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Non Availability of Sulphur Due To High Thermo-Climatic Variation in Oil Crop under Tarai Region of Uttar Pradesh

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ABSTRACT

Sulphur (S) is an essential nutrient for the plant growth and its metabolic activities. Its occurrence depends upon the parent materials and rocks from which soil is derived. Sulphur is a structural constituent of many co-enzymes and secondary plant products and acts as a functional group directly involved in metabolic reactions in plants. Further, it is an essential component for plant system which is present in soils in both organic and inorganic forms. Organic form particularly sulphate ester and carbon-bonded sulphur contributes approximately 75-90% of the total sulphur. Widespread sulphur deficiencies in soils and crops have increased worldwide because of low input of S in the soil . This might became the cause of valuable yield reduction in many crops. Sulphur deficiencies in soils are generally attributed due to low in organic matter, coarse-textured, well drained, and subject to leaching etc .Conversion of natural ecosystems into agricultural lands for intensive cultivation severely depletes soil organic carbon pools , which ultimately depletes the sulphur content of the soil in the Tarai region of UP. The importance of sulphur (S) nutrition in crops for their growth and development has been receiving increased attention in recent years. Sulphur plays an important role in the synthesis of S-containing amino acids (cystine, cysteine, and methionine), proteins, vitamins, chlorophyll, oils, etc. Although essential for plants, proper monitoring in the fertilization process was not initiated in the past which resulted in depletion of S reserves. Widespread deficiencies of S have been attributed to S mining by the use of high analysis or S-free fertilizers and continuation of rice-wheat or rice mustard cropping system.

The temperature of soil is a significant parameter in agriculture since proper warmth at proper depths not only conditions efficient plant growing. It also determines the time for sowing, due to the importance of soil temperature for seed germination. Soil temperature regimes vary monthly, seasonally, and daily, and since the main source of earth heating is solar radiation, farmers have to manage the hottest peaks during the day, with ultimate sun activity. Studying soil temperatures, earth heat fluxes, and, in particular, correlations between wet and dry lands and their heat absorbing capacities helps agriculturalists to productively schedule field events.

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INTRODUCTION

Sulphur deficient soils have been reported in Tarai region of Uttar Pradesh and analysis of large number of surface (0-15 cm) soil samples collected from the eastern region of the state indicated S-deficiency to the tune of 50% . Thus, significant reduction in quality and yield of several crops could be noticed.

Application of S from suitable sources is one of the key measures to optimize S use for sustainable crop productivity . Sulphur requirement in crops were mainly met through single super phosphate (SSP) and ammonium sulphate (AS) fertilizers or through micronutrient fertilizers (zinc sulphate, copper sulphate, etc.).

Sulphur deficient Brassica

There are few studies regarding the use of improved S fertilizers for enhancing the productivity and quality of crop species. Some field experiments have been carried out using commercial grade fertilizers like elemental S, bentonite S, gypsum, phospho-gypsum, and pyrites.[1]

The study revealed that improved bentonite S fertilizers can be adopted by the farmers for successful production of rice, especially in the S deficient areas of Tarai region (Uttar Pradesh). These are slow release fertilizer which can supply S as per the crop demands. Based on the findings, application of Gromor Rapid Blue® @ 7.5 kg acre-1 is recommended for enhancing the productivity and S use efficiency of crops.

Sulphur deficient radish and turnip

The continuous use of S-free high analysis N and P fertilizers in the intensive cropping system with the diminishing use of organic manures has resulted in the depletion of S from the soil reserves in Tarai regions of UP. The improper nutrient management has led to emergence of sulphur deficiencies in the soils. The deficiencies of S which were sparse and sporadic initially are now widespread. Sulphur deficiency tends to adversely affect the growth and yield of oil seed crop to an extent of 10-30 per cent due to poor nourishment. The different genotypes of oilseed crops differed significantly in respect to their responses to sulphur application. Sulphur plays an important role in growth and development of crops as it is constituents of amino acids like methionine, cystein and cystine needed for the synthesis of other metabolism like co-enzyme-A, thiamine and glutathione and also required for synthesis of chlorophyll. Thus, this element is needed in plants for oxidationreduction reactions, chlorophyll formation and in protein synthesis.[2]

Sulphur deficiency symptoms in Brassica

Sulphur also plays an important role in the formation of amino acids, synthesis of certain vitamins like biotin, thiamine and protein. The increase in oil content in linseed due to sulphur application upto S60 could be due to the fact that S helped in the synthesis of fatty acids and their esterification by accelerating biochemical reactions in glyoxalate cycle. The increase in oil content in linseed with S application might be due to the fact that S helped in oil synthesis by enhancing the level of thioglucosides. The increase in oil content on addition of S was probably due to the increase in glycosides. Similar increases in protein and oil contents in linseed due to increasing levels of sulphur have been supported by many research workers.[3]

OBSERVATIONS

Each of the soil groups have developed under the combined influence of a wide range of soil forming factors including climate, vegetation and parent material. They show characteristically different agricultural conditions with respect to crop adaptability, fertility and management practices. Variations in marco and micro-relief and the influence of pedogenic factors have contributed to the development of a number of soil associations in each of these tract. Geologically, erosion is the chief agent

responsible for the natural topographic cycles as it wears down the higher elevations and deposit the sediments in the plains. It is aggravated due to human interventions through indiscriminate felling of trees, excessive grazing, cultivation without adopting conservation measures etc. It is well known that exposed soils may erode very rapidly if it is not managed as per its limitations and requirements. Soil erosion not only retard soil development but also detrimental to the soil productivity and thereby reduces the land capabilities significantly. This degradation is mainly the manifestation of the human intervention with the nature. Many fertile productive lands mostly in command areas suffer from this problem chiefly because of sharp rise in water table resulting from marked disturbances in the hydrologic equilibrium under canal irrigation. As a result the crop yields have decreased significantly and the cropping pattern has shown a shift towards the relatively more tolerant crops. Such negative trends question the sustainability of irrigated agriculture into long term perspective and this is a matter of concern.[4]

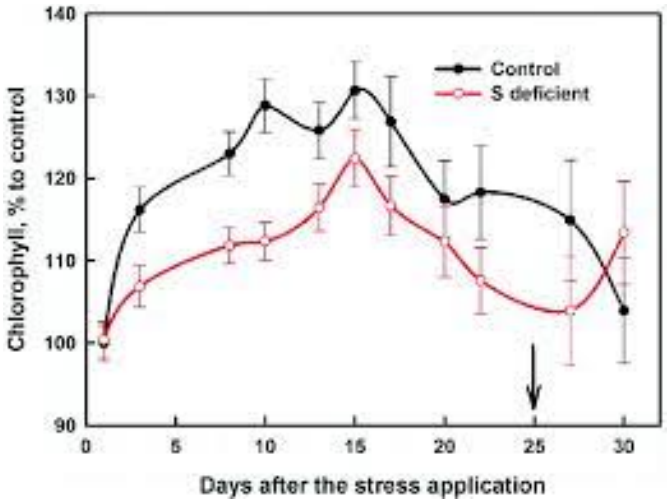
Sulphur deficient cotton plant

The high water table by flooding and very slow surface drainage give rise to the hydromorphic condition in these areas resulting in uncertainity of kharif crops. The information is quite indicative of the grave danger to the soil health and sustainable agriculture posed by such vast dimensions and severity of land degradation. It is therefore, imperative to restore the productivity of the affected areas adopting soilsite suitable strategies and preventing further deterioration/degradation of new lands through adopting eco-friendly resource planning.[5]

Climate change is characterized by higher temperatures, elevated atmospheric CO2 concentrations, extreme climatic hazards, and less water available for agriculture. Sunflower, a spring-sown crop often cultivated in Tarai UP, could be more vulnerable to the direct effect of heat stress at anthesis and drought during its growing cycle, both factors resulting in severe yield loss, oil content decrease, and fatty acid alterations. Adaptations through breeding (earliness, stress tolerance), crop management (planting dates), and shifting of growing areas could be developed, assessed and combined to partly cope with these negative impacts. New cultivation opportunities could be expected in Tarai areas where sunflower is not grown presently and where it could usefully contribute to diversify cereal-based cropping systems. In addition, sunflower crop could participate to the mitigation solution as a low greenhouse gas emitter compared to cereals and oilseed rape. Sunflower crop models should be revised to account for these emerging environmental factors in order to reduce the uncertainties in yield and oil predictions. The future of sunflower is probably related to its potential adaptation to climate change but also to its competitiveness and attractiveness for food and energy.

DISCUSSION

Calcareousness affects both the physical condition as also the nutrient availability of soils. A hard pan or layer of lime not only restrict water movement but also prevent root penetration. The high amount of lime when present in fine fraction may cause lime induced chlorosis in plants. Phosphorous and molybdenum availability restricted as a result of high level of magnesium associated with carbonates. In addition, micronutrient cation deficiencies like sulphur are common in the soils having high calcium carbonates equivalent . The accumulation of calcium carbonate in the sub-surface layers is noted in the soils of Gangetic plain, Tarai region of UP. Soils high in lime are productive for some crops like forage, maize, cotton and vegetables, while some of the other crops like sorghum, citrus suffers from lime induced chlorosis. [6]



Sulphur deficiency graph

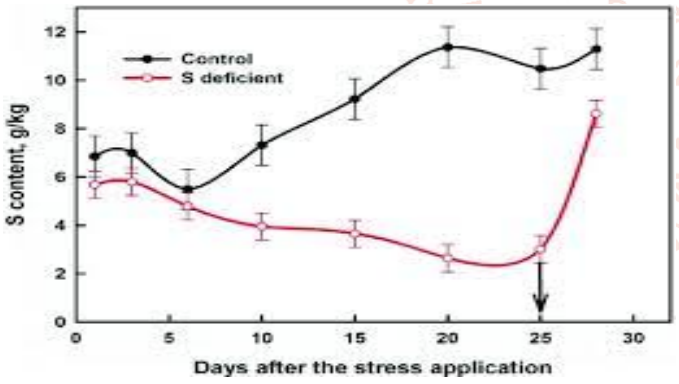
All soil in the Tarai contains some amount of salts but when this concentration increases beyond a specific limit plant growth is adversely affected. High concentration of neutral salts such as sodium chloride

and sodium sulphate may interfere with the absorption of water by plants by developing high osmotic pressure in the soil solution. The presence of sodium carbonate results in high pH and a buildup of sodium on the exchange complex. Soils with high sodicity increase the dispersion of clay and organic matter leading to a general degradation of soil structure. Hence, the information on the degree of salinity and sodicity and their extent are imperative for any ameliorating plan and sound land use.[7]

Sulphur deficient oil crops are due to thermo-climatic conditions basically dryness which vaporizes the volatile sulphur.

RESULTS

Soil degradation is more precisely described as deterioration in physical, chemical and biological properties of the soils. It occurs through a combination of lowering of soil organic matter and loss of nutrients. The main processes involved are the following. 1. Lowering of soil organic matter with associated decline in soil biological activity. 2. Degradation of soil physical properties (structure, aeration, water holding capacity) as brought about by reduced organic matter. 3. Adverse changes in soil nutrient resources, including reduction in availability of the major nutrients, i.e., nitrogen, sulphur, phosphorous, potassium. 4. Buildup of toxicities, primarily acidification through incorrect fertilizer use.



Sulphur deficiency graph due to stress

Non scientific use of land creates numerous problems like land degradation, ravine and water logging. Poor soil health and low organic matter content in the soil is also a major cause for low productivity . Soils are getting deficiency is some important nutrients like sulphur, iron, zinc, boron etc. which also results in low productivities of different crops and vegetables and low seed replacement rate particularly in case of pulses and oilseeds the main crops of the rainfed areas like Tarai , UP. [8] Various crops such as mustard, sunflower and oilseeds containing sulphur have become deficient of it due to high temperature conditions and vaporization of volatile sulphur from crops as well as from soils.

CONCLUSION

Degradation of soil becomes the important element of environmental degradation causes a serious threat for the economic development in the state. However, deforestation, salinity, waterlogging, decline of water table, improper use of fertilizer in both irrigated and non-irrigated area, are serious causes of land degradation in the state. Evaluating the precise magnitude of soil degradation and its impact on the environment and agriculture are major challenge. Urgent measures are taken to arrest the degradation process and to restore productivity of degraded soils. It is not possible to produce more food to fulfill the obligations to leave a better heritage for prosperity. A well-defined integrated land use policy at the implementable level should be developed especially in required areas of the Terai, UP. [9,10]

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