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REVIEW ARTICLE

A REVIEW ON NUTRIENT DEFICIENCY SYMPTOMS AND EFFECTS ON TOMATO PLANT

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ABSTRACT

Tomato consists of nutrition and antioxidant like lycopene which avoids cancer. Nutrient deficiency occurs when the plant doesn't get enough nutrients like Nitrogen, Phosphorus, Calcium, and so on, causing a severe reduction in production. In this review, the nutrient deficiency symptoms and their effects on the tomato plant are included. The tomato plant requires mainly three primary nutrients, i.e., Nitrogen, Phosphorus, and Potassium, in the highest quantity. The nutrient deficiency in tomatoes can be noticed by observing the symptoms like stunted growth, curling down of young leaves, tip burn, abnormal green foliage, and chlorotic lesions on the leaf margin. Due to nitrogen deficiency, uniform yellowing of leaves occurs, causing Chlorosis. Phosphorus deficiency slows down the development of plants along with the development of anthocyanin gathering. Potassium deficiency causes slow growth on leaves along with less photosynthesis. Blossom end rot causes by Calcium while root cracking occur by Boron and Zinc occur rosette. Some of the external factors contributing to nutrient deficiency are excessive soil moisture; microbial activity; high salinity especially in Ca, so it is suggested that the nutrient level should be maintain by applying nutrient containing compound. Some of them are managed by below management practices also. Further studies require to know the causes of these nutrient deficiency in tomato plant.

KEYWORDS

Solanum lycopersium, Nitrogen, Phosphorus, Potassium, Calcium, Zinc

1. INTRODUCTION

Tomato is a highly cultivated horticultural crop in the world and used for industrial purposes (Andryei et al., 2021). It stands as the second most cultivated vegetable in the world after potatoes (DJ, 2018). The total area where tomato is cultivated in 46.16 lakh ha with global production of 1279.93 lakh tonnes according to the paper of Veilumuthu and Christopher 2022 (Veilumuthu and Christopher, 2022). Tomato contains vitamins A, C, and minerals like Na, K, Fe, Ca, and Mg, and it contributes antioxidant elements such as lycopene which avoids cancer (Sanjida et al., 2020). While the scarcity of nutrient show deficiency symptom that directly affects the yield and quality of tomato (Sainju et al., 2003). Among the important mineral nutrients, N, P, and K are the macronutrients that require the highest agricultural venture with think of fertilizer inputs (Wang et al., 2002). Blossom-end rot (BER) is a common physiological illness that occurs on the fruit of tomatoes due to Ca (de Freitas et al., 2012; Taylor and Locascio, 2004). Some studies said that use of magnetized water will improve water productivity and crop yields by increasing the solubility of water-soluble minerals such as calcium, nitrogen, potassium, iron and lead which can enhance absorption of nutrients for crops (Maheshwari and Grewal, 2009).

2. NITROGEN

Lack of Nitrogen causes chlorosis and reduce the total of light engrossed per unit time ultimately reduce the number of photosynthates, lead to both fruit and flower abortion and the outcome of Nitrogen deficiency in fruit is low total soluble salt (JK et al., 2011). Photosynthesis inhibition and altered photosynthates segmentation show reduced light-saturated photosynthetic rate, stomatal conductance throughout the vegetative stage, decreased variable to maximum fluorescence ratio (Fv/fm) was observed, along with an increase in leaf starch content and starch to sucrose ratio, reduction in CO2 conductance in the mesophyll (Guidi et al., 1997). Stem diameter shrinkage and expansion amplitudes were lowered by reducing the magnitude of the daytime shrinkage and night-time expansion, with decreases in ^{13}C and ^{15}N concentrations were seen in fruits in the absence of Nitrogen (Kanai et al., 2008). Plants that were poor of Nitrogen for 10 or 19 days had higher amounts of chlorogenic acid and rutin (Bénard et al., 2011).

3. POTASSIUM

Potassium deprivation slowed growth on adult leaves (12–17) but not on older leaves near to the first bind (Pujos and Morard, 1997). As potassium was decreased, malic, oxalic, and occasionally pyruvic acids fell in concentration, but citric, a-ketoglutaric, and glyoxylic acids accumulated (Jones, 1961). Flowers took longer to develop, and the fruit set was less effective (Besford, 1975). Protein content increased up to 130 percent in growing leaves of potassium-deficient plants, but protein per leaf decreased (Besford, 1975). Leaf water expected and relative water content fell. Potassium-deficient leaves had less photosynthesis because their photosynthetic abilities were harmed, not because their stomata were closed (Behboudian and Anderson, 1990).

4. PHOSPHORUS

Phosphate starvation in tomatoes. Physiological responses such as anthocyanin gathering and cell death are noticeable seven days after Phosphate deficiency, accompanied by the extreme amount of transcriptional modification in the genome (Satheesh et al., 2022).

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Phosphorus deficiency is a positive aspect of enhancing the Molybdenum uptake by the tomato plant. It is observed that there is a three-fold higher molybdenum uptake by tomato plant after four days of limiting Phosphorus; however, PH of soil increases gradually (Heuwinkel et al., 2020). Lack of phosphorous will show the result in slow stunted growth and reduction in yield and marketable fruits (Fandi et al., 2010)

5. Calcium

In tomato, blossom end rot has been reported as related to a lack of calcium or a physiological illness that is influenced by cultivar and environmental factors like high salinity, high magnesium (Mg), ammonium (NH4) and potassium(K), unfavourable moisture (de Freitas et al., 2012; Indeche et al., 2020; Vinh et al., 2018). Shortage of calcium in tomato fruits may cause ethylene production and consequence in the biogenesis of carotenoids (de Freitas et al., 2012).

6. Magnesium

The yield of tomatoes is decreased due to deficiency of magnesium or no use of magnesium and also decreases the distribution of potassium and molybdenum, which leads to affect the plant development and product quality (Quddus et al., 2021). Magnesium is a component of chlorophyll and vital for plant growth, fruit maturation, and quality improvement and their deficiency symptoms of magnesium usually start with mottled chlorotic areas developing in the interveinal tissue (Ogura et al., 2020).

7. Sulfur

Sulphate-S is easily influenced by factors such as urine and dung from grazing animals, leaching, fertilizer, and atmospheric inputs, which is the indicator of sulphur deficiency in pastoral soils (Consulting, 2021). Oilseed rape crop is an indicator plant of sulphur deficiency (Kühn-institut, 2008). At a PH level higher than 5 in soil, sulfur is highly mobile in soil solution; with heavy irrigation or high rainfall on PH>5 soils, sulfur is leached out and resulted sulphur deficiency (Kühn-institut and Kühn-institut, 2003). Chlorosis of foliage, yellowing of the top leaves first, anthocyanin formation in leaves and stems, small leaves with ridged texture, and weak stems were some of the symptoms (Eaton, 1935). Lack of exogenous sulphate causes the deficient symptoms, to slowly emerge in root and stem and had substantially higher glucose and nitrate concentrations in it (Nightingale et al., 1932).

8. Iron

In tomato plants, deficiency of iron leaves shows strong Chlorosis which mostly appears in calcareous soil, and anaerobic conditions (Grioui et al., 2021). Lack of iron resulted in variation in root biology like more production of root hair and increased total SOD activity and decreased CAT activity (Chaney et al., 1992; M'sehli et al., 2014).

9. Molybdenum

Molybdenum shortage can occur in acid soils, peats, and soilless manure (Sainju et al., 2003). The symptoms of Mo deficiency appear as pale green interveinal chlorosis in older leaves, marginal necrosis, and downward curling of the margins (Cox, 2019). The absence can be reduced by applying NaMoO3 or NH4 MoO3 at 5 mg. L-1 in the foliage (Sainju et al., 2003).

10. Boron

Boron deficiency causes a defect in shoot growth, mainly in the development of new leaves; the younger leaves curl inward latter become small, and deformation occurs; the chlorotic spots are also observed between the veins from yellow or orange to yellow or purple under boron deficient conditions that lead to the drawback of both vegetative and generative growth (Uraguchi et al., 2014). Boron deficiency affects the growth (Gündeş and Sönmez, 2020; Haleema et al., 2018). Photosynthesis has reduced the damage to the structure of thylakoids affecting electron transmission and decreasing the maximal quantum yield in tomatoes (Han et al., 2008). Leaves become curled, wilted, or thickened along with fruit and root cracking or rotting due to B deficiency (Yeasmin et al., 2021).

11. Zinc

Zinc deficiency may cause rosette, mottled leaves with leaf bronzing, yellowing and white bud, or little leaf (Agricultural and Station, 1936; Lingle et al., 1957). The plant having zinc deficiency shows many depositions of phenolic materials along with tannin in the root tips (Eltinge et al., 2016). Acute stunting of the seedling is seen along with yellow margins between the veins of the leaves, creating brittleness and new leaves show a dusty appearance, older leaves colour changes to orange or bronze having necrotic spots along the leaf margins due to zinc deficiency (Lingle et al., 1957).

Table 1: Management Practices for Few Nutrient Deficiency

Nutrients	Their Deficiency Can Be Managed by Appling Fertilizer Like	Citation
Nitrogen	NH4-N; NO3-N	(Sainju et al., 2003)
Phosphorus	Nitro-phosphate; triple super phosphate	(Von et al., 1979)
Calcium	Spray in the foliage by Calcium solution like Caco3	(Sainju et al., 2003)
Magnesium	Epsom Salt at 2.6 gram per liter	(Sainju et al., 2003)
Iron	Spray Fe-EDTA at 37 milligram per liter	(Needham et al.,1973)
Molybdenum	NaMoO3 or NH4 MoO3 at 5 mg. L-1 in the foliage.	(Sainju et al., 2003).
Boron	Spray borax solution in the foliage	(Kocevsky et al., 1996)

12. Conclusion

Tomato is second most vegetable cultivated in the world which contain different minerals and vitamin. Lack of nitrogen lead to chlorosis, stem diameter shrinkage; Potassium show slowed growth and less photosynthesis activity and Phosphate resulted anthocyanin gathering whereas Calcium deficiency outcome as blossom end rot disorder. Magnesium defiance consequences as the affect on fruit maturation and moulted chlorosis; Sulphur lead to slow development and emerge of root and stem where as iron to variation in root biology like in root hair. Molybdenum inefficient effect appear as pale green interveinal chlorosis in older leaves and marginal necrosis; Boron as root cracking or rotting and zinc as brittleness, where new leaves show a dusty appearance and older leaves colour changes to orange or bronze having necrotic spots.

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