



Role of Sulphur in Plant Nutrition and Growth

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Calcium, magnesium and sulphur are considered as secondary nutrients for plants; however, they play no secondary role in plant nutrition. They are just as essential for plant nutrition as any of the other 14 essential plant nutrients. Although, secondary nutrients are needed in lesser amounts than that of primary nutrients but they are important for plants. Many factors can affect the availability of these three nutrients to plants. The best estimates of their availability can be determined by soil analysis or a combination of soil and plant analyses. However, field observations and deficiency symptoms are also important diagnostic tools. Sulphur is an essential nutrient for the plants was so far discovered by Salon Horstmas. Sulphur is a major constituent of organic matter and involved in enzymic processes. Sulphur is essential in formation of plant protein because it is a part of certain amino acids. It is an essential constituent of several other biologically active compounds such as vitamins, lipoic acid, acetyl coenzyme A, ferredoxin and glutathione.

Characterstics of Sulphur Nutrient

- Symbol – S
- Atomic number- 16
- Atomic weight- 32.065
- Specific gravity at 20°C- 2.07
- % proportion of earth crust- 0.10%
- Ionic forms absorbed by plants- SO_4^{2-} , SO_2 , SO_3^{2-}
- Approximate conc. in dry weight of plant- 0.1-0.4%
- Mobility in plants- Relatively immobile

Role of Sulphur in Plants Growth

- Component of amino acids (methionine, cysteine).
- Constituent of coenzymes and vitamins.
- Responsible for pungency and flavour (onion, garlic, mustard).
- It also enhances the oil synthesis in oil seed crops.
- Though it is responsible for protein synthesis, it is an important content for pulse crop.
- Involved in the formation of Chlorophyll and promotes nodule formation.
- It increases root growth and stimulate seed formation

Source of Sulphur Nutrient in Plants

- Sulphur consist of earth crust about 0.06%, it occurs as sulphide in igneous and sedimentary rocks.
- The S-bearing mineral in rocks and soils are Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$), Epsomite ($\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$), Mirabilite ($\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$), Pyrite (FeS_2), Sphalerite (ZnS), Chalcopyrite (CuFeS_2), Cobaltite (CoAsS) and Galena (PbS).
- Atmosphere is an another source of Sulphur.
- A considerable amount of Sulphur is released by the breakdown of the soil organic matter that is 20-30 kg SO_3 /ha.
- Sulphur content is also there in organic fertilizers.
- Cow and Pig manure contains 1.8 kg SO_3 /t, compost contains around 3.8 kg SO_3 /t and poultry manure contains around 8.3 kg SO_3 /t.
- Some mineral fertilizers also have sulphur content in the form of sulphate, elemental sulphur and liquid form.
- Acid Rain also provides sulphur.

Losses of Sulphur

- Loss of sulphur by crop plants.
- Loss of sulphur by erosion.
- Loss of sulphur by weeds.
- Loss of sulphur through leaching.
- Loss of sulphur by volatilization.

Deficiency Symptoms

- Sulphur deficiency symptoms first appear on younger leaves, because S is immobile nutrient.
- The younger leaves become pale or chlorotic.
- The stem and leaf petioles become brittle and may collapse.
- Plants looks withering.
- Different plants have different deficiency symptoms like shortened panicle in Rice, delayed flowering in soybean, leaves become narrow and short in wheat and less oil content in mustard etc.

Forms of Sulphur Nutrient in Soil

- Sulphur is present in the soil in both organic and inorganic form.
- Sulphur can be broadly grouped into five forms, viz. Organic S, inorganic S, soluble S insoluble S and adsorbed S.
- Among of these forms Organic Sulphur is most important i.e. 5 to 98% of available S in Indian soils.

Transformation/Mineralization of Sulphur

- All the forms of Sulphur are not available to the crop plants, therefore, its mineralization is essential to convert unavailable form of S into available form.

- This transformation/mineralization depends upon several factors, these factors are:-
 - Microbial activity
 - Effect of soil temperature
 - Effect of soil pH
 - Effect of soil moisture content
- Transformation of elemental sulphur to SO_4^{2-} form was necessary for sulphur to be available for crop uptake (Singh, 1988).
- The oxidation was faster in coarse textured soils and is completed in 3-4 weeks.
- Sulphur transformations in soil are considered to result primarily from microbial activity which involves process of mineralization, immobilization, oxidation and reduction and the microbes involved are Thiobacillus, Chlorabium and Desulfotomaculam.
- The biogeochemical transformation of sulphur has been formulated by Vernadski (1927).

Sulphur Cycle

- Sulphur from all the sources changes in the sulphate or available form of sulphur.
- The crop plant uptake that available S and some of this lost due to leaching and a considerable part losses to atmosphere.
- A part of sulphur from the residues of plant and animal losses to atmosphere.
- The sulphur from atmosphere comes down with acid rain.

Interaction of 'S' Nutrient with Other Nutrients

- S and Fe:- Low level of S exhibited low iron uptake.
- S and Mn:- Application of S fertilizer to soil will enhance Mn uptake by the plants.
- S and Cu:- Application of S increased the conc. of Cu in the leaves due to the better uptake.
- S and Zn:- Antagonistic relationship between S and Zn is observed.
- S and B:- Positive interaction between B and S.
- S and Mo:- Antagonistic relationship between S and Mo is observed.
- S and Cl:- Mutual antagonistic relationship.

Importance of Sulphur Nutrition in Indian Agriculture

- In India, S-deficiencies are found in almost 40% of the cultivated area.
- Different crop species have different S requirements.
- S-bearing compounds like non volatile S-glucocides. Sulphur in brassica seeds is around 1.19%, in straw it is 0.19% and in legumes it is 0.25%.