{III}$ -reducing capacity, but was related with the exudation of some organic acids (malonic, citric, malic, pisidic and oxalic acids) which can make chellate rings with Al and Fe to release P available to plants. S.Mori (Tokyo University, Japan) referred the role of mugineic acid in iron acquisition with possible mechanism involved in the process of Fe reduction by mugineic acid. E. Delhaize (CSIRO, Australia) indicated that some Al tolerant species excrete organic acids in the rhizosphere to chelate Al to render it toxic effect as a tolerance mechanism.

In the third session, the role of apoplastic components (mucilage, cell wall and outer surface of plasmamembrane) and plasmamembrane in tolerance mechanism and in nutrient acquisition was highlighted. The possible role of cell wall in Al tolerance through Al-bound compounds by T. Wagatsuma (Yamagata University, Japan) and through pectic compounds F.P.C Blamey (Univ. of Queensland, Australia), in boron nutrition through B-RG-II complex by T. Matoh (Kyoto University, Japan), in P acquisition in groundnut by N. Ae (NIAES, Japan) and nutrient acquisition

through phenolic acid bound wall polysaccharides by Y. Kato (Hirosaki university, Japan) was discussed.

In the fourth session, L. Marry (Philom Bios Inc., Canada) explained the implications and achievements in the development of phosphate inoculants ie., *Bacillus megatherium* var. *phosphaticum* (phosphobacterin) and *Penicillium bilaii* (provide). T. Karasawa (Hokkaido NAES, Japan) indicated that the P uptake by maize largely depended on previous crops and different soil types, which were affected the AM colonization, moisture conditions and availability of nutrients. He also indicated that AM colonization mainly depend on P status in soil rather than the soil type. CH Wu (Taiwan agri. res. Institute, Taiwan) concerned about the VAM in high input agriculture, who indicated that the inoculating at young seedling stage and cultivation in medium or low P would be rather an efficient way for sustainable agriculture. K. Matsuo (NARC, Japan) showed a new control method of soyabean cyst nematode using animal feces, stressed on the use of balanced and appropriate application timing of animal feces on cyst nematode control.

In the fifth session, PR Poulton (Rothamsted, UK) indicated the benefits of soil organic matter (SOM) from long term experiment results, however he opined that sustaining the SOM with addition of organic matter depends on soil type. He also pointed out that the greater loss of N by leaching is due to lack of synchrony between mineralization and N uptake by crop species. K Kielland (University of Alaska, USA) indicated that in the arctic ecosystems, where slow decomposition and slow soil organic matter turn over, the organic form of nitrogen (amino acids) seems to be major source of nitrogen. M Yamagata (Hokkaido Agr. Exp. Station, Japan) showed that the upland rice has the ability to secrete protease enzymes to enhance nitrogen mineralization and also its efficiency in taking up the organic nitrogen such as amino acid, peptide and proteins directly. N.K Nishizawa (Univ. of Tokyo, Japan) showed an evidence of vesicular transport mechanism referred as endocytosis in the uptake of extracellular substances like macro organic molecules

In the sixth session, the organizing committee members J. Arihara (NARC, Japan) and N.Ae (NIAES, Japan) discussed about the implications and future needs of plant nutrition research.

In addition to the above oral presentations, there was a poster session with lot of presentations in the above related research fields. In this session, my self presented a poster on a new method to estimate nitrate uptake through rhizosphere pH mapping. K. Yano (Nagoya Univ. Japan) suggested that the individual roots could respond to P-deficient conditions under the strategy to fit P demand of the whole plant.

This workshop clearly showed that plant species have an added ability with specific mechanisms to acquire sparingly available nutrients, organic form of nutrients and in tolerance to toxicity to adopt themselves to the environmental conditions where it grown. For example various root exudates from crop species have clearly shown a major role in nutrient acquisition, nutrient mineralization, render toxic effect of heavy metals and to enhance soil microorganisms. Added information on such mechanisms involved in the process of plant nutrition is essentially needed to improve and sustain crop productively under low or naturally available nutrients for sustainable agriculture with balanced eco-system, rather than going for high input agriculture. Which is proved to be not only sustainable in long run but also major pollutant of the eco-system. More over high input agriculture is seldom offedable by large number of farmers in the developing world.