Preface

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Prof.Dr.Dr.h.c. Horst Marschner [he preferred to be addressed as Herr (Mr) Marschner] was the greatest plant nutritionist of the 20th century. He has left an indelible mark on the development of science and application of plant nutrition around the world. Scores of students and early career researchers have been trained in his lab or benefitted from talking to Herr Marschner at conferences or during his many visits to various countries and labs. His textbook (Mineral Nutrition of Higher Plants, Academic Press, 1st ed in 1986, 2nd ed in 1995) was widely read and valued around the world (he insisted that the book be printed as soft-cover to reduce the price and increase affordability). Having a single person write a textbook that covers the topics ranging from traditional soil science and plant physiology to microbiology, agronomy, genetics, molecular biology and myriad of other inter-related disciplines is a rare feat in the modern times. It is worth noting that the 3rd revision of Marschner's textbook has had 29 co-authors engaged to cover almost the same range of topics as Herr Marschner did all by himself in the first two editions. Those of us who

have had a privilege to work with Herr Marschner (and I dare say all others who have come across him or his work), we remain in awe of his inspiring talent, immense and wide-ranging knowledge, and outstanding work ethic.

The year 2012 was important in acknowledging the legacy of Herr Marschner's work in plant nutrition. The 3rd revision of his textbook was published by Elsevier, and the 2nd Marschner Colloquium was held in Beijing. This Plant and Soil Special Issue contains selected papers from the Colloquium. The variety of topics covered at the Colloquium and in this Special Issue is befitting a wide range of interests that Herr Marschner had in the science and application of plant nutrition.

Optimizing nitrogen and phosphorus nutrition is crucial in sustainably increasing crop and pasture yields to feed burgeoning world population. Four papers deal with these issues: from determining critical soil P and N levels to underpin high yields (Bai et al., Peng et al.), to integrated nutrient management system that considers a crucial role of soil organic matter and nutrient cycling in the agricultural landscapes (Tian et al.), to extending science into practice by manipulating conditions in the rhizosphere to increase root proliferation and enhance crop utilization of P (Ma et al.).

Judicious placement of the right fertilizers is important, not just for root growth and nutrient uptake, but it results in increased loading of nutrients into the grain. This is particularly important for micronutrients such as Zn and Fe, because up to half of the world's

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population is deficient in these micronutrients. Zhang et al. showed that soil Zn fertilization can be an effective way of increasing Zn concentration in maize grain.

The 3-D root models started appearing at around the time of the 1st edition of Marschner's textbook, initially as a somewhat frustrated attempt to conceptualize the important "hidden half" of plants, but quickly progressed to encompass structure-function relationships, paying particular attention to spatio-temporal variability in soil resource availability and how that variability influences 3-D distribution of roots over time. In the paper included in this issue, a group of authors (led by Dr Vanessa Dunbabin) from six countries concluded that the 3-D structure-function models are starting to make an impact on (i) designing agricultural management and (ii) as a breeding tool to aid in selecting genotypes with increased efficiency in utilizing soil water and nutrient resources.

Various types of roots are not equally important in accessing soil resources. Liu et al. showed that lateral roots are more important in accessing the nutrients that are relatively poorly mobile in soils (e.g. P, Zn, Cu, Mn) than the soil-mobile ones such as N and S.

Root growth is hampered by Al toxicity in acidic soils (about 40 % of the world arable soils). As effective as liming is in ameliorating soil acidity and Al toxicity, its effects are mostly limited to topsoil. Hence, the plant capacity to explore the soil profile is impaired by Al toxicity; this is particularly important under drought, whereby topsoil dries out and Al-affected roots are unable to access potential water reserves in the subsoil horizons. Yang et al. (in a Marschner Review) assessed the state of knowledge on the interactions between drought stress and Al

toxicity, emphasizing the importance of breeding drought-tolerant crops that are also resistant to Al toxicity.

All papers mentioned so far have concentrated at least to some extent on root growth and function. Aboveground plant parts of course also represent an interesting and challenging array of research topics. The epidermal cells of rice leaves accumulate silicon. Zhang et al. show that biosilicification is a gradual process, whereby lignification and silicification of the cell walls of silica cells occur first, followed by silicon deposition in such cells up to the leaf maturity.

It is not just the production of food, feed and fiber that is dependent on scientific and practical advances in plant nutrition. Biofuel production also relies on growing a large amount of biomass in a water- and nutrient-efficient manner. Straub et al. show that *Miscanthus* genotypes differ in leaf N, K, and Zn concentration, intensity of the secondary metabolism, and the leaf bacterial profile; this knowledge can be used in phenotyping and breeding of genotypes with high biomass production.

We are confident that the discipline of plant nutrition, so effectively promoted by Herr Marschner and celebrated by the 2nd Colloquium in his honor, has a bright and exciting future at the interface of many traditional (e.g. soil science, crop physiology, agronomy) and modern scientific and technological endeavors (e.g. genetics, molecular biology, virtual reality). We are looking forward to the 3rd Marschner Colloquium.

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