



Feed the Future Tanzania Kilimo Tija Project

Technical Bulletin: Plant Nutrition for Avocado Production

INTRODUCTION

The cultivation of avocados (*Persea americana*) in Tanzania is an increasingly lucrative agricultural venture with an ever-increasing demand. As the global demand for this versatile fruit continues to rise, the need for improved plant nutrition strategies becomes increasingly essential. This bulletin focuses on optimal plant nutrition practices tailored to the specific requirements of avocado trees in Tanzanian environments. Proper nutrition is essential for maximizing fruit yield and quality, enhancing disease resistance, and ensuring sustainable farming practices.



Figure 1: A well-fertilized avocado tree from a KTP beneficiary at Njombe DC.
Photo: Fintrac Global Inc.



I. NUTRITIONAL REQUIREMENTS AND FUNCTION

Avocado trees have unique nutritional demands that change across different stages of growth and development. Understanding these needs is crucial for effective nutrient management.

I. PRIMARY NUTRIENTS

- **Nitrogen (N):** Essential for vigorous leaf and stem growth. Over-application can lead to lush foliage at the expense of fruit production. Recommended management includes split applications throughout the growing season to balance growth with fruiting. Nitrogen can be applied through soil applications of urea or ammonium sulphate, or via foliar sprays in a diluted urea solution to quickly address deficiencies during critical growth stages.
- **Phosphorus (P):** Supports the development of robust root systems and aids in flower and fruit formation. Phosphorus is critical during the early planting stages and again as trees mature and prepare for fruiting. It is typically applied to the soil in the form of superphosphate or monoammonium phosphate (MAP) during planting to ensure availability for root development.
- **Potassium (K):** Crucial for fruit development, improving size, color, and taste. It helps in water regulation within the plant and enhances resilience against diseases and pests. Potassium sulphate or potassium chloride (muriate of potash, or MOP) can be applied through soil incorporation before planting or via fertigation during the fruit development stages to enhance fruit quality.

2. SECONDARY NUTRIENTS

- **Calcium (Ca):** Integral for cell integrity and growth, reducing common fruit disorders like blossom end rot. Calcium is often applied via foliar sprays or added to the soil in the form of gypsum to ensure adequate availability.
- **Magnesium (Mg):** A core component of chlorophyll, essential for effective photosynthesis. Magnesium can be corrected with applications of magnesium sulphate, especially in acidic soils, either as a soil amendment or through foliar spraying.
- **Sulphur (S):** Integral for protein synthesis and overall plant vitality. It also helps in chlorophyll formation and improves resistance to cold. Sulphur is often applied in the form of gypsum or ammonium sulphate, especially in alkaline soils where sulphur aids in lowering the soil pH and provides sulphur for protein synthesis.

3. MICRONUTRIENTS

- **Zinc (Zn):** Vital for phytohormone regulation and starch formation. Zinc deficiency can be corrected by applying zinc sulphate, either to the soil or as a foliar spray, to quickly alleviate symptoms like leaf curling or stunted growth.
- **Manganese (Mn):** Involved in photosynthesis and the metabolism of nitrogen. Manganese deficiency often appears as interveinal chlorosis. Manganese sulphate can be applied to the soil or through foliar applications, especially when soil pH is high, which can lock manganese in forms unavailable to plants.
- **Boron (B):** Critical for reproductive growth, including flower retention and fruit set. Boron deficiencies can lead to flower drop and poor fruit set and are typically corrected with applications of borax or solubor, particularly effective as foliar applications.



- **Iron (Fe):** Essential for chlorophyll synthesis. iron chelates are preferred for foliar application or soil drenches, especially in calcareous soils where iron availability is challenged.

II. SOIL AND WATER MANAGEMENT

Ideal soil and water management practices are essential to maximize nutrient efficiency and ensure the health of avocado trees.

- **Soil Testing and Adjustment:** Regular soil testing is crucial for monitoring pH levels, nutrient content, and overall soil health. Adjustments may include the application of lime to increase pH or sulphur to decrease it, depending on the specific needs identified.
- **Irrigation Management:** Implementing efficient irrigation systems such as drip or micro-sprinkler systems can significantly enhance water use efficiency. These systems deliver water directly to the root zone, reducing wastage and preventing potential nutrient runoff.
- **Water Quality Monitoring:** Continuously monitoring the quality of irrigation water, especially its salinity levels, is vital as high salinity can hinder nutrient uptake and affect tree health.

III. FERTILIZATION STRATEGIES

Developing and implementing precise fertilization strategies can significantly influence the productivity and health of avocado orchards.

- **Tailored Fertilizer Programs:** Based on soil and leaf test results, customized fertilizer programs should be developed. These programs should consider the specific growth stage of the trees, targeting nutrient applications to meet their developmental needs.
- **Fertigation:** Utilizing fertigation systems allows for the precise application of soluble fertilizers through the irrigation system, enabling the adjustment of nutrient delivery in real-time based on the trees' growth responses.
- **Micro-dosing:** Applying small, precise amounts of fertilizers through foliar feeds can address immediate nutrient deficiencies without the risk of over-application, ensuring nutrients are directly available to the foliage where they are most needed.

IV. ENVIRONMENTAL INFLUENCES ON NUTRIENT UPTAKE

Environmental factors significantly impact nutrient dynamics and uptake:

- **Climate Factors:** Temperature and humidity levels influence the rate of nutrient uptake and metabolism within the plant. Cooler temperatures might slow down metabolic rates, affecting how quickly nutrients are utilized.
- **Soil Type and Condition:** The physical structure of soil affects its ability to hold nutrients and water. Loamy and well-structured soils with good organic content typically provide better conditions for root growth and nutrient uptake.

V. INTEGRATED NUTRIENT MANAGEMENT

Combining various nutrient sources and management practices will enhance nutrient availability and plant health.

- **Use of Organic Amendments:** Incorporating organic matter such as compost not only improves soil fertility and structure but also improves the soil's water-holding capacity and microbial activity, which are beneficial for nutrient mineralization.



- **Combination of Nutrient Sources:** Using both inorganic and organic nutrient sources can help maintain sustained nutrient availability throughout the growing season. This approach also helps in building up the soil's nutrient bank.

VI. NUTRIENT DEFICIENCY SYMPTOMS

Insufficient soil fertility and nutrient deficiencies significantly impede the growth and development of avocado trees. Nutrient disorders in avocado are prevalent and manifest in several ways. Below are the descriptions of these deficiencies, followed by images of each deficiency¹:

- **Nitrogen (N) Deficiency:** Primarily affects older leaves which become small, narrow, and pale green due to inadequate nitrogen. These leaves may also exhibit a slight upward curl. Overall, the plants appear stunted.
- **Potassium (K) Deficiency:** This occurs due to an imbalance of Calcium (Ca), Magnesium (Mg), and Potassium (K), leading to symptoms such as yellowing from the margins to the veins and subsequent browning of affected areas.
- **Magnesium (Mg) Deficiency:** Common in acidic sandy soils, this deficiency is visible in older leaves as a progressive yellowing from the tips and margins towards the main vein, with a distinctive dark green band remaining along the main veins.
- **Zinc (Zn) Deficiency:** Often due to alkaline soil pH and excessive phosphorus levels in the soil. Symptoms include uneven, blotchy yellowing between the veins. In mild cases, leaves exhibit reduced spacing, resembling a feather duster, with minimal distortion and size reduction. Severe deficiencies lead to significant leaf distortion, reduced size, yellowing, and small, distorted young leaves.
- **Manganese (Mn) Deficiency:** Shows as a loss of color in leaves, generally between the veins, turning them pale green. This deficiency is typically induced by excessive use of lime and is common in coarse, sandy soils.
- **Iron (Fe) Deficiency:** This is a significant issue in high sodic soils (pH > 7.5), exacerbated by elevated soil manganese levels or excessive use of lime and/or phosphorus fertilizers. Symptoms include completely yellow or white upper leaves with green veins, which also appear on the lower young leaves of the summer flush, while spring flush leaves may remain green.
- **Boron (B) Deficiency:** Leads to yellowing and stunted growth of trees. Affected leaves become distorted, and holes may develop, especially evident in the spring leaf flush. This deficiency also impacts the main stem, branches, flowers, and fruits, causing sickle-shaped fruits with navel-like lesions. Proper foliar B concentrations should range from 40 to 80 mg/kg. Misshapen fruit is often correlated with low mean foliar B concentrations below adequate levels.
- **Salt Injury:** Typically results from the use of salty irrigation water and fertilizers high in chloride, causing an even burning of leaf margins which extends towards the veins.
- **Manganese (Mn) Toxicity:** Occurs when soil-available Mn levels exceed 40 ppm and soil pH is below 6. This is often due to waterlogged conditions and continuous application of ammonium fertilizers. Symptoms include irregular yellowing between the leaf veins with small dark spots and occasional burning at the tips, particularly noted during summer leaf growth.

¹ Rajendiran Selladurai & Chandrakant Madhav Awachare (2020) Nutrient management for avocado (*Persea americana* miller), Journal of Plant Nutrition, 43:1, 138-147, DOI: [10.1080/01904167.2019.1659322](https://doi.org/10.1080/01904167.2019.1659322)

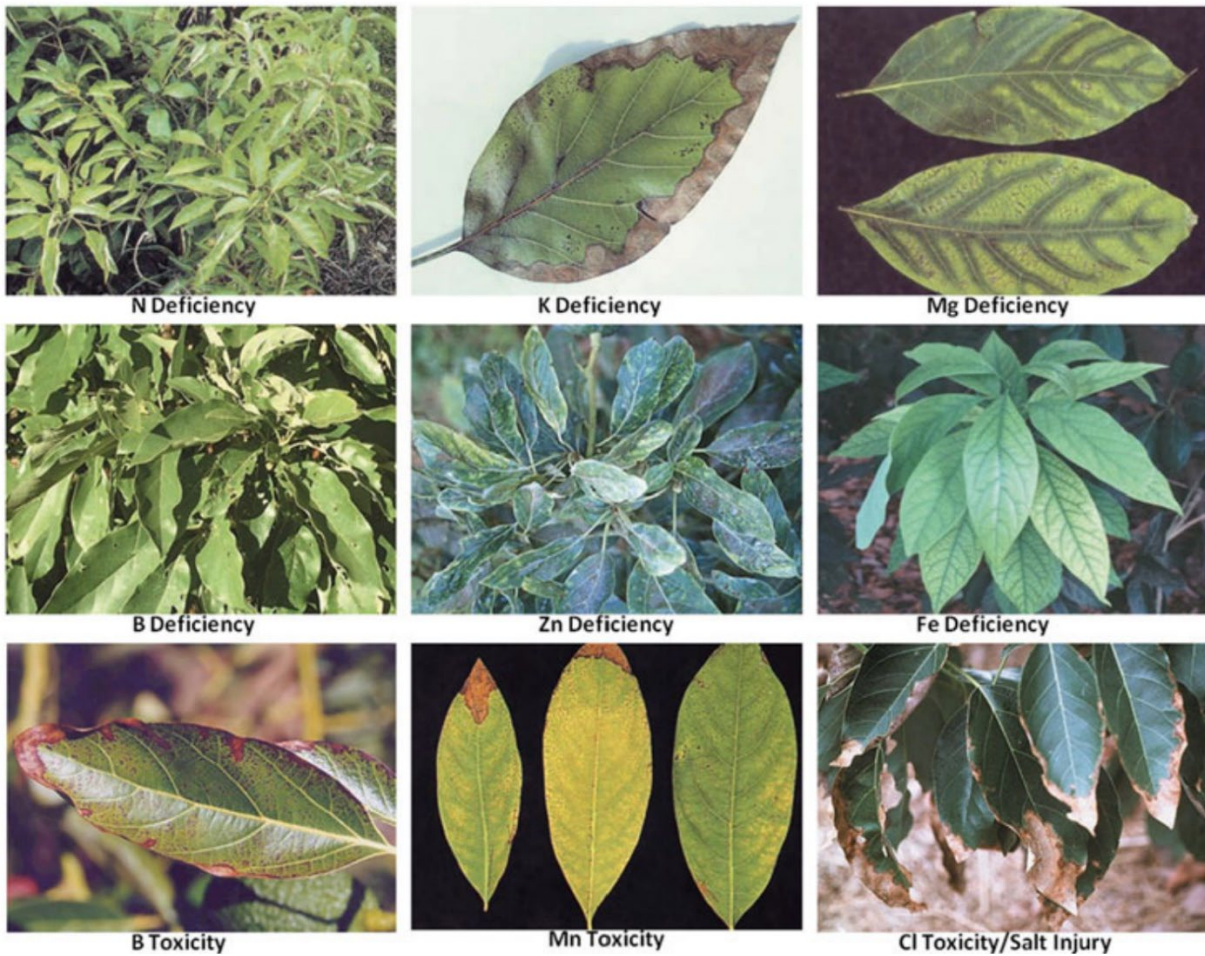


Figure 2: Mineral nutrient deficiency and toxicity symptoms in avocado.

Photo credit: Rajendiran Selladurai & Chandrakant Madhav Awachare (2020) *Nutrient management for avocado (Persea americana miller)*, *Journal of Plant Nutrition*, 43:1, 138-147

CONCLUSION

The right nutrient management can make all the difference in the success of avocado farming. In this bulletin, we've covered the fundamental strategies—from understanding what your trees need, to keeping a close eye on the health of your soil, to adjusting your fertilization tactics specifically for avocado orchards in Tanzania. By putting these strategies into practice, farmers can look forward to richer harvests and more robust fruit. By applying these integrated approaches, growers can enhance fruit quality and yield, ensuring their avocado orchards remain productive and sustainable.