Tackling malnutrition with plant mineral nutrition

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Despite significant achievements in reducing global hunger problem, micronutrient malnutrition (“hidden hunger”) still represents a major health problem in the world. Around 2 billion people are affected from micronutrient deficiencies such as zinc, iodine and iron deficiencies. Inadequate dietary intake of micronutrients is the particular reason of the problem, especially in the developing countries where extensive amounts of cereals are consumed with very low concentrations of micronutrients. High prevalence of micronutrient deficiencies is commonly associated with the regions where soils contain low amounts of micronutrients. Most of the cereal cultivated soils globally have diverse of chemical and physical problems (such as high pH and low amounts of organic matter and water) which limit chemical solubility and root uptake of micronutrients. Under such adverse soil and climatic conditions, the new genotypes developed by classical plant breeding or genetic engineering for high macronutrients in grain may not be able to fully exploit their genetic capacity to absorb and accumulate sufficient amounts of micronutrients in their grains. Therefore, treatment of plants with micronutrients seems to be an essential agronomic practice to ensure and maintain sufficiently high micronutrients in grains for human nutrition. The field studies conducted in the past 7-8 years under the HarvestZinc project (www.harvestzinc.org) on different cereal species demonstrated that the plant nutrition-based (i.e., agronomic) approach is a quick and cost-effective solution. A targeted foliar spray of micronutrients, such as right after anthesis, either individually or as a cocktail of micronutrients was found to be highly effective in increasing grain micronutrients. Maintenance of high pool of zinc, iodine and selenium in the leaf tissue during the reproductive growth stage through foliar spray seems to be a critical issue in achieving desirable concentrations of micronutrient in grains for human nutrition. The increases were found not only in whole grain but also in endosperm part or polished rice. It is also important to highlight that application of plant mineral nutrition approaches on genotypes with high genetic capacity for root uptake and seed translocation of micronutrients will further maximize accumulation of micronutrients in grain. The foods made from cereal grains biofortified agronomically with micronutrients, such as bread and cookies, had also sufficiently high micronutrients indicating higher stability of the micronutrients in the end-products. Consuming agronomically-biofortified foods is expected to result in significant contribution to human nutrition with high biological impacts.