Smart Sulphur Management for Quality Crop Production and Soil Health Sustenance

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ABSTRACT

There is an increasing demand for south Asian farmers to be informed with appropriate technologies and management practices that increase the both quality and quantity of crop production which faces the deficiency of secondary macronutrient sulphur from the green revolution era. Sulphur plays vital role in physiological and biological growth of the plant. In this article, we discussed about various management modern practices for sulphur management. Modern approaches like SSNM, STCR, fertigation, controlled released fertilizers, nano-fertilizers etc. have potential to enhances the effectiveness of plant nutrient supply which gives the effectiveness in crop production with synergic to maintain soil-plant dynamics.

INTRODUCTION

Realizing mounting demand for adequate and highly nutritious food for the rising human population, there is need to increase both quantity and quality of crop production. One way for improving the crop productivity is through modifying the soil nutrient supply, among other strategies. Sulphur (S) is referred to the fourth important macro plant nutrient. Sulphur in Indian agriculture is increasingly acknowledged due

to its role in enhancing crop production, not only in oil seeds, pulses, legumes, and forages, but also in various cereals (Singh et al. 2000). Sulphur is an essential to plant nutrition as the constituent of amino acids which helps in synthesis of proteins. It also improves the quality and content of oil in oil seed crops. Insufficient sulphur in plants hampers protein synthesis and results in chlorosis of younger leaves. In legume crops, deficiency leads to poor nodulation.

Sulphur, as an element which mobile in soil system, is often gets leached to lower soil layers due to irrigation, rain and pedological processes, which enhances the amount of S movement and alteration in the soil. Soil is a large source of sulphur for plant nutrition, and its availability is determined by sulphur fractions. In soil sulphur present in both form organic sulphur and inorganic sulphur. The organic sulphur, which constitutes more than 90% of the total sulphur, has the greatest impact on the amount of sulphur accessible to plants among these sulphur pools.

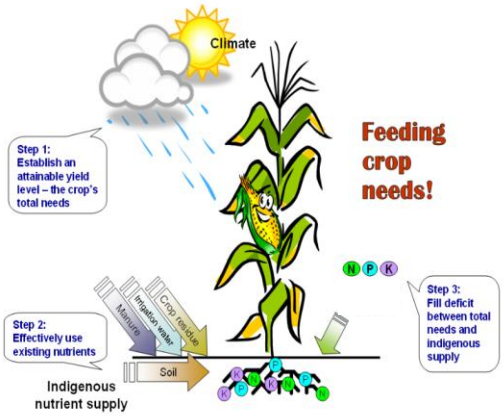
Sulphur deficiency is a common issue in many types of soils across India (Shukla et al. 2021). Soils in the Indo-Gangetic plains, red soils, lateritic soils and hill soils are often prone to sulphur deficiency. Sulphur deficiency in Indian agriculture was identified as a foremost problem after the green revolution due to various factor as highly recommended fertilizers which are deficient in sulphur, low sulphur returns from farmyard manure, high-yielding crops, intensive agriculture, decreased usage of sulphur fungicides, and reductions in atmospheric inputs that's gives result by tighter emission regulations. India now has a large gap in N: P2O5: K2O: S, around 14.7: 5.1: 1.6: 1, well below the desired limit. That's why, it is an urgent need to improve it by implementing enhanced strategies created for long-term sulphur management.

To upgrade from traditional farming practices to a smart farming concept for effective nutrient supply through fertilizer application by implementing the following management strategies approaches:

1. Site Specific Nutrient Management
2. Soil Test Crop Response
3. Integrated Nutrient Management
4. Fertigation
5. Controlled-Released Fertilizers
6. Remote sensing and GIS
7. Variable rate Technology (VRT)
8. Nanotechnology

Site-Specific Nutrient Management (SSNM):

This method is such an option which emphasizes on balanced and crop need based nutrient application (Johnston *et al*. 2009)



where the management practice follows the three principal steps:

Step 1: By setting the target yield with regards to crop demand

Step 2: Assessing the inherent fertility of soil for effectively using the existing nutrients to the crops

Step 3: After the assessing of the inherent fertility, synchronizing it with crop demand and fill the deficit demand through inorganic sources.

Soil test crop response (STCR):

This is a scientific approach of nutrient application for crops by using the soil test values and targeted yield equations. These equations are developed by taking an account of nutrients which contributed from soil, manures and fertilizers. Using STCR based sulphur application obtained maximum productivity in the sugarcane crop and also improves the soil fertility (Raghunath et al. 2021).

Integrated Nutrient Management (INM):

This is an integrated approach where all the organic and inorganic sources of fertilizer are judiciously used together in balance manner for maximizing production with balancing the soil ecosystem. Research studies have shown that green manuring and sulphur fertilization increases the yield parameters of cereals such as Basmati rice (Mandi and Shivay 2021). Similarly, quality and yield parameters of sunflower are enhanced by using sulphur-oxidizing biofertilizer with different sulphur levels (Chaudhary *et al*. 2017).

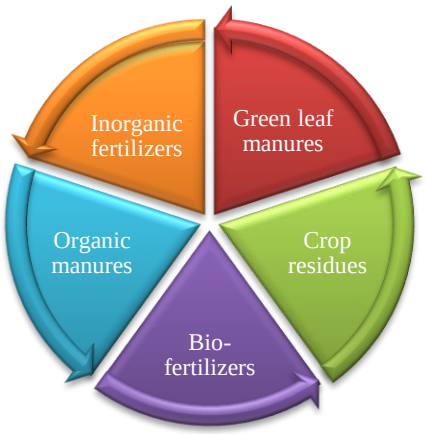
Fertigation:

Fertigation applied through micro-irrigation systems is an efficient strategy that greatly influence nutrient usage efficiency by supplying nutrients at a low rate and high frequency which highly uptake the nutrient from the root zone and also reduces the risk of nutrient loss.

Controlled-Released Fertilizers:

Controlled Release Fertilizers (CRFs) are discovered where nutrients can be released in a timely and gradually manner, which attempt to coincide and match with the specific nutrient demand during plant growth. Therefore, the CRF products possess huge potential and prospect to enhances the usage of fertilizer consumption and preventing environmental problems caused by imbalanced fertilizer management

Remote sensing and GIS:



Remote sensing and GIS are modern tool which gathering information about any object through satellite by sensing it with emitted and reflected light then further processing, analysing gives information by computer application. These modern technologies are getting importance for acquiring spatial-temporal meteorological and crop status information for complementing the traditional methods. Remote sensing data can contribute with efficiently to the monitoring the by providing timely, synoptic, cost-efficient and repetitive information about the earth's surface.

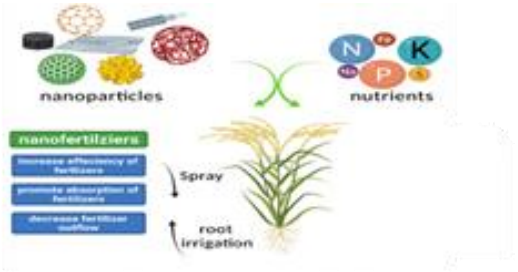
Variable Rate Technology:

Variable rate technology is a precise agricultural technology that can properly and accurately adjust the dose rate viz., seed rate, fertilizer doses are giving with respect to the variability of soil properties, terrain, meteorological conditions and other soil factors.

Nano-technology:

Agriculture systems might be revolutionized by nanotechnology. As Nano-composite consists of macronutrient and micronutrients in fertilizer. This approach increases the

nutrient use efficiency that promotes absorption of nutrient from fertilizer for long period during crop season and decreases the losses from fertilizer because of slow and steady released. Nano-sulphur is sufficient to attain higher sulphur use efficiency from the sulphur reserve in soil without harming the environment. (Thirunavukkarasu *et al*. 2018).



CONCLUSIONS:

Sulphur, now called as the fourth major plant nutrient, with respect to N, P and K. High yield of crop with good quality can be possible only when crop uptake the optimum amount of S. Technological advancements like SSNM, STCR, fertigation, controlled released fertilizers, nano-fertilizers etc. have capacity to optimization of plant nutrient supply which gives the significant effect in crop production.

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