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Nutrient Deficiencies and Management in Maize

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Abstract

Nutrient deficiencies are a significant constraint in maize cultivation, affecting plant growth, development, and yield. This article provides a comprehensive overview of common nutrient deficiencies observed in maize, highlighting their symptoms, underlying causes, and practical remedies. Key nutrients such as nitrogen, phosphorus, potassium, and micronutrients like zinc, iron, and boron are discussed, with a focus on their roles in plant physiology and the impact of their deficiencies. Strategies such as balanced fertilization, foliar applications, and soil amendments are emphasized for effective nutrient management. By understanding and addressing these deficiencies, farmers can enhance crop health, optimize yields, and ensure sustainable maize production.

Key words: Nutrient defieiciecy, balanced fertilisation, soil amendments, sustainable

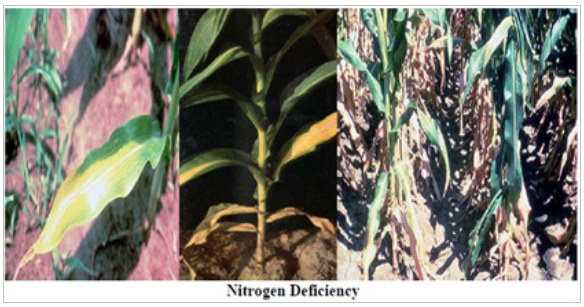
Introduction

Maize is a major cereal crop and food source for both humans and animals. Maize, a nutrientdemanding crop, significantly depletes soil nutrient reserves due to its high biomass production requirements, and under India's intensive cereal-cropping systems, nutrient extraction often surpasses replenishment. This imbalance has led to widespread multi-nutrient deficiencies (Kumar et al., 2024). Identifying and addressing these deficiencies promptly is essential to ensure optimal crop performance. This guide provides detailed information on the symptoms, causes, and remedies for nutrient deficiencies in Rabi maize, enabling farmers to implement timely and effective interventions to maximize productivity.The challenge for future nutrient management is the creation of innovative and advanced fertilization techniques that enhance crop NUE, maintain sufficient soil nutrient levels and avoid deficiencies, imbalances or excessive fertilizer use, all of which have positive effects on the economy and the environment (Bruulsema and Tom, 2022).

1. Nitrogen (N) Deficiency

Symptoms:

- General chlorosis (yellowing) starting from older leaves as nitrogen is mobile and moves to newer growth.
- Stunted plant growth with thin stems.
- Reduced ear and grain size.



Nitrogen Deficiency

Cause: Insufficient nitrogen in the soil or leaching in light-textured soils.

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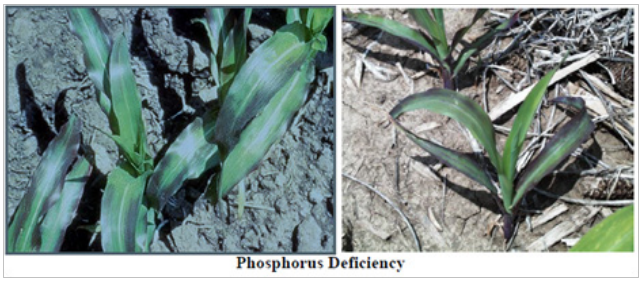
Remedy:

* Apply nitrogen-rich fertilizers like urea or ammonium nitrate in 3 splits.
* Maintain proper irrigation to reduce leaching losses.
* Use nitrogen-fixing bio-fertilizers as a supplement.
* Integrating the use of biofertilizers with DAP + urea, helped to maintain optimum yield (Dennis et al., 2024)

2. Phosphorus (P) Deficiency

- **Symptoms:**

* Leaves appear dark green with reddish-purple discoloration, particularly on older leaves.
* Poor root development and delayed maturity.
* Reduced kernel size and yield.


Phosphorus Deficiency

Cause: Low soil temperature in Rabi limits phosphorus uptake, even if soil phosphorus levels are adequate.

Remedy:

* Apply phosphorus fertilizers like DAP (Di-Ammonium Phosphate) at sowing.
* Incorporate organic manure or phosphate-solubilizing bacteria.

3. Potassium (K) Deficiency

- **Symptoms:**

* Yellowing or necrosis (dead tissue) at the leaf edges, starting from older leaves.
* Weak stems leading to lodging (plants falling over).
* Poor grain filling and reduced resistance to stress (drought, disease).


Potassium Deficiency

Cause: Imbalanced fertilization or potassium fixation in clayey soils.

Remedy:

* Apply muriate of potash (MOP) or sulphate of potash.
* Maintain balanced fertilization for optimal uptake.

4. Zinc (Zn) Deficiency

Applications of zinc is essential for plant water relations, cell membrane stability, chlorophyll synthesis, osmolyte accumulation, stomatal regulationand photosynthesis, all of which enhance plant growth (Kaya and Higgs, 2002).

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Symptoms:

* Interveinal chlorosis on newer leaves (yellowing between green veins).
* Stunted growth and shortened internodes.
* White bands or stripes on the leaves(White bud).

Zinc Deficiency

Cause: High soil pH, cold temperatures, or excessive phosphorus can reduce zinc availability.

Remedy:

* Apply zinc sulfate (25 kg ha -1) or chelated zinc.
* Foliar sprays can quickly correct deficiencies in severe cases.

5. Iron (Fe) Deficiency

Symptoms:

* Interveinal chlorosis in young leaves, turning them pale yellow or white.
* Reduced vigor and slow growth.

Iron Deficiency

Cause: Alkaline soils or excessive irrigation leading to waterlogged conditions.

Remedy:

* Use iron chelates for foliar application (0.5 %) or soil amendment.
* Improve drainage and aeration of the soil.

6. Magnesium (Mg) Deficiency

Symptoms:

* Interveinal chlorosis on older leaves, progressing to necrosis.
* Leaves may curl upwards along the margins.

Magnesium Deficiency

Cause: Sandy soils or imbalances with potassium or calcium.

Remedy:

o Apply magnesium sulfate (Epsom salt) or dolomite lime.
o Maintain proper nutrient balance.

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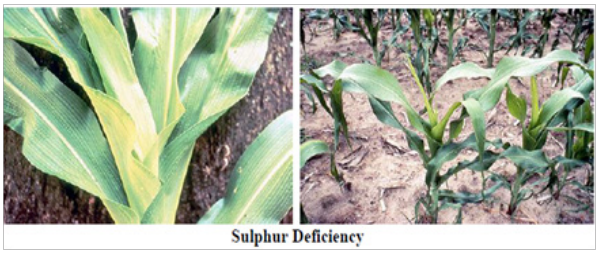
7. Sulfur (S) Deficiency

Symptoms:

* Uniform yellowing of newer leaves, unlike nitrogen deficiency which starts in older leaves.
* Stunted growth and delayed maturity.



Sulphur Deficiency

Cause: Low organic matter content or use of sulfur-free fertilizers.

Remedy:

* Use sulfur-containing fertilizers like ammonium sulfate or gypsum.
* Incorporate organic matter into the soil.

8. Boron (B) Deficiency

Symptoms:

* Brittle leaves with necrotic tips.
* Poor cob development with missing kernels (empty grains).
* Tassels and silk formation are affected, reducing pollination success.

Cause: Low organic matter and high pH soils.

Remedy:

* Use borax or boric acid as a soil amendment.
* Foliar sprays of boron solutions can quickly correct deficiencies.

9. Manganese (Mn) Deficiency

Symptoms:

* Interveinal chlorosis of young leaves, resembling iron deficiency.
* Leaf edges may curl inwards.

Manganese Deficiency

Cause: Alkaline soils or over-irrigation.

Remedy:

* Apply manganese sulfate to the soil or as a foliar spray.
* Reduce irrigation frequency if waterlogging is an issue.

• **Symptoms:**

o Poor root development with stunted shoot growth.

o Younger leaves may display tip burn or curling.

Cause: Acidic soils or competition with magnesium and potassium.

Remedy:

* Lime application to acid soils to improve calcium availability.
* Calcium nitrate can be applied for a quick remedy.

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General Recommendations:

1. Soil Testing: Conduct regular soil testing to identify nutrient levels and deficiencies before planting.
2. Integrated Nutrient Management (INM): Combine chemical fertilizers, organic manures, and bio-fertilizers to ensure a balanced nutrient supply.
3. Irrigation Management: Avoid over-irrigation to prevent nutrient leaching, especially nitrogen and potassium.
4. Timely Interventions: Address deficiencies early during the vegetative stage to avoid yield loss.

By following these guidelines, nutrient deficiency symptoms in Rabi maize can be effectively managed, ensuring healthy crop growth and better yields.

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