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RESEARCH NOTE

ZINC DEFICIENCY: PROBLEMS AND POSSIBLE SOLUTIONS

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Since seventy's agricultural research has largely been focused on increasing food production to meet the food demand of ever increasing population. No doubt increased use of high analysis chemical fertilizers, high yielding crop varieties and increase in cropping intensity enhanced food production, but at the same time led to enhanced micronutrients deficiency in soil. These deficiencies are causing not only hidden hunger but also leading to lower content of trace elements in plant parts. So people feeding such food showed lower trace element content in their blood plasma, compared to areas, which had high available micronutrients status and lower deficiency in soil. Besides to provide more calories modern agricultural systems are directed in such a way that reduce the area of crops such as pulses, making many micronutrient-rich plant foods less available and more expensive to poor families. The cereals e.g. rice, have displaced micronutrient-rich crops of pulses, vegetables and fruits, are less responsive in accumulating micro nutrient in grain (Graham and Welch ,1996) and are eaten primarily after milling, while pulses are normally consumed whole after cooking; Milling removes most of the micronutrients cereals contain (IRRI, 2006; Prasad ,2010). More-over, presence of high levels of antinutrients (substances that reduce the absorption i.e. bioavailability, of micronutriens to humans) and lower levels of substances that promote the bioavailability of these nutrients, further reducing the nutritional value of cereal products with respect to micronutrients (Kennedy *et al.*, 2002a; Ma, 2007).Although major emphasis is on protein energy malnutrition but WHO data shows deficiency of micronutrient specially Zn is far more severe through-out the world. The Copenhagen Consensus Conference 2008 thus ranks the alleviation of zinc deficiency as a top priority.

ROLE OF ZINC IN HUMAN NUTRITION:

Zinc deficiency affects, on an average, one third of world's population, ranging from 4 to 73% in different part of world (Hotz and Brown, 2004).In humans, zinc is an essential cofactor for more than 300 enzymes that are involved in the synthesis and degradation of carbohydrates, lipids, proteins, and nucleic acids. Zinc stabilizes the molecular structure of cellular components and membranes and, in this way, contributes to the maintenance of cell and organ integrity. Zinc deficiency is responsible for many severe health complications, including impairments of physical growth, immune system and learning ability, DNA damage and cancer development (Hotz and Brown, 2004; Gibson, 2006; Prasad, 2007). The groups most at risk for being affected by zinc deficiency are infants, young children, and pregnant women, especially in developing countries (Hurrell, 1997).

STRATEGIES TO COMBAT ZINC MALNUTRITION:

Developing crops with high Zn through the process of "biofortification" aims to combine high mineral content with grain quality and agronomic characteristics, such as high yield and pest and disease resistance, to ensure acceptability by both farmers and consumers. There are several approaches which can be used to increase the concentration of Zn in foods, including food nutrient fortification, supplementation programmes, conventional breeding and genetic engineering, to diagnose and manage the problem of micronutrient mal nutrition. Although genetic or breeding approach has proven to be effective, but at the same time they are very expensive and has as such unpleasant side effects that people can hardly afford it or show poor compliance with it. Bio-technology and plant breeding currently show efficiency of nutrient enrichment of grains with Zn but these approaches are long term processes, and may be affected from very low chemical solubility of Zn in soils due to high pH (Sarkar and Wyn Jones, 1982; Marschner, 1993) and low organic matter content (Catlett *et al*. 2002).

Agronomic Approach:

Agriculture is the primary source of intervention for all nutrients required for crops and human health. Soil-crop management may be a quick solution to the problem and can be considered an important approach along with the other programs essential to solve Zn-deficiency problems. It is important to create better conditions for crop growth and exploitation of the biological crop-potential for Zn mobilization and utilization.

Zinc deficiency can be corrected by soil or foliar applications of Zn fertilizers, as well as seed treatments. Zinc sulphate is a common fertilizer because of its high solubility and low cost. Zinc can also be applied to soils in form of ZnO, ZnEDTA and other chelated compound. The use efficiency of Zn fertilizers in soil application is higher with ZnEDTA than the inorganic Zn fertilizers. However, due to its high cost, use of ZnEDTA is limited (Mordvedt and Gilkes, 1993). Many studies of last decades showed beneficial effects of Zn applications on crop growth and grain yield of various cereal crops. But their focus was not in increasing Zn concentrations in grain to the extent that they curb Zn malnutrition in human being. More over soil application of zinc fertilizer in calcareous soil cause little increase in grain-Zn concentration of cereals. In contrast, modification in the mode of application and scheduling of Zn fertilizers can increase grain Zn concentration up to the mark. The most effective method for increasing Zn in grain was the soil+foliar application method (Cakmak, 2008). So when a high concentration of grain Zn is aimed along with a high grain yield, combined application is recommended. Timing of foliar Zn application is also an important factor .It is expected that foliar Zn fertilizers applied at late growth stage can direct more Zn into grain (Yilmaz *et al.*, 1997). Among the different forms, the application of Zn as ZnSO4 was most effective in increasing grain Zn compared to other. Besides sole Zn application blended Zn fertilizer can also be a potential tool to enrich Zn concentration in grain (Shivay *et al.*, 2008). Urea fertilizers containing Zn (e.g., zincated urea) maybe a good foliar N fertilizer to improve both grain Zn and protein concentrations. However, the extent of increase in grain-Zn concentration by Zn fertilization seemed to be influenced by genotypes, soil types and cultivation measures. More investigations are needed to understand this interrelationship.

Many studies showed the importance of the rhizosphere effect on Zn mobilization and

up take by plants. It also offers the possibility to improve Zn bioavailability by manipulating plant rhizosphere, such as selecting Zn efficient crop. To screen genotype that response well for fertilizer application may be a good option (Hacisalihoglu and Kochian, 2003). Cropping systems such as rotation and intercropping may also have many advantages in terms of increasing micronutrients, including Zn, availability. Enhanced phytosiderophores release by one crop may mobilize Zn in the soil and enhance Zn uptake by the other inefficient crop. Investigations are needed to identify the role of rhizosphere in intercropping systems (Zhang and Li, 2003).

CONCLUSION:

Biofortification offers a long-term, food-based solution to fight against malnutrition problem in the developing countries. Thus the challenge to the present scientists is to develope biofortified crops, rich in micronutrients, to satisfy the physiological needs of the poor along with vertical expansion in yield to provide calorie to the poor. So demand of the modern agriculture not only restricted at productivity and sustainability, but also at better nutrition, for betterment of the entire human race.

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