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Harnessing Secondary Nutrients for Crop Growth and Soil Enrichment

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Plant nutrients in fertilizers are classified as major nutrients and micronutrients. The most important major nutrients are nitrogen (N), phosphorus (P) and potassium (K). The other major nutrients, also called secondary nutrients, are calcium (Ca), magnesium (Mg) and sulphur (S). Calcium, magnesium, and sulfur are essential plant nutrients. They are called "secondary" nutrients because plants require them in smaller quantities than nitrogen, phosphorus, and potassium. On the other hand, plants require these nutrients in larger quantities than the "micronutrients" such as boron and molybdenum. Calcium, magnesium, and sulfur are generally adequate in most Mississippi soils with favorable pH and organic matter levels. They affect pH when applied to the soil. Calcium and magnesium both increase soil pH, but sulfur from some sources reduces soil pH. Compounds containing one or more of these nutrients are often used as soil amendments rather than strictly as suppliers of plant nutrition. They are also required in relatively large amounts but are less likely to be deficient. It is essential for normal growth and development of plant. Calcium, magnesium, and sulphur are very important and often are required as fertilizer or as soil amendments. These secondary nutrients required in equal amounts as primary nutrients, but are added inadvertently along with primary nutrients. Lime which contains Ca and Mg is applied to raise the pH and sulphur compounds are used to lower the pH of soil. Irrigation water may contain on an average 25 ppm of SO_4, 50 ppm of Ca and 5 ppm of Mg.

Needs of Secondary Nutrients

Secondary nutrients deficiencies are increasingly becoming an important limiting factor in intensive crop production systems, especially in soils fertilized only with n, p and k. many soils worldwide are poor in fertility – specifically in secondary nutrients – as they have consistently been depleted of their native nutrients due to continuous cultivation. this has resulted in the soil becoming a poor food crop producer.plants get their secondary nutrients from the soil, but natural processes don't supply enough to sustain crop production. mineral fertilizers containing s, mg and ca replenish nutrients in the soil to ensure plants grow to their full potential. this results in crops that contribute enough mineral elements for adequate animal and human nutrition and improve global food security.

CALCIUM

Function of calcium: Calcium is an essential plant nutrient. As the divalent cation (Ca^{2+}), it is required for structural roles in the cell wall and membranes, as a counter-cation for inorganic and organic anions in the vacuole, and as an intracellular messenger in the cytosol

Deficiency symptoms

- Deficiency is first observed on the young leaves and growing tips (immobile in plants).
- Leaves become small, distorted, cup shaped, crinkled and malformation of leaves

- Terminal buds may deteriorate and die in fruits trees. Root growth is impaired.
- Destruction of cell well structure results in disturbance of nuclear and cell division.
- Fruit quality is reduced, loss of fruit fleshy, sometimes rotting of fruits and susceptible to fungal disease.
- Calcium deficiency Death of growing point and die-back of main stem from tip; die-back of leaves, progressing from terminal leaflets and of flower and fruiting trusses.

Sources and distribution of calcium

The mean Ca content of the earth's crust is about 3.64%. It is usually far greater amount than that of most other plant nutrients. Calcium is present in soils in various primary minerals, which include Ca-bearing Al-silicates namely feldspars and amphiboles, Ca-phosphates and Ca-carbonates.

Factors affecting the availability of Ca in soils:

(i) Supply of Ca
(ii) Soil reaction or pH
(iii) Cation exchange capacity (CEC) of soils
(iv) Percent saturation of Ca in soil colloids
(v) Nature, amount and type of soil colloids
(vi) Ratio of Ca to other cations in soils

MAGNISIUM

Function of magnesium: Magnesium is absorbed as the Mg^{2+} ion and is mobile in plants, moving from the older to the younger leaves. It leaches from the soil like calcium and potassium. Magnesium is the central atom amid four nitrogen atoms in the chlorophyll molecule, so it is involved in photosynthesis. It serves as an activator for many enzymes required in plant growth processes and stabilizes the nucleic acids.

Deficiency symptomps: One of the first signs of magnesium deficiency is chlorosis. Chlorosis is the yellowing of the leaf structure found between veins, giving the leaf a marbled appearance, while the veins remain green. Another indication of chlorosis is for the leaf margins to turn a red-brown-purple colour.

Forms of magnesium

Forms of Mg Taken up by Crops: Magnesium is absorbed by plants from the soil solution as Mg^{2+} ion. Plant Mg needs in most soils can be satisfied by the process of mass flow similar to that of Ca. Very little amount of Mg may reach to plant roots by interception.

Forms of Mg in Soils:- Magnesium is also present in soils as its various forms like water soluble, exchangeable and non-exchangeable

Sources and distribution of magnesium:- Magnesium oxide, Dolomite, Magnesium sulphate

Behaviour of magnesium in soils: It is evident that the exchangeable and water soluble Mg in soils are available to plants. The behaviour of Mg in soils, however, is similar to that of K and Ca^{2+}. The availability of Mg in soils is affected by various factors, viz. amount of Mg, soil pH, texture of the soil, clay content, presence of other exchangeable ions etc.

SULPHUR

Functions of sulphur: Sulphur plays an important role in the nutrition of oil seed crop and it act as a constituent of sulphur containing amino acids cystine, cysteine and methionine. One of the main functions of sulphur in proteins or polypeptides is the formation of disulphide bonds between polypeptide chains. Disulphide linkages are important in stabilizing and determining the configuration of proteins

Deficiency of sulphur: Sulphur deficiency symptoms in many ways resemble those of nitrogen that is, the leaves become pale-yellow or light-green. Unlike nitrogen, sulphur

deficiency symptoms appear first on the younger leaves, and persist even after nitrogen application. In cotton, tobacco and citrus, some of the older leaves are affected first.

Sources of sulphur:- The commonly used S-containing fertilizers are ammonium sulphate, ammonium thiosulphate, magnesium sulphate, potassium magnesium sulphate, ammonium phosphate sulphate, potassium sulphate, calcium sulphate (gypsum), iron pyrites, single superphosphate and elemental sulphur.

Forms of sulphur: Sulphur is present in the soil as its various forms viz. inorganic and organic fractions. It occurs in various oxidation states starting with +6 in H_2SO_4 and its derivatives (oxidised form of Sulphur) to -2 in H_2S and its derivatives (reduced sulphur). Besides, sulphur exists in solid, liquid or gaseous phases. However, various forms of sulphur are described below very shortly.

(A) Total Sulphur

(B) Inorganic Forms

- Easily Soluble Sulphate
- Adsorbed Sulphate Sulphur
- Sulphate Co-Precipitated with Calcium Carbonate and other Precipitated Forms
- Reduced Inorganic Sulphur
- Sulphide Form
- Elemental Sulphur

(C) Organic form of Sulphur

Conclusion

Use of secondary nutrients in agriculture, helps in sustaining yield of crops over a long period. Widespread nutrient deficiencies and deteriorating soil health are cause of low nutrient use efficiency, productivity and fertility. Conjunctive use of secondary nutrients along with primary nutrients augment the yield and soil health. Effective soil testing service to back up precise fertilizer use.