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Zn Biofortification and Importance of Zn

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Abstract

Zinc (Zn) deficiency is a well-documented problem in food crops, causing decreased crop yields, nutritional quality. It has been estimated that about 50 per cent of cereal cultivated soils of India are deficient in zinc to support high crop yields. There is a synergistic effect between applied zinc in rice because Zn is very dependent on the size of plant available Zn pools in soil, in most parts of cereal growing areas, soils have less availability of Zn to plant roots. Till-date, the focus was on balanced application of N, P, K. But of late, it has been realized that deficiency of many secondary and micronutrients can also further limit the productivity of the many field crops. In India, first reported zinc deficiency in lowland rice. Thereafter, it has recognized as a wide spread and important nutritional problem throughout the rice- growing world. Zn plays role in synthesis of plant growth substances and enzyme systems and is essential for promoting certain metabolic reactions. It is necessary for production of chlorophyll and carbohydrates. Zinc deficiency affects stem elongation, auxin activities and protein synthesis.

Introduction

Agronomic biofortification strategy appears to be essential in keeping sufficient amount of available Zn in soil solution, maintaining adequate Zn transport to the seeds during reproductive growth stage. Finally, agronomic biofortification is required for optimizing the cereal grains with zinc. The requirement of Zn for the function of a wide range of enzymes indicates that the metabolism of proteins, carbohydrates, auxin as well as reproductive processes are hampered under Zn deficiency. Three billion people, mostly in developing countries suffer from several nutrient deficiencies due to the malnutrition of micronutrients especially Zn which comprises about 33%. According to a report published by the World Health Organization in 2002, deficiency of Zn ranks fifth in terms of leading causes of malnutrition among humans in developing countries. Zinc deficiency is a growing public health and socio-economic issue, particularly in developing world. The major reason for zinc deficiency causing deaths is high consumption of cereal based foods with low zinc concentrations. In the rural areas of India, rice and wheat contributes nearly 75% of the daily calorie intake.

Importance of Zn in plants and human

Zn is important for development of immune system and brain function in humans, also plays an important role in enzymatic reactions and metabolic activities

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in plant system. Zinc is required in small but critical concentrations to allow several key plant physiological pathways to function normally. In plants, zinc plays a key role as a structural constituent or regulatory co-factor of a wide range of different enzymes and proteins in many important biochemical pathways, these are mainly concerned with: carbohydrate metabolism, both in photosynthesis and in the conversion of sugars to starch, protein metabolism, auxin (growth regulator) metabolism, pollen formation. Limiting factors such as pH, electrical conductivity, organic carbon, free lime status and nutrient interaction play a major role in decreasing ZUE. Zinc deficiency (49%) in soil is a worldwide nutritional problem in crop production. Zn is essential for gene regulation and expression under stress conditions and is therefore, required for protection against infections and diseases. Zn plays an important role in the production of proteins in the body and thus, helps in wound healing, blood formation, growth and maintenance of all tissues. Zn also supports immune function, storage release and function of insulin and it is important in host defence against cancer. Zinc is known to occur in soil in a number of discrete chemical forms differing in their solubility and availability to plants. Zinc exists in distinct pools in soils *viz*., water soluble and exchangeable/adsorbed, chelated or complexed zinc. The availability of zinc to plants has been observed to vary with different zinc fractions. The form in which zinc is present in soil plays a important role in determining its availability to plants. Khanda *et al*. (1997) also reported that control and farmers' practice, i.e. unbalanced application of nutrients causes poor results in rice.

Conclusion

Fertilization is the key point of nutrient management in agronomic approaches to enhance crop quality and produce. Application of Zn containing fertilizers to enhance the Zn content in the rice grain seems to be the possible solution for this problem. Fertilizer application times and rates play key role in influencing plant growth and nutrient uptake (Gill *et al*., 2009). Recently, a few high yielding varieties suitable for cultivation have been developed but considerable variations are manifested by varieties in their responsiveness to zinc supplements. Improved quality of grain of these varieties has to be studied futher in order to come up with suitable agronomic recommendations. There are several methods to avoid zinc deficiency such as zinc supplementation, food fortification and soil application, ferti-fortification and conventional breeding etc (Zhang *et al*., 2012). It is, therefore, essential to have a short-term approach to improve Zn concentration in cereal grains. Application of Zn fertilizers or Zn-enriched NPK fertilizers (e.g., agronomic biofortification) offers a rapid solution to the problem, and useful complementary approach to on-going breeding programmes.

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