Procedure International Journal of Science and Technology

(International Open Access, Peer-reviewed & Refereed Journal)

(Multidisciplinary, Monthly, Multilanguage)

ISSN : 2584-2617 (Online)

Volume- 2, Issue- 3, March 2025

Website- www.pijst.com DOI- https://doi.org/10.62796/pijst.2025v2i3001

Symptoms of Nutrient Deficiencies in Plant

Dr. Devesh Mishra

Msc (Botony), PhD (Botony), BHU, Varanasi, Uttar Pradesh

Abstract:

Availability of nutrients is essential for proper growth and production of plants. When plants do not receive the necessary nutrients in sufficient quantities, their growth is disrupted and a variety of symptoms appear. In this research paper, the symptoms of nutrient deficiency in plants have been studied in depth. Nutrients are mainly divided into two parts - macronutrients and micronutrients. Each nutrient plays a specific role in plants and its deficiency leads to specific symptoms. Due to the deficiency of nitrogen the leaves start becoming yellow, while due to the deficiency of phosphorous the color of the leaves becomes dark green or purple. Lack of potassium can lead to burn-like spots on the edges of the leaves. Similarly, a deficiency of calcium and magnesium can lead to the development of structural defects in plants. Deficiency of micronutrients such as iron, zinc, boron, copper, etc. also leads to specific symptoms, including intervenial chlorosis, leaf shedding, and stunted root growth. The study also highlighted the causes of nutrient deficiencies, including decline in soil fertility, unbalanced fertiliser use, waterlogging or drought, and root damage. In addition, the diagnosis of nutrient deficiencies and their effective solutions have also been discussed. Special attention has been given to right nutrition management techniques such as balanced use of organic and inorganic fertilizers, crop rotation, and strategies to maintain soil fertility.

Keywords: Nutritional deficiencies of plants, Traits of nutrients, Nitrogen, Phosphorus, Potassium, Magnesium, Micronutrients, Soil fertility, Crop management, Agricultural improvement.

Introduction

The growth of plants and their proper health depends on the availability of nutrients. Nutrients play an important role in the life

cycle of plants, as they regulate their physiological and biochemical processes. Deficiency of nutrients manifests a variety of symptoms in plants, affecting their growth and causing a decline in production capacity. If there is a deficiency of a particular nutrient, it can cause an imbalance in the bodily functions of plants, which can lead to problems such as yellowing of leaves, weakening of branches, abnormal growth of flowers and fruits, etc. In today's time, the role of nutrients has become extremely important in the agriculture sector, as it is necessary to provide balanced nutrition to plants to achieve higher production. The nutrients necessary for the healthy growth of plants are obtained from the soil and also depend to some extent on atmospheric factors. These nutrients work in the tissues and cells of plants and help in their proper growth and development. The nutrients found in plant tissues are divided into two main categories - macronutrients and micronutrients. The main nutrients are those that plants need in large quantities, such as nitrogen, phosphorus, potassium, calcium, magnesium and sulfur. At the same time, micronutrients are needed in small amounts, but they are also extremely important for plants, such as iron, manganese, zinc, copper, molybdenum, boron, and chlorine. If the plants do not get adequate amounts of essential nutrients, their growth is affected and they are unable to perform their normal bodily functions smoothly. Elements like nitrogen are helpful in the formation of chlorophyll, which is necessary for the process of photosynthesis. Phosphorus drives the process of energy transfer in plants and is essential for the strength of roots. Similarly, potassium maintains water balance in plants and boosts immunity.

Each nutrient has a specific function in plants, and their presence is important in the overall development of plants.

Nitrogen (N) Nitrogen helps in the formation of proteins, enzymes, and chlorophyll in plants. Because of its deficiency the leaves start becoming yellow and the growth of the plant stops.

Phosphorus (P) Phosphorus strengthens the root system in plants and plays an important role in energy transmission. With its deficiency, the number of flowers and fruits in plants decreases, and the leaves turn dark green or purple.

Potassium (K) Potassium is essential for maintaining water balance in plants and increases immunity. Due to its deficiency the edges of the leaves appear brown and scorched.

Calcium (Ca) Calcium is essential for the strength of the cell wall of plants. Its deficiency can lead to deformation of new leaves and weakening of the root system.

Magnesium (Mg) is a major component of magnesium chlorophyll and aids in photosynthesis. Due to its deficiency yellow spots start appearing on the leaves.

Role of micronutrients: Nutrients like iron, zinc, copper, boron etc also play an important role in plant metabolism, enzyme actions and biochemical processes. Their deficiency leads to various kinds of deformities like intervenial chlorosis, shortening of leaves and deterioration in the quality of fruits.

If the amount of a particular nutrient is insufficient in the soil, a variety of symptoms arise in plants, which can affect their growth and production. For example, a lack of nitrogen leaves plants weaker and smaller, while a lack of phosphorus results in less flowering and fruit formation. Lack of nutrients in the soil can have many causes, such as excessive rainfall, poor soil management, excessive irrigation, acidic or alkaline soil, and improper fertilizer use. In addition, the lack of nutrients can also affect the immunity of plants, making them more susceptible to various diseases.

The common symptoms of nutrient deficiencies

The growth of plants and their overall health depends on the balanced availability of essential nutrients. If a nutrient is deficient, plants cannot carry out their normal physiological and biochemical processes smoothly, leading to a variety of symptoms. These symptoms can be subtle at an early stage, but can become severe over time and disrupt the growth of the plant. The plants can be kept healthy by proper nutrient management by recognizing the symptoms of nutrient deficiency.

Chlorosis is one of the most common symptoms of nutrient deficiency in plants, in which the green color of the leaves begins to fade and they begin to appear yellow. This is mainly due to the lack of nitrogen, iron, magnesium and sulfur. Chlorosis occurs when the formation of chlorophyll in the plant is disrupted, thereby affecting the process of photosynthesis. If this symptom is identified at an early stage, it can be corrected with proper nutritional management. The old leaves are the first to be affected by the lack of nitrogen, while the new leaves from the lack of iron develop the symptom of intervenial chlorosis (yellowing between the veins). Similarly, with a lack of magnesium, the veins of the leaves remain green, but the surrounding area begins to turn yellow. In the deficiency of sulphur new leaves are affected more and their color becomes light yellow.

Necrosis is the condition when plant tissues begin to die and the affected parts appear brown or black in color. This is mainly due to the lack of calcium, potassium, copper and zinc. Lack of calcium affects the growth of new leaves and their tissue cells are damaged. With a lack of potassium, the edges of the leaves are first affected and they gradually begin to dry out. With the deficiency of copper the new leaves of the plants start withering, while with the deficiency of zinc dry and dead spots start appearing on the leaves. Balanced nutrition is necessary to reduce the effects of necrosis.

If the plants do not get the required nutrients in sufficient quantity, their normal growth is stunted and they appear small and weak in size. This symptom arises mainly from a lack of nitrogen, phosphorus, and zinc. The plants become small and weak due to lack of nitrogen because it is helpful in protein and enzyme formation. Lack of phosphorus affects the growth of roots, which stops the growth of plants. The lack of zinc shortens the internodes (the length between the knots) in plants, making the plants appear bushy.

The lack of certain nutrients causes uneven development in the leaves, causing them to twist or deform. This is mainly due to the lack of boron,

calcium, and manganese. The new leaves become abnormally thick and deformed due to the lack of boron. Due to the deficiency of calcium the edges of the leaves start curling and their color becomes light. The lack of manganese leads to unbalanced growth in the leaves, which causes them to appear asymmetrical. If a plant does not receive the necessary nutrients in sufficient quantities, the quality of its flowers and fruits is affected. It is mainly caused by a lack of boron, phosphorus, and potassium. The lack of boron causes the flowers to develop small and unevenly, which disrupts the process of pollination and reduces fruiting. With a lack of phosphorus, the number of flowers in plants decreases and the seeds do not develop properly. The lack of potassium worsens the quality of fruits and they can fall prematurely.

The common symptoms of nutrient deficiencies

Adequate amounts of nutrients are essential for the healthy growth of plants. If the availability of a nutrient is insufficient, plants exhibit a variety of symptoms that affect their biological and physiological functions. Lack of nutrients can cause plant growth to stop, tissues to be damaged, and the process of photosynthesis to be disrupted. If these symptoms are identified and treated at the right time, then the productivity of the plants can be saved. Common symptoms of nutrient deficiency include chlorosis (yellowing of leaves), necrosis (dying of plant tissue), stunted growth, leaf curling and deformation, and poor flowering and fruiting.

Chlorosis is one of the most common symptoms of nutrient deficiency in plants, in which the color of the leaves begins to change from green to yellow. This situation arises when the formation of chlorophyll in the plant is disrupted. Chlorosis is mainly caused by a lack of nitrogen, iron, magnesium and sulfur. If there is a lack of nitrogen, then the old leaves are affected first, while in the lack of iron the new leaves are more affected and intervenial chlorosis appears. In the deficiency of magnesium the part between the veins becomes yellow, while due to the deficiency of sulphur the new leaves become light yellow.

Necrosis is the condition when plant tissues begin to die and the affected area begins to appear brown or black. This symptom usually develops due to a lack of potassium, calcium, zinc and copper. Because of the deficiency of calcium the new leaves become weak and the roots remain underdeveloped. The edges of the leaves are the first to be affected by potassium deficiency and gradually burn-like spots emerge. Due to the lack of zinc and copper, dry and dead spots appear in the leaves, which disrupt the growth of plants.

The normal growth of plants is hindered due to lack of nutrients. This symptom arises mainly from the lack of nitrogen, phosphorus and zinc. Due to the lack of nitrogen, plants are left small and weak, as it plays an important role in protein and enzyme formation. Lack of phosphorus impairs the growth of the root system, causing plants not to absorb enough nutrients. Due to the lack of zinc, the internodes (the distance between the knots) are reduced, which makes the plant appear bushy and small.

When plants do not get enough nutrients, the shape of the leaves can

become abnormal and they begin to appear deformed. This problem arises mainly due to the lack of boron, calcium and manganese. Due to the lack of boron, the new leaves become abnormally thick and deformed, which affects the overall development of the plant. Due to the deficiency of calcium the edges of the leaves start curling and they become asymmetrical. The lack of manganese leads to an unbalanced growth of leaves, which makes their shape appear irregular.

The chemical effects of nutrients also affect the reproductive processes of plants. If the plants do not get the necessary nutrients, their flowers and fruits develop normally or may not be fully developed. This problem is mainly due to the deficiency of boron, phosphorus and potassium. The boronic microcephaly affects the quality of the fruit as the shape of the fruit is shortened and the process of pollination is disrupted. Due to phosphorus deficiency, the growth of seeds and fruits is reduced, which increases the fertility of plants. Due to potassium deficiency, the shape of the fruits may be small and they may last for a long time.

Causes of nutrient deficiencies

Balanced availability of essential nutrients is essential for healthy growth and higher production of plants. If, for some reason, plants do not receive adequate amounts of nutrients, their growth is stunted and nutritional disorders can occur. The acidity or alkalinity of the soil affects the ability of plants to absorb nutrients. If the pH level of the soil is too acidic (pH less than 5.5) or too alkaline (pH greater than 7.5), many important nutrients become unavailable to the plants. Acidic soils reduce the availability of calcium, magnesium and molybdenum, while highly alkaline soils inhibit the absorption of iron, manganese and zinc. Soil pH imbalance is seen more in saline and alkaline soil, which leads to problems like chlorosis in plants, stunted growth and less production of flowers and fruits. This problem can be controlled by using soil testing and appropriate modification techniques such as organic manure and pH regulatory elements.

When the natural fertility of the soil is depleted, the supply of essential nutrients to the plants is disrupted. This problem arises mainly due to excessive agricultural production, destruction of crop residues, lack of organic matter and improper fertilizer management. When the amount of organic carbon and microorganisms in the soil is reduced, nutrients are not readily available to plants. In addition, frequent plowing of land and burning of crop residues affect soil composition, reducing the availability of nitrogen, phosphorus, and potassium. Use of organic manure, green manure, crop rotation and natural fertilizers are essential to maintain soil fertility.

Both waterlogging and drought conditions can cause nutrient deficiencies in plants. When the soil is over-watered, the roots are unable to absorb nutrients due to lack of oxygen. Waterlogging is mainly caused by a lack of nitrogen and sulfur, which can lead to the development of symptoms of yellowing (chlorosis) in plants. On the other hand, when there is a prolonged drought, the solubility of nutrients in the soil decreases and plants do not receive the necessary mineral salts with water. Deficiency of potassium and phosphorus is seen more in drought

conditions, which weakens plants and reduces crop production. This problem can be controlled by methods such as water management techniques, proper irrigation systems and drip irrigation.

Fertilizers are used to provide nutrients to plants, but if they are used in excess, it can cause nutrient imbalance in the soil. The use of excessive nitrogenous fertilizers increases the acidity of the soil, which reduces the availability of zinc, magnesium and copper. Similarly, excess of phosphorus can inhibit the absorption of iron and zinc. Excessive use of chemical fertilizers also affects soil microorganisms, leading to a decline in the natural fertility of the soil. To avoid this problem, fertilizers should be balanced and used as per requirement, and preference should be given to organic manure and green manure.

The absorption of nutrients in plants takes place through the roots, but when the roots are damaged by insects, microorganisms or pathogens, they become unable to absorb the necessary nutrients. Root rot, nematode infestation and other diseases can reduce the availability of nutrients in the soil. When roots are damaged, plants show symptoms of nitrogen, phosphorus, and potassium deficiency, such as yellowing of leaves, stunted growth, and untimely fall of flower-fruit. To avoid this problem, organic pesticides, crop rotation, and soil biological treatment methods should be used.

Diagnosis of nutrient deficiencies

Balanced nutrition is essential for plant growth and productivity. If the amount of a nutrient is less or more than necessary, a variety of symptoms appear in plants, which can affect their growth. Scientific and practical methods are used to diagnose nutrient deficiencies. The earliest signs of nutrient deficiency in plants are seen in their external structural changes. When an essential nutrient is unavailable, the plant's leaves, stem, roots, and flowers are affected. The symptoms caused by the deficiency of various nutrients can be identified as follows-

1. **Nitrogen deficiency:** Old leaves turn yellow and the growth of the plant slows down.
2. **Lack of phosphorus:** The color of the leaves becomes dark green or purple and the growth of the roots is inhibited.
3. **Lack of potassium:** the edges of the leaves begin to dry out and the plant becomes weak.
4. **Calcium deficiency:** New leaves become deformed and the growth of roots is affected.
5. **Magnesium deficiency:** In old leaves, the area between the veins becomes yellow, while the veins remain green.
6. **Deficiency of sulphur:** New leaves turn yellow and plants remain small.

The actual amount of nutrients present in the leaves, stems and other parts of the plant is checked by tissue test. This test measures the availability of essential minerals in plant tissues to determine which nutrients are being absorbed and which are unavailable. If a nutrient

deficiency is found in the tissue test, this problem can be overcome by using the necessary fertilizers or biological modifications. Soil and tissue testing is especially used in commercial agriculture to improve the productivity and quality of crops. This method is the most reliable from a scientific point of view, since it presents a detailed analysis of the nutritional status of plants.

Hydroponic system is an advanced method being adopted in modern agriculture, which is helpful in studying the deficiency of nutrients and providing appropriate nutrition to the plants. In hydroponic experiments, plants are grown without soil, in a water-based nutrition solution, in which essential nutrients are provided in controlled amounts. Using the hydroponic method, scientists can test which traits develop in plants when a particular nutrient is removed from the nutrient solution. Thus, this method provides a reliable technique for identifying nutritional disorders and studying their effects. In addition, the hydroponic system is also being widely adopted in commercial farming, as it provides greater nutritional efficiency compared to traditional soil-based agriculture. This method is particularly beneficial in areas where soil quality is poor or water availability is limited

Management and Treatment of Nutrient Deficiencies

The lack of nutrients in plants is a serious agricultural problem, which affects their growth, development and production. Nutritional disorders can cause plants to become weak, their leaves to turn yellow, root systems to become underdeveloped, and flower and fruit production to decrease. If this problem is not managed in time, both the quality and quantity of the crop can be adversely affected. Soil amendment and proper use of fertilizers is an effective way to prevent and treat nutritional disorders in plants. Lyming agents, organic carbon, green manure and gypsum are used in soil amendment, which can improve soil fertility. To maintain the pH balance of the soil, lime and dolomite are used, which increases the availability of calcium and magnesium to plants.

In addition, fertilizers rich in nitrogen, phosphorus, potassium, sulfur and micronutrients are used to meet the lack of nutrition in plants. The balanced use of fertilizers not only improves the quality of the crop, but also maintains the balance of nutrients in the soil. However, excessive use of chemical fertilizers can reduce soil fertility, so it is necessary to combine fertilizers with biological modifications.

Many times the roots of the plants are not able to absorb the nutrients properly, in such a case foliar spray is an effective option. In this method a nutrient solution is sprayed on the leaves of the plants, allowing them to absorb the necessary nutrients directly. This method is highly effective to overcome the deficiency of micronutrients like iron (Fe), zinc (Zn), manganese (Mn) and copper (Cu). The biggest advantage of the foil spray is that it provides nutrients quickly and reduces the nutritional problems caused by poor soil quality. The use of foliar nutrition is particularly useful in soils with high pH, where the availability of certain nutrients is reduced. Excessive use of chemical fertilizers can affect soil fertility and biodiversity. Therefore, biological methods are more

effective for long-term solutions to nutritional problems. Organic fertilizers like compost, farmyard manure and biofertilizers are helpful in restoring the essential nutrients in the soil and increasing the water holding capacity of the soil. Biofertilizers such as Rhizobium Azotobacter and Phosphate Solubilizing Bacteria (PSB) increase the amount of nutrients available in the soil and nourish the plants naturally. In addition, biofertilizers strengthen the root system of plants and are also helpful in water conservation.

Crop rotation and intercropping is an extremely effective technique to prevent nutritional disorders in plants. By growing different crops in a sequence in crop cycle fertility of soil is maintained and deficiency of nutrients is prevented. For example, if maize has been grown in one year, then the amount of nitrogen in the soil remains balanced by sowing pulses crops, such as chickpea or green gram, the next year. In mixed farming two or more crops are grown together, due to which the consumption of various nutrients in the soil remains balanced. For example, growing maize and rajma (maize-bean intercropping) or millet and pigeon pea (millet-pigeon pea intercropping) together can ensure recycling of nitrogen and other nutrients in the soil.

Conclusion

The growth and production capacity of plants directly depends on their nutritional level. Lack of essential nutrients affects the physical, chemical, and biological processes of plants, which can inhibit their growth and lead to a decline in crop production. Maintaining balance in nutrition management is not only essential for healthy growth of plants, but it is also extremely important from the point of view of sustainable agriculture. From this study, it became clear that nutrient deficiencies in plants cause many visible symptoms, including chlorosis (yellowing of leaves), necrosis (death of tissues), stunted growth, twisting and deformation of leaves, and poor growth of flowers and fruits. Deficiency of various nutrients produces different symptoms, for example, lack of nitrogen causes yellowing of leaves, lack of phosphorus slows down the growth of plants, lack of potassium causes burning of the edges of leaves, and lack of calcium deforms new leaves.

Further, on studying the causes of nutrient depletion, it was found that soil pH imbalance, decline in soil fertility, water logging and drought stress, excessive fertilizer use, and damage to roots by pests and diseases are the major causes. To diagnose these problems, it is necessary to use scientific methods like soil testing, tissue testing, and hydroponic experiments. In terms of management and treatment, this study shows that methods such as soil amendment and balanced use of fertilizers, foliar nutrient spray, use of organic manure and biofertilizers, and crop rotation and mixed farming are effective for nutrient management. If these techniques are adopted in the right way, not only the productivity of crops can be increased, but the fertility of the soil can also be maintained.

Timely diagnosis and management of nutrient deficiencies in plants is essential to maintain their growth, production and nutritional quality. Balanced nutrition is an essential component for sustainable agriculture,

thereby preserving soil fertility and mitigating environmental problems. Significant progress can be made in this direction by adopting innovative techniques, biological approaches and modern agricultural practices in the field of plant nutrition research. If these strategies are implemented in collaboration with scientists and farmers, long-term agricultural production and food security can be ensured.

References

1. Gupta, P. K. (2015). Plant Physiology: Nutrient Uptake and Metabolism. Scientific Publishers. Jodhpur, India. pp. 112-150.
2. Mehrotra, R. S. (2009). Plant Nutrition and Deficiency Disorders. New India Publishing Agency. New Delhi, India. pp. 67-89.
3. Kale, S. P. (2012). Soil Fertility and Plant Health. Agrobios Publications. Jodhpur, India. pp. 204-230.
4. Reddy, S. R. (2018). Plant Nutrition and Fertilizers. Kalyani Publishers. Ludhiana, India. pp. 155-180.
5. Sarkar, A. (2016). Soil Science and Plant Health. PHI Learning. New Delhi, India. pp. 98-124.
6. Choudhary, D. K. (2014). Biochemical Basis of Plant Stress. Springer India. New Delhi, India. pp. 133-160.
7. Singh, H. (2017). Molecular Approaches in Plant Nutrition. CRC Press. Boca Raton, FL. pp. 88-112.
8. Datta, S. K. (2011). Nutrient Management in Indian Soils. Daya Publishing House. New Delhi, India. pp. 45-78.
9. Rao, D. L. N. (2020). Micronutrients in Agriculture. Indian Society of Agronomy. New Delhi, India. pp. 210-235.
10. Sharma, R. (2013). Diagnosing Plant Disorders. ICAR. New Delhi, India. pp. 33-58.

Cite this Article-

"Dr. Devesh Mishra", "Symptoms of Nutrient Deficiencies in Plant", Procedure International Journal of Science and Technology (PIJST), ISSN: 2584-2617 (Online), Volume:2, Issue:3, March 2025.

Journal URL- https://www.pijst.com/

DOI- https://doi.org/10.62796/pijst.2025v2i3001

Published Date- 01/03/2025