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# Sulphur Nutrition for Sugarcane

Sugarcane is a commercial crop grown for the production of sugar and other by products like baggase, molasses, filter cake etc. Being a C<sub>4</sub> plant assimilates larger biomass and exhausts the large quantities of macro and micro nutrients from the soil. Hence, the balanced application of nutrients is essential for achieving the higher cane and sugar production for sustaining the soil fertility level. Sulphur deficiency is exhibited in sugarcane crops where ever the oil seed crops are grown in the previous season. The critical level of available sulphur is fixed as 20 ppm for sugarcane. Hence, sulphur application is needed to achieve higher productivity in sugarcane.

## INTRODUCTION

Sulphur (S) is one of the essential elements among the sixteen elements required for sugarcane crop to achieve higher cane yield and juice quality, next to nitrogen, phosphorous and potassium. Due to continuous use of high analysis fertilizers which are containing little or no sulphur, its deficiency becoming common in sugarcane growing area now a days than in the past. The other reasons worsen the sulphur deficiency are high yielding and high nutrient exhaustive sugarcane varieties which require more sulphur, reduction in atmospheric sulphur fallout during rainfall and leaching of soil sulphur resources. The deficiency symptoms are noticed mostly in the coarse textured soil and soil with low organic matter content.

## TEXTS IN DIFFERENT TITLES

### SULPHUR IN THE SOIL

In most of the soil, the sulphur is present in the top soil along with the organic matter. The sulphate form of (SO<sub>4</sub><sup>-</sup>) of sulphur is the available

form to the plants, the elemental sulphur and other forms of sulphur in organic matter are not available to the plants. The sulphate form of sulphur is negatively charged (anion) and is produced in the soil by the action of the microbes. The favorable conditions for the conversion of sulphur into sulphate form by microbes are moist, warm and well drained soil. The sulphate form of sulphur ( $\text{SO}_4^-$ ) is highly leachable through soil similar to nitrate. In clay type of soil the leached sulphate accumulates in clay layer in sub soil and they are available to the plants when root region reaches the sub soil. The sulphur dioxide gas in the atmosphere is brought down to soil during rainfall and irrigation water replenishes it in the soil.

#### FACTORS AFFECTING AVAILABILITY OF SULPHUR

- **Sand:** Sulphur is leachable in sandy soils and are typically low in organic matter content, therefore these soils are often low in sulphur.
- **Soil organic matter:** Organic matter is a reservoir for sulphur. The soil contains higher amount of organic matter, the 'S' is also higher.
- **Cold soil:** The conversion of various forms of sulphur to the available sulphate ( $\text{SO}_4^-$ ) form is a microbial process; therefore low soil temperature slows down this process.
- **Poor drainage:** The conversion of various forms of sulphur to the available sulphate ( $\text{SO}_4^-$ ) form is a microbial process requiring oxygen and therefore saturated soil slow down this process.
- **Pollution:** Soil that, over the years, has been subject to high levels of deposition from industrial sources of sulphur.
- **Irrigation water:** Irrigation water may contain high levels of sulphur and excess irrigation of sandy soils can leach sulphur out of the root zone.

#### ROLE OF SULPHUR IN SUGARCANE PLANT

After nitrogen, phosphorous and potassium, sulphur is considered as fourth most important element. Sugarcane crop removes about 25 to 40 kg of sulphur per hectare. In plant metabolism it plays major role in biosynthesis of amino acids, proteins and photosynthesis and is component for amino acids viz., cystine, cysteine and methionine. Of these, cysteine is essential to all living things and is formed from sulphate sulphur in a metabolism in which ATP is an active participant and in which  $\text{SO}_4^-$  changes from the inorganic anion to a reduced -SH group in the amino acid  $\text{HSCH}_2\text{CHNH}_2\text{COOH}$ -cysteine. Sulphur is capable

of high energy bonding, thus enabling it to take part in the synthesis of high energy components at ordinary temperature. It also helps to form enzymes, vitamins and necessary in chlorophyll formation. Presence of sulphur is essential for functioning of enzyme nitrate reductase which converts nitrate into ammonia. The addition of sulphur into the structure of amino acid like cysteine or methionine increase the resistance to pathogen where as presence of free amino acids leads to the susceptibility to pathogen.

#### DEFICIENCY SYMPTOMS

The elemental sulphur is non-mobile in plant system. The deficiency symptoms are similar to nitrogen deficiency. The symptoms may be visualized in the young leaves as light green or yellowish in colour often with purplish margin. It differs from nitrogen deficiency by the absence of die back in leaf tips. The leaves become shorter in length and narrow. The stalks become shortened with thin internodes. When the severity of the sulphur deficiency is less, the yield and quality may be affected without showing any visual symptoms.

#### SULPHUR CONTAINING FERTILIZERS

It is advisable to use following sulphur containing fertilizers like,

- Ammonium sulphate (contains 24% S)
- Single super phosphate (contains 12% S)
- Potassium sulphate (contains 18% S)
- Gypsum (contains 13 – 18% S)

The severity of the sulphur deficiency can be reduced by application of above mentioned fertilizer @ 10 to 20  $\text{kg ha}^{-1}$ . The sulphur deficiency was less in soil with high organic matter content as the presence of organic matter reduces the leaching of sulphur and increases its availability to the roots. The practice of burning the sugarcane trashes after cane harvest leads to loss of sulphur to the atmosphere and also reduce the organic matter content and hence the burning of trashes are to be avoided in soil where sulphur is low. Pressmud, the sugar industry waste is a good source of sulphur for sugarcane crop especially sulphitation pressmud is an excellent source as it contains 2 – 3% of sulphur.

#### MANAGEMENT OF SULPHUR DEFICIENCY

Foliar spray of  $\text{K}_2\text{SO}_4$  1% twice at fortnight interval.



Figure 1. Sulphur-deficient leaf (right), with chlorosis and purple leaf margins in comparison with a healthy leaf (left)



Figure 2. Sulphur deficiency in a sandy soil with narrow and shorter leaves than healthy plant

## REFERENCES

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## CONCLUSION

The increase in use of high yielding varieties, rising intensive cropping pattern, increase in cultivable area under irrigation, decreasing fertilizer use efficiency, deteriorating soil health, imbalanced use of fertilisers and unrestricted use of irrigation to sugarcane crop in high water table regions are few reasons which had led to rapidly depleting the levels of sulphur nutrient in the soil to a major extent. The deficiency symptoms of sulphur resemble as nitrogen deficiency symptoms but it appears in young leaves. The deficiency symptoms are not expressed in less severe cases but the productivity of the crop is reduced. Hence, application of sulphur is needed for sustaining the crop productivity. Superphosphate application itself can meet the sulphur requirement since it contains 12% sulphur.