CSIRO PUBLISHING
Crop & Pasture Science, 2015, **66**, i–ii
http://dx.doi.org/10.1071/CPv66n12_FO

Foreword

Magnesium in Crop Production, Food Quality and Human Health

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How magnesium (Mg) supply in soils contributes to maintenance of good yields under various stressful environmental conditions, especially under soil acidity and aluminum toxicity was one of the key themes of the **2nd International Symposium on Magnesium in Crop Production, Food Quality and Human Health** held in Sao Paulo, Brazil, in November 2014. A role of Mg in human nutrition, changes in Mg supply in the global food chain, and variation in Mg content in plant-based foods were other important topics of the symposium that was organized by the Institute of Applied Plant Nutrition (IAPN, Georg August University, Göttingen, Germany). The University of São Paulo, Sabanci University (Turkey), Center for Magnesium Education & Research (USA), and the Brazilian office of the International Plant Nutrition Institute (IPNI) were the co-organizers of the Symposium.

"The current mineral nutritional situation of agricultural soils and major crop plants in Brazil was the important reason for us to organize the second symposium on magnesium in Brazil", said Prof. Dr. Klaus Dittert, scientific director of the Institute of Applied Plant Nutrition in his opening speech. Indeed, Symposium presentations showed that crops growing in common Brazilian soils such as Oxisols and Ultisols respond substantially to fertilisers containing Mg and micronutrients especially Zn (Dechen *et al.* 2015). These soils are acidic, with high concentration of aluminum and low levels of Ca and Mg. The Mg-containing liming materials used to increase soil pH do not adequately meet the crop Mg demand. Therefore, soluble Mg fertilisers are important in such acidic soils to improve Mg nutrition and protect roots from Al toxicity. Besides high Al concentration, high K:Mg or Ca:Mg ratios can also interfere with root Mg uptake. All these factors emphasize importance of Mg fertilisation programs (Senbayram *et al.* 2015).

One of critical physiological roles of Mg in plants is regulation of assimilate partitioning into sink organs such as roots and seeds (Cakmak and Kirkby 2008). It was shown during the Symposium that Mg deficiency affects wheat yield by decreasing individual seed weight rather than seed number per spike. Magnesium has a role in protecting roots from oxidative stress caused by toxicity of heavy metals and Al (Rengel *et al.* 2015). Limited transport of photoassimilates from shoots to roots and decreased H^+-ATPase activity, needed for release of organic acid anions from roots to inactivate Al in the rhizosphere, make Mg-deficient plants highly susceptible to Al toxicity.

Concentration and content of Mg in various edible plant tissues and organs were discussed at the Symposium with respect to human and animal nutrition. Different plant species grown under the same conditions differ substantially in their shoot Mg concentrations (White *et al.* 2015). For example, species of the order Poales have consistently lower shoot Mg concentrations than Caryophyllales. It was suggested that such differences have important implications for the nutritional value of animal diets. An important natural variation in Mg uptake and tissue concentrations was documented in *Arabidopsis thaliana* (Xiao *et al.* 2015) and can be used for characterization of physiological and genetic mechanisms affecting Mg homeostasis in plants, which has implications for biofortification of food crops with Mg.

Biofortification of food crops with Mg to improve human nutrition is becoming a popular topic because of increasing number of reports indicating reduced dietary intake of Mg, especially in western countries. However, there are also reports (based on food supply and composition) suggesting a minimal risk of deficient dietary Mg intake in many countries (Kumssa *et al.* 2015). Consumption of diets with high Ca:Mg ratio was discussed at the Symposium as an important factor contributing to impaired human Mg nutrition, especially in USA. High intracellular Ca:Mg ratio in body may be an important factor in chronic disorders such as cardiovascular disease, metabolic syndrome and type-2 diabetes (Rosanoff *et al.* 2015). Moreover, reduced dietary intake of Mg may result in diverse physiological alterations, especially in heart, brain, kidneys and vasculature, leading to neurodegenerative diseases, immunodeficiency, stroke, and cancer (Nielsen 2015). These findings highlight importance of adequate content of Mg in food crops to meet the human demand for Mg. Hence, future research on linking Mg nutrition of crops, pastures and animals with the human diet, health and well-being is a high priority.

The organizers thank K + S Kali GmbH for its substantial support, and *Crop & Pasture Science* for publishing this magnesium special issue.

References

Cakmak I, Kirkby EA (2008) Role of magnesium in carbon partitioning and alleviating photooxidative damage. *Physiologia Plantarum* **133**, 692–704.

Dechen AR, Carmello QAC, Monteiro FA, Nogueirol RC (2015) Role of magnesium in food production: an overview. *Crop & Pasture Science* **66**, 1213–1218.

Kumssa DB, Joy EJM, Ander EL, Watts MJ, Young SD, Rosanoff A, White PJ, Walker S, Broadley MR (2015) Global magnesium supply in the food chain. *Crop & Pasture Science* **66**, 1278–1289.

Nielsen FH (2015) Importance of plant sources of magnesium for human health. *Crop & Pasture Science* **66**, 1259–1264.

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Rengel Z, Bose J, Chen Q, Tripathi BN (2015) Magnesium alleviates plant toxicity of aluminium and heavy metals. *Crop & Pasture Science* **66**, 1298–1307.

Rosanoff A, Capron E, Barak P, Mathews B, Nielsen F (2015) Edible plant tissue and soil calcium : magnesium ratios: data too sparse to assess implications for human health. *Crop & Pasture Science* **66**, 1265–1277.

Senbayram M, Gransee A, Wahle V, Thiel H (2015) Role of magnesium fertilisers in agriculture: plant–soil continuum. *Crop & Pasture Science* **66**, 1219–1229.

White PJ, Bowen HC, Farley E, Shaw EK, Thompson JA, Wright G, Broadley MR (2015) Phylogenetic effects on shoot magnesium concentration. *Crop & Pasture Science* **66**, 1241–1248.

Xiao QY, De Gernier H, Kupcsik L, De Pessemier J, Dittert K, Fladung K, Verbruggen N, Hermans C (2015) Natural genetic variation of *Arabidopsis thaliana* root morphological response to magnesium supply. *Crop & Pasture Science* **66**, 1249–1258.