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Micro nutrients: Function and their status in India

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Abstract
Micronutrients are most important for many crops. Though these are required in traces yet if the concentration is below the critical limits, the crop production is impaired to great extent. Micronutrients are involved in physiological functions of plant. If the amount available is not adequate, plants will suffer from physiological stress brought about by the dysfunction of several enzyme systems and other metabolic functions in which micronutrients play a part. Micronutrients deficiency in plants not only reduces the yield but also the nutritional quality of grains.

Keywords: Micronutrients function, Cereals, Micronutrient status in India

Introduction
Micronutrients are essential for the normal growth of plants. Deficiencies of micronutrient drastically affects the growth, metabolism and reproductive phase of plants Micronutrients are essential for plant growth and play an important role in balanced crop nutrition. Though these are required in traces yet if the concentration is below the critical limits, the crop production is impaired to a great extent. Micronutrients are involved in physiological functions of plant. If the amount available is not adequate, plants will suffer from physiological stress brought about by the dysfunction of several enzyme systems and other metabolic functions in which micronutrients play a part.

On an average 49, 33, 13, 12, 5 & 3% of the soil samples in India were deficit in available Zn, B, Mo, Fe, Mn & Cu, respectively due to intensive cultivation and use of high analysis NPK fertilizers (Singh, 2004) [5].

- Micronutrients have been called minor or trace elements indicating that their concentration in plant tissues are minor or in trace amounts relative to the macronutrients (Durgesh *et al*., 2015) [3].
- Micronutrients are essential for the normal growth of plants. Deficiencies of micronutrient drastically affects the growth, metabolism and reproductive phase of plants (Arvind *et al.*, 2009) [1].
- The essential micronutrients are Zinc (Zn), Manganese (Mn), Copper (Cu), Iron(Fe), Boron(B), Molybdenum(Mo) and Chlorine(Cl), Nickel.
- These micronutrients are as important as major nutrients for plant development and profitable crop production.

Functions of micronutrients in plant
Zinc
- Aids plant growth hormones and enzyme system
- Necessary for chlorophyll production
- Necessary for carbohydrate and starch formation.
- Aids in seed formation.
- It is involved in auxin synthesis

Iron
- Promotes formation of chlorophyll
- Structural component of porpyrin molecules like cytochromes, heamatin, ferrichrome and leghemoglobin.
- Constituent of enzyme systems like cytochrome oxidase, catalase, peroxidase etc.

Copper
- Catalyses several plant processes
- Major function in photosynthesis
- Improves flavor of fruits and vegetables.
- It also Act as electron carrier in enzymes.
- It helps in the utilization of iron during chlorophyll synthesis.

Manganese
- Function as a part of certain enzyme systems
- Aids in chlorophyll synthesis
- Involved in N metabolism and assimilation.
- It takes part in electron transport in photo system Π
- It also take part in oxidation – reduction processes and decarboxylation and hydrolysis reaction.

Boron
- Essential for germination of pollen grains and growth of pollen tubes.
- Essential for seed and cellwall formation.
- Promotes maturity
- Necessary for sugar translocation
- Boron regulates carbohydrate metabolism.

Molybdenum
- Required to form the "nitrate reductase" which reduces nitrate to ammonium in plant.
- Aids in the formation of legume nodules.
- Structural component of nitrogenase.
- It is also reported to have an essential role in iron absorption and translocation in plants.

Chlorine
- Chloride is important in the opening and closing of stomata. The role of the chloride anion (Cl-) is essential to chemically balance the potassium ion (K+) concentration that increases in the guard cells during the opening and closing of stomata.
- Chloride also functions in photosynthesis, specifically in the water splitting system.
- Chloride functions in cation balance and transport within the plant.
- Chloride diminishes the effects of fungal infections in an as yet undefined way.
- Chloride competes with nitrate uptake, tending to promote the use of ammonium nitrogen. Lowering nitrate uptake may be a factor in chloride's role in disease suppression, since high plant nitrates have been associated with disease severity.

Choudhary *et al.*, (2015) [2] revealed that application through soil + foliar spray significantly increased plant height, weight of panicle, grain weight of panicle and 1000 grain weight, grain, stover and biological yield over soil application. Combined application of micronutrient (Fe+ Zn+ B) increased significantly the mean plant height, weight of panicle, grain weight of panicle and 1000 grain weight, grain, stover and biological yields by 11.4, 20.5, 32.7, 13.4, 25.4, 15.5 and 17.4% over control, respectively and similarly Zeidan *et al.* (2010) [6] results indicated that grain yield, straw yield, 1000-grain weight and number of grains/spike, Fe, Mn and Zn concentration in flag leaves and grains as well as, protein content in grain were significantly increased by application of these(Fe, Mn and Zn) elements

Micronutrients Status in India

Diversity in parent material of Indian soil- Variability in total Micronutrient content, Deficiency of micronutrient in Indian soil is due to
- High yielding varieties of crop
- Extension of area under irrigation
- Use of high analysis NPK fertilizers
- Land under intensive cultivation

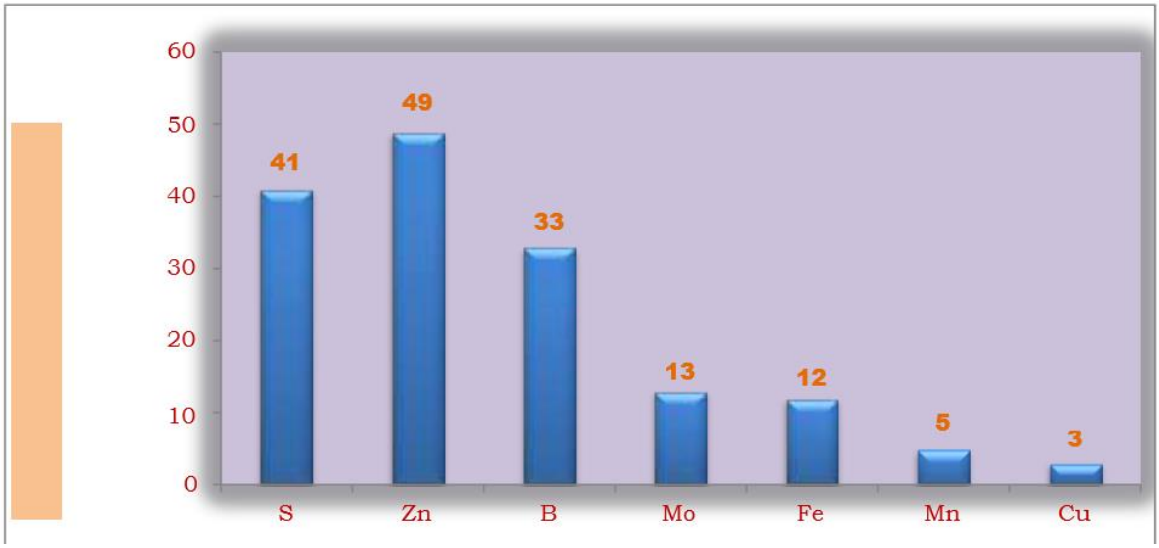

Fig 1: Show the Micro nutrients Zn Mo etc.

In Indian institute of soil science, analysis 2.5 lakh soil sample from different parts of the India by Fageria *et al.*, 2002, studied that country revealed that predominance of zinc deficiency in divergent soils. Of these sample 49% Zn deficient etc. the magnitude of Zn deficiency varied widely among soil types and various states.

Table 1: Micronutrients content of Indian soils

Micronutrients	Total (mg/kg)	Available (mg/kg)
Zn	0.7- 1019	0.2- 6.9
Cu	1.9 – 960	0.1- 8.2
Fe	2700 – 19,100	0.8- 196
Mn	37- 11,500	0.2- 118
B	3.8- 630	0.08- 2.6
Mo	0.01- 18.1	0.07- 67

Table 2: Guideline for critical, sufficient and toxic levels of plant Nutrients

Element	Critical level	Sufficient level	Toxicity level
Fe (mg/ kg)	<50	100-500	>500
Zn (mg/ kg)	10-20	27-150	100-400
Mn (mg/ kg)	15-25	20-300	300- 500
Cu (mg/ kg)	2-5	5-30	>20
B (mg/ kg)	5-30	10-20	50-200
Mo (mg/ kg)	0.03-0.15	0.1-2.0	>100
Cl (mg/ kg)	<100	100-500	500-1000

Table 3: Critical level of nutrients in soil

Nutrient	Critical level (mg/kg)
Iron	2.5
Manganese	2.0
Copper	0.2
Zinc	0.5
Boron	0.5
Molybdenum	0.2

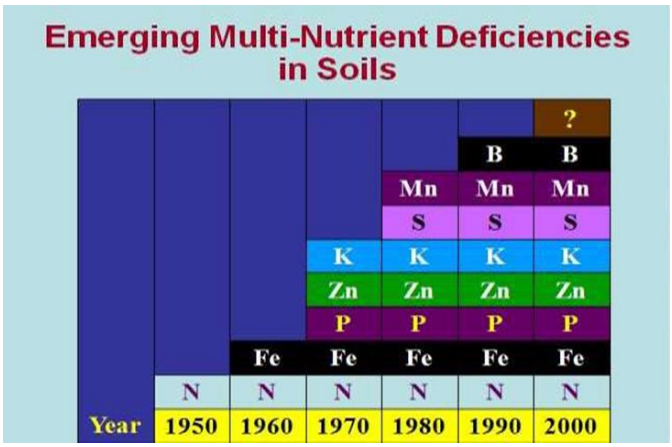

Fig 2: Progressive expansion in the occurrence of nutrient deficiencies in India

Due to introduction of high yielding varieties, extension of areas under irrigation and use of high analysis NPK fertilizers, particularly under intensively cultivated lands, deficiencies of micronutrients have been on the rise in india over the past four decades. Out of about 250,000 soil samples analysed from 20 states of india under the aegis of the all india coordinated scheme on micronutrients in soils and plants of the ICAR (now redesignated as all india coordinated research project on secondary, micronutrients and polutant elements in solis and plants), Zn- deficiency appeared to be widespread with 49% of the samples found deficient with less than 0.6 ppm DTPA- extractable content. Compared to Zn, deficiency of other micronutrients is less in proportion, although in extent, B-deficiency is next to Zn in order. Thirty three percent of the 36,825 soil samples analysed found to be deficient in available B. the percent samples deficient in Fe, Mo and Mn reported are 13%, 7% and 4%, respectively (Singh, 2004) [5].

Coarse texture, high pH, calcareousness, declining organic carbon and leaching aggravate Zn-deficiency. Irrespective of these soil properties, irrigated crops whose productivity is two to three times higher than rainfed crops, suffered more often from Zn deficiency. In general, Zn deficiency is most widespread in red lateritic soils of Karnataka; leached and acid soils of West Bengal, Orissa and Maharashtra, and highly calcareous and old alluvium of Bihar.

Table 4: Micronutrient deficiency in various states

States	% Sample deficient			
	Zn	Cu	Fe	Mn
Andhra Pradesh	49	<1	3	1
Assam	34	<1	2	
Bihar	54	3	6	2
Gujarat	24	4	8	4
Himachal Pradesh	42	0	27	5
Karnataka	73	5	35	17
Kerala	34	31	<1	0
Madya Pradesh	44	<1	7	1
Maharashtra	86	1	24	0
Punjab	48	<1	14	2
Tamil Nadu	58	6	17	6
Uttar Pradesh	46	1	6	3
West Bengal	36	<1	0	3
TOTAL	48	3	4	5

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