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Impact of Macro and Micronutrients on Crop Growth and Yield

[1]Ankit Sharma, [2]Ajay Abrol, [3]Sumeer Khajuria
[1]M. Tech Scholar, [2] Associate Professor, [3] Associate Professor
[1]Department of Electronics & Communication Engineering
[1]Government College of Engineering & Technology, Jammu, India

Abstract: A number of studies are conducted on the functionality of different nutrients present in the soil. In this work a survey of the functioning and importance of different soil components is studied.

I. INTRODUCTION

A soil comprises of various components that decide the quality and utility of a crop based on season and atmospheric conditions. Mungbean is known for high protein and vitamin D and is a source of balanced diet when taken with cereal. Cereals contain low level of protein. Plant growth is related to boron as it plays key role in leaf area expansion, nodule development, seed production and biological yield. It is essential for cell differentiation in plants, at a stage where cell division is happening. Zinc acts as functional and structural component for several enzymes like carbonic anhydrase, alcohol dehydrase, alkaline phosphatase, etc. Maintenance of seed quality is important for successful crop production. Grain productivity increases due to N, NP Nitrogen Phosphorous, Nitrogen Potassium, Nitrogen Phosphorous potassium, Nitrogen Sulphur, Nitrogen Sulphur Zinc, Nitrogen Phosphorous Potassium Sulphur Zinc etc. [5]

In this work the effect of association of micronutrients like potassium (K) and nitrogen (N) are evaluated. Level of K affected only plant height. The extract and crude protein increased along with N obtained from coated urea.[6]

Principal component analysis highlights that height of plant and it's diameter that are positively correlated with root length, root diameter, root number and parameters like photosynthetic rate, stomatal conductance etc. [7] The growth and development of plant depends upon climate and nutrient factor. These factors rely on weather condition. Climate factors and nutrients utilization is crucial for achieving growth [8].

Evaluating nutrient interactions in crop plants is of paramount importance in order to formulate the balanced supply of fertilizers for the crops. Limited data is present in relation to nitrogen (N), phosphorous(P), and potassium (K) interactions in upland rice under Brazilian conditions. Potassium is one of the key nutrients for the plants but it is available in different forms i.e. freely available in soil for plant uptake and fixed K. Soil property i.e., moisture, aeration, temperature, tillage system also influence the availability of K. Thus the rate of exchange of k is different among different soils and this further effects plants growth and yield. [9]

Among the essential nutrients, potassium (K) is unique. It performs the multiple roles. K interacts with other plant systems and constituents. Reviewing the interactions between K and other essential nutrients, the mineral concentration in the plants essentially depends on the processes of absorption, transport, and accumulation.[10]

Although required in very small amount each micronutrient plays an essential and specific role. Zinc plays essential role in producing seeds, proteins and enzymes, thus effecting plant growth and yield. Iron plays key role in the production of chlorophyll which is essential for the process of photosynthesis, a process that is responsible for energy for the crops. Copper is essential for the development of fruit and flower and also for the formation of stems. Manganese is required for creating proteins and it is also required in the process of photosynthesis. Boron is required for strengthening of cell wall. Chlorine improves resistance to diseases and regulates water in plants. Nickel is essential for efficient use of nitrogen, which is essential for improving crop quality and yield. Interactions between K and other nutrients are influenced by factors like time, date, prevailing environmental conditions etc. Potassium has intricate relation with all essential macronutrients. [11]

The role of micronutrients is as essential as macronutrients. Two major sources of these are fertilizers and soil. Micronutrients play a very crucial role in the determining the quality of crops yields. An insufficient supply of micronutrients can be harmful for quality of crops but excess supply can be detrimental. Insufficient supply hampers the biological and physiological processes which are decisive in the process of growth of crops. So, it is important that micronutrients are provided in judicious amount. [12]

Globally, the lack of micronutrient has acted as bottle neck for the crop yield and quality, this in turn has an effect on human health. In African areas, this has resulted in deficiencies in the crops as this area lacks both primary micronutrient like

calcium, magnesium, potassium, sodium, phosphorus, chloride, sulphur and secondary micronutrients iron, zinc, copper, manganese, iodine, selenium, fluoride. Therefore, importance needs to be given to both macro and micro nutrients [13]

Manganese is also a critical micronutrient playing important role in various physiological processes like photosynthesis, enzyme activation etc. Availability of manganese to plants is determined by its environmental cycle that is driven by natural processes and microbial activity, further affecting the crop yield. Similar to other micronutrients it is essential to provide it in optimum amount and its deficit supply can result in impaired growth and stunted development. [14]

Soil health is crucial factor in determining the crop quality. It should be rich in both macro and micronutrients to support agriculture. Lack of these micronutrients makes the crops susceptible to pathogens. The addition of soil organic matter boosts micronutrients of water soluble and exchangeable forms which in turn lead to its further rise in uptake of micronutrients. [15]

In Peninsular Malaysia, utisols and oxisols are the most common soils used for oil palm cultivation. These generally lack in calcium and magnesium but the magnesium deficiency is given more importance than that of calcium. In case of oil palm, Ca is required in high amount during all stages of growth, particularly in cell formation. [16]

Availability of micronutrients is influenced by many factors like soil pH effect micronutrients solubility, mobility etc in the soil. Soil organic matters which are of two types water soluble and water insoluble also effects metal mobility and its availability to plants. Similarly reduced root activity and microbial activity at lower temperature reduces the availability of micronutrients. [17]

Every micronutrient although required in minute quantity to perform a specific role but it can perform the specified function when other elements are available in balanced ratio. Manganese play important role oxidation and reduction process Manganese deficiency has major impact carbohydrates, particularly on non-structural carbohydrates, and roots carbohydrates. Manganese deficiency has severe impact on fertility of pollen and as such effects crop quality and quantity. Eroded, calcareous and weathering acidic soils often have zinc deficiency. Calcareous soil which has zinc deficiency is more likely to be deficient iron also. Due to low solubility of minerals rich in iron, its availability for crops and microorganisms is very low even though iron is fourth most abundant element present on the earth.[18]

Micronutrient deficiency is widespread in many Asian countries. Given the calcareous nature of soils, elevated pH, reduced organic content, salt induced stress, frequent drought and improper fertilizer use. The improper use of micronutrient fertilizers causes inappropriate absorption of trace elements, which ultimately leads to significant yield losses in different crops and this further leads to loss of health for both domestic animals and humans. Researches of the last decade show that zinc deficiency is primary cause fall in crop yield. The importance of micronutrients can be gauged from the findings that their adequate supply can enhance the crop yield by up to 50% and can also raise the macronutrients use efficiency. As per this study it is important to consider the optimum level of micronutrients, which is not only important for crop yield and quality and also for human health.[19]

Sulphur (S), calcium (Ca), and magnesium (Mg) are secondary macronutrients, these are not as strongly related to crop yield as the primary macronutrients like nitrogen, phosphorous and potassium but still they are required relatively in larger amounts. Sulphur is important in the formation of amino acids, proteins and oils and it is also a structural component of protoplasm. Calcium is critical component present in the plant cell wall and plant leaves. It also plays important role in cell growth and boosts uptake of nitrate by plants. Magnesium which is vital constituent of chlorophyll plays key role in proteins synthesis and plant metabolism. Even the lack of one nutrient can be detrimental to the growth of plant but the deficiency of one key nutrient cannot be met with the supply of other inputs. In addition the oversupply of one nutrient can lead to deficiency of other. Excessive soil acidity can be detrimental to the growth of roots.[20]

Boron (B), chlorine (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni) and zinc (Zn). are trace elements playing crucial role in plant growth. Even if one of them is deficient, it will be harmful for the crop yield but the extent of this damage varies along different species and varieties of plants. Zinc deficiency is one of the most prevalent causes of decline in crop yield across the globe encapsulating the staples maize, wheat and rice. Boron deficiency is the second most key issue especially in dicotyledon species. In Mediterranean climate iron deficiency is prominent. In Europe and Australia, iron deficiency is prominent. There are distinct symptoms corresponding to different deficiencies but asymptomatic deficiencies are more widespread.[21]

Micronutrients have far reaching influence on multitude of activities going on within plants. Consequently it is crucial to understand their contribution in plant growth and yield. These are called tracer elements considering the fact that although these are present in abundance in soil but plants need them in comparatively trace amounts. Boron, iron, manganese, copper and zinc are such micronutrients which are used in trace amount by the plants but vital functions in various activities which effect plant growth and yield. Examples of these important functions are plant metabolism, reproductive growth, nutrient regulation, fruit and seed development etc. Their deficiency is detrimental for the plants and results in abnormal growth. In recent years the deficiency of micronutrients has become more prevalent. Owing to the various factors like soil erosion, the rate of reduction has further escalated. In the near future the deficiency of these micronutrients can prove to be bottleneck for the agricultural growth. Even the overexposure of these micronutrients can raise the toxicity levels thus inhibiting the plant growth.[22]

II. CONCLUSION

Nutrients in the soil decide the quality of soil and productivity of the crops. In future scope the effect of moisture and water content can be studied and analysed using mathematical models and soft computing approaches by incorporating experimental works in the studies.

REFERENCES

[1] Rahman, M.M., Bhuiyan, M.M.H., Sutradhar, G.N.C., Rahman, M.M. and Paul, A.K., 2008. Effect of phosphorus, molybdenum and rhizobium inoculation on yield and yield attributes of mungbean. Int. J. Sustain. Crop Prod, 3(6), pp.26-33.A.Renukadevi, P. Savithri, K. Andi , July 2002. Evaluation of boron fertilizers for a sunflower (Helianthus

annuus L.) - Green gram (Vigna radiata L.) cropping sequence in Inceptisols Acta Agronomica Hungarica 50(2), pp.163-168

[2] Renukadevi, A., Savithri, P. and Andi, K., 2002. Evaluation of boron fertilizers for a sunflower (Helianthus annuus L.)-green gram (Vigna radiata L) cropping sequence in Inceptisols. Acta agronomica hungarica, 50(2), pp.163-168.

[3] Singh A, Dubey D, Assessing the Zinc, Boron and Rhizobium Inoculation on Yield and Economics of Kharif Mungbean (Vigna radiata L.), International Journal of Plant & Soil Science Volume 36, Issue 11, pp. 1-7, 2024; Article no.IJPSS.125195 ISSN: 2320-7035.

[4] Blessy, R.J. and Nivedhitha, M.S., 2024. Organic Grain Protectants for Enhancing Storability of Rice Seeds. International Journal of Plant & Soil Science, 36(11).

[5] Tabassum, T., Afrose, R. and Kader, M.A., Comparative Analysis of Nitrogen Use Efficiency in Boro Rice under Long-term Inorganic and Organic Fertilization Practices.

[6] Magalhães, R.M.F., Edvan, R.L., Nascimento, K.S., Nascimento, R.R., Silva, I.R., Lacerda, J.J.J., Morais, E.M., Lima Neto, A.F., Araújo, M.J. and Oliveira, M.E., 2024. Effect of the Association of Levels of Potassium and Nitrogen from Coated Urea on the Forage Potential of Cactus Pear in Brazilian Savannah Soil. Communications in Soil Science and Plant Analysis, pp.1-13.

[7] Kaur, N., Thakur, A., Sharma, V., Sharda, R., Dhaliwal, H.S. and Rattanpal, H.S., 2024. Fertigation with Nitrogen and Phosphorus Improve Plant Growth, Root Growth, and Buddability of Containerized Citrus Nursery Plants. Communications in Soil Science and Plant Analysis, 55(22), pp.3330-3348.

[8] Pazhanisamy, S., Singh, D., Singh, A., Kumar, S., Devi, R.C., Singh, U. and Singh, A.K., 2024. Impact of Weather Parameters and Application Methods of Micronutrients on Dry Matter Production and Yield of Chickpea Under the Riverine Area of Bihar Region of India. Communications in Soil Science and Plant Analysis, 55(22), pp.3349-3362.

[9] Dibb, D.W. and Thompson Jr, W.R., 1985. Interaction of potassium with other nutrients. Potassium in agriculture, pp.515-533.

[10] Mouhamad, R., Alsaede, A. and Iqbal, M., 2016. Behavior of potassium in soil: a mini review. Chemistry International, 2(1), pp.58-69.

[11] Fageria, N.K. and Oliveira, J.P., 2014. Nitrogen, phosphorus and potassium interactions in upland rice. Journal of Plant Nutrition, 37(10), pp.1586-1600.

[12] Khatun, A., Mukherjee, S., Bullah, M.M. and Bhattacharya, P., Effects of micronutrients on crop quality.

[13] Adal, Y.M. and Mulat, K.S., 2024. Micronutrient Limitations in Crop Production and Strategies for Improvement: A Review.

[14] Obeng, S.K., Kulhánek, M., Balík, J., Černý, J. and Sedlář, O., 2024. Manganese: From Soil to Human Health—A Comprehensive Overview of Its Biological and Environmental Significance. Nutrients, 16(20), p.3455.

[15] Dhaliwal, S.S., Naresh, R.K., Mandal, A., Singh, R. and Dhaliwal, M.K., 2019. Dynamics and transformations of micronutrients in agricultural soils as influenced by organic matter build-up: A review. Environmental and Sustainability Indicators, 1, p.100007.

[16] Shamshuddin, J., Fauziah, C.I. and Syed Omar, S.R., 2024. Calcium Has Been a Neglected Nutrient in Oil Palm Cultivation. Malaysian Journal of Soil Science, 24, pp.388-399.

[17] Rahman, R., Sofi, J.A., Javeed, I., Malik, T.H. and Nisar, S., 2020. Role of micronutrients in crop production. International Journal of Current Microbiology and Applied Sciences, 8, pp.2265-2287.

[18] Zewide, I. and Sherefu, A., 2021. Review paper on effect of micronutrients for crop production. *J. Nutr. Food Process*, *4*(7), pp.1-8.

[19] Malakouti, M.J., 2008. The effect of micronutrients in ensuring efficient use of macronutrients. *Turkish Journal of agriculture and Forestry*, *32*(3), pp.215-220.

[20] Bekele, D. and Birhan, M., 2021. The impact of secondary macro nutrients on crop production. *International Journal of Research Studies in Agricultural Sciences*, *7*(5), pp.37-51.

[21] Alloway, B.J., 2008. Micronutrients and crop production: An introduction. In *Micronutrient deficiencies in global crop production* (pp. 1-39). Dordrecht: Springer Netherlands.

[22] Tripathi, D.K., Singh, S., Singh, S., Mishra, S., Chauhan, D.K. and Dubey, N.K., 2015. Micronutrients and their diverse role in agricultural crops: advances and future prospective. *Acta Physiologiae Plantarum*, *37*, pp.1-14.