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Resview Article

Nutrients and Their Importance in Agriculture Crop Production: A Review

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ABSTRACT

Plant growth and development are directly depended on the source of nutrients. Basically, plants need different type of nutrients which are categories into two groups i.e. macro nutrients and micro nutrients according to their requirements. These nutrients include Nitrogen (N), Phosphorous (P), Potassium (K), Calcium (Ca), Zinc (Zn), Iron (Fe), Boron (B), Sulphur (S), Magnesium (Mg) etc. In the plant body, many nutrients influence biochemical processes as well as provide resistance against diseases and finally disturb the quality of crops. According to fast increasing in the world population and the decreasing trend in yields of crop make food safety a main challenge. That's why balanced application of nutrients is very important to rise the crop yield and to attain the necessary increase in the production of food. Furthermore, nutrients play a significant role in fertility of soil and make it more productive for the growth of plant. This review article will discuss the recent information that concerning about the nutrients and their use in sustainable agriculture for the growth of plant.

Keywords: *Sustainable Agriculture; Biochemical processes; Micro Nutrients; Macro Nutrients; Resistance.*

INTRODUCTION

The world is facing a various concerning problems to get significant food in a sustainable manner, fulfilling the requirements of an increasing world population because of decreasing food resources (Rehman et al., 2020a). Many countries are facing the problems nutrients deficiency (Saeed et al., 2020). Growth of plants influenced by a number of factors including water availability, temperature, availability of nutrients and light in the soil.

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The growth of the plant is also dependent upon the mocrobs including plant growth promoting rhizobacteria that are involved directly by fixing the atmospheric nitrogen, solubilization of insoluble phosphate and secretions of hormones including IAA, kinetics and GAs (Rehman et al., 2020b). Justus von Liebig, a German scientist, was one of the first scientists who illustrated that the nutrients are vital for the growth of plant. According to researches, there are above 100 chemical elements but study has determined almost 17 nutrients that are also called essential nutrients (Jones & Jacobsen, 2005). For the growth and development of plants these nutrients are vital (Kalsoom et al., 2020). Out of the 17 necessary elements, some are the non-mineral nutrients like carbon (C), hydrogen (H) and oxygen (O) because they are derivative from the water and air. The remainings are 14 essential nutrients that comprise of 6 macronutrients: nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg) (Adnan et al., 2020a; & Adnan et al., 2021), and sulphur (S); and 8 micronutrients: boron (B), chlorine (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni) and zinc (Zn) (Brady & Weil, 2008).

The plants nutrition depends on the uptake and availability of macro nutrients and micro nutrients that are enclosed in the soil (Acosta-Durán et al., 2007). The effect of a single nutrient in the growth of plant has been studying in most plant nutrition experimentations, on the other hand, study observing the influence of more than one nutrient in the similar experiment is limited. In this condition, collaboration amongst the nutrients can be recognized as the effects of increasing the nutrient concentration in the immersion of additional nutrients and the corresponding response of the crop (Fageria, 2001). For cultivated land it is necessary to reach highest yield per unit area requirements to attain supreme productivity because population is speedily growing and it is important to meeting the increasing in food needs. Productivity and quality in agricultural depend upon plant nutrition. To supply these nutrients, the use of fertilizers is the one way. On the other hand, surplus use of fertilizers possibly will lead to the accumulation of heavy metal which is also a cause of distraction for crop (Hayyat et al., 2020). Moreover, Imbalanced plant nutrition is a most important problem in sustainable crop production (Wasaya et al., 2019). They can result in the nitrate accumulation and eutrophication of water (Savci, 2012). Like unnecessary application of phosphorus badly affects the quality of water. In well-developed industrial countries deficiencies of micronutrient are also widespread. Globally more than 3 billion people suffer from deficiencies of Fe and Zn (Graham et al., 2001). Furthermore, in 2050 around 6 billion to 10 billion world's population is expected to grow (Byrnes & Bumb, 1998). To sustain the humans well-being and to feed a world with huge increases in population, a great increase in the production of food need to be attained. In the world population the estimated increases will result in a severe stress on the current cultivated land by intensification and urbanization for the production of crop.

We have to focused on sustainability according to current conditions, because in the current years, it is a term that has been used comprehensively in several phases of our lives, and particularly in agriculture because of the effect that certain methods of the crop production have on the environment (Hanson et al., 2007). Agricultural sustainability is the management and the agricultural ecosystem consumption in a way that sustains its productivity, biotic diversity, capacity of regeneration, functional vitality and ability, so that it can fulfill - in the present day and in the forthcoming – ecologically significant, social and economic functions at the native, countrywide and worldwide levels, and that does not damage other environments (Lewandowski et al., 1999). In the current years the agriculture sustainability has tackled some of the most significant challenges (Oborn et al., 2003; & Hanson et al., 2007). Such as we study that, the collaboration among nutrients in plant and soil exudates modifies the microclimate of the rhizosphere (Rehman et al., 2020a; & Niu et al., 2013). For the first time rhizosphere was defined by Lorenz Hiltner in 1904. In the soil it fluctuates with the species of plant, usually measured at 2 mm distance from the surface of root identified as rhizoplane (Rehman et al., 2020a). But in some cases scientists have shown that the influence can be up to 10 mm (Jones et al., 2009). This review article will discuss the recent information that concerning about the nutrients and their use in sustainable agriculture for the growth of plant.

Macronutrients and its role in plant

National economy significantly depended on agriculture sector (Adnan et al., 2020b). Firstly, all over the world in for most of the crops nitrogen is the nutrient that is more deficient. Furthermore, nitrogen is the element which is mostly absorbed in soil under normal conditions by plants growing. Among the 3 main primary nutrients plants need nitrogen in the largest quantity. Nitrogen has various roles in plant body including: quick growth of plant body, increasing quality and sizes of leaf, increase in the development of seed and fruit; it also has vital role in the formation of amino acids that are structural blocks of enzymes and proteins, also involved in many biochemical processes as a catalyzing agent. Moreover, for the growth of plants nitrogen is the most important nutrient and its role in resistance against many disease is relatively easily established that’s why there is a wide literature about the nitrogen effect on diseases are available (Huber & Watson 1974).

Secondly, a very important macronutrient that involved in most growth processes is phosphorus. In the growth of plant including proteins, nucleic acids, phospholipids, phosphates of sugar, enzymes and compounds with energy-rich phosphate phosphorus is a vital component of most organic compounds, for example adenosine triphosphate (ATP) (Balkwill et al., 1988). In other words, plants need phosphorus for the energy development (ATP), nucleic acids and sugars. Deficiency of phosphorus will be occurring during the early growing season in the cool soils. In the young plants deficiency symptoms of phosphorus are usually more visible, (Brady & Weil 2008). When phosphorus is applied for fungal diseases and control seedlings it has been shown to be most beneficial (Omar, 1997). In addition, potassium is a vital nutrient that is mostly intake by plants in higher amounts than any other nutrient excluding nitrogen. In the plants potassium is utilized in enzymes activation, formation of protein, photosynthesis, and transport of sugar. Deficiency of potassium does not directly result as a hidden hunger (visible symptoms). At the start, in growth rate there is only a decrease, with occurring as necrosis and chlorosis in later stages. Potassium application can decrease the severity of leaf blight (*Helminthosporium* sp.) and increase yields of wheat grain (Sharma & Duveiller, 2004; & Sharma et al., 2005). In the case of calcium, plants used it in large amounts second only after nitrogen and potassium (Brady & Weil, 2008). In plant body calcium is responsible for the activation of several enzymes which are critical (Brady & Weil, 2008). In the carbohydrates translocation and other nutrients calcium plays an important.

Micronutrients and its role in plant

In plant metabolism, the micronutrients play a significant role by affecting the lignin and phenolics content and also stability of membrane. Firstly, regarding effect on susceptibility of plant to disease zinc was found to have a number of different effects as in some cases it increased, in others decreased, and in others had no effect (Grewal et al., 1996). In biochemical pathways and metabolic activities zinc is a major activator of several enzymes and metal component (Grotz & Guerinot, 2006). It is a dynamic element that plays a significant role in various biotic processes. Moreover, application of zinc considerably condensed the negative effects of droughts on plants (Toor et al., 2020). In addition, in the plant iron in a component of enzyme system which brings about oxidation-reduction reactions, it regulates photosynthesis, respiration, sulphates and nitrates reduction. It has been demonstrated that the foliar use of iron can upturn the resistance capacity of pear and apple to Sphaeropsis malorum and cabbage to *Olpidium brassicae* (Graham, 1983). Moreover, for proper germination of seed nickel is required by plants. In urease, nickel is the metal component which plays an important role in the formation of ammonium from the urea. Furthermore, for the growth and development of plant boron is the least understood vital micronutrient, and at the same time deficiency of boron is the most common deficiency of micronutrient in the world (Brown et al., 2002). About additional nutrients such as magnesium and sulfur, there is not sufficient material about their role in the diseases of plant. The potato scab severity can be reducing by the application of Sulphur. Condensed concentrations of magnesium in forage wheat can lead to grass tetany in the grazing of animals on winter wheat. According to USA report sufficient levels of Mg increased profits and quality (Graham & Webb,1991).

Main role of Macro and Micro nutrients in Plants body

About 17 elements are known as essential nutrients for plants growth and development. The soil supplies nitrogen, phosphorus, potassium, calcium, magnesium and sulfur in relatively large amounts. These largely supplied elements are called the macronutrients. The soil supplies iron, manganese, boron, molybdenum, copper, zinc, chlorine, and cobalt in relatively small amount. These elements are so-called micronutrients. For the growth and development of plant, the nutrients must be available in sufficient amounts. The provision of nutrients in appropriate ratios is also necessary. Plant nutrition is a vast subject and a bit difficult to get complete understanding. There are geeat variation between requirements of different plants and even between different species or individuals of a given clone. Deficiency of elements may cause deficiency symptoms. The higher supplies can also result in toxicity, which is possible at levels that are too high. The deficiency of one element can give the symptoms of toxicity from another element and vice versa. An abundance of one nutrient can cause a deficiency of another nutrient. Just like the uptake of K^+ is greatly influenced by the amount of NH^{+4} available in soil. The main role of macro and micro nutrients in plants body has been discussed as below in Table No. 1: (Foth, 1978).

Table 1:

Nutrients	**Role in plants body**
Nitrogen (N)	Component of proteins, coenzymes, and in chlorophyll, and nucleic acids.
Phosphorous (P)	Important in transfer of energy as part of ATP.
Potassium (K)	Main role in adjusting mechanisms as translocation of carbohydrate, synthesis of protein etc.
Calcium (Ca)	Plays role in membranes structure and permeability
Zinc (Zn)	In the systems of enzyme zinc regulate several metabolic actions.
Iron (Fe)	Synthesis of chlorophyll and in enzymes for the transfer of electron
Boron (B)	vital in translocation of sugar and carbohydrate metabolism
Sulphur (S)	Significant component of plant proteins.
Magnesium (Mg)	Activator of enzyme and component of chlorophyll

CONCLUSION

In conclusion, taking everything into consideration, it has been proved that all the nutrients like Nitrogen (N), Phosphorous (P), Potassium (K), Calcium (Ca), Zinc (Zn), Iron (Fe), Boron (B), Sulphur (S), Magnesium (Mg) will influence the quality of crop. Even though the application of nutrients in the form of fertilizers will improve the resistance strategies of plants against many diseases. The productivity of crop as well as its health can be improve by the proper use of nutrients in a balances way that will help in to meet the food requirements of global population according to present situation. For this purpose, first we have to understand the role of essential nutrients and their mobility in the plant body.

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