Feed the Future Tanzania Kilimo Tija Project

Technical Bulletin: Plant Nutrition for Irish Potato Production

INTRODUCTION

Irish potatoes (Solanum tuberosum) serve as a staple food and a significant agricultural commodity across the globe. In regions like Tanzania, where the demand for high-quality potatoes is on the rise, the adoption of precision nutrition practices is essential. This bulletin aims to equip growers with the knowledge and strategies to optimize plant nutrition tailored specifically to the needs of Irish potatoes. Enhanced nutrition management is pivotal for increasing tuber yield, improving quality, and extending shelf life, thereby increasing profitability and sustainability. By exploring soil health, nutrient funtions, and effective application techniques, this guide offers practical insights essential for making potato farming more productive and sustainable.

Irish potatoes growing at a farm managed by Isowelo Amcos cooperative in Njombe District, Mtwango Ward, Welela Village. These plants are approximately 45 days away from harvesting. *Photo: Fintrac Global Inc.*

I. NUTRITIONAL REQUIREMENTS AND FUNCTION

Irish potatoes require a balanced supply of macro and micronutrients to grow vigorously and produce high yields. The key nutrients include nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), and micronutrients such as boron (B), iron (Fe), zinc (Zn), manganese (Mn), and copper (Cu).

1. MACRONUTRIENTS

- **Nitrogen (N):** Essential for vegetative growth, nitrogen promotes the development of leaves and stems. It is particularly critical during the early growth stages of potatoes. Over-application can lead to excessive foliage at the expense of tuber formation. Nitrogen can be applied through soil applications of urea or ammonium sulfate and via foliar sprays in a diluted urea solution during critical growth stages.
- **Phosphorus (P):** Important for root development and energy transfer within the plant, phosphorus deficiency can lead to poor root systems and stunted growth. Apply phosphorus as triple superphosphate (TSP) or diammonium phosphate (DAP) during planting to ensure availability throughout the growing season.
- **Potassium (K):** Vital for water regulation, enzyme activation, and disease resistance, potassium helps improve tuber quality and yield. Potassium chloride (muriate of potash) or potassium sulfate are commonly used sources, applied both at planting and as a top dressing.

Recently harvested Irish potatoes grown by a KTP farmer. *Photo: Fintrac Global Inc.*

- **Calcium (Ca):** Necessary for cell wall formation and stability, calcium deficiencies can result in weak plant structures and poor tuber quality. Calcium is often applied via foliar sprays or added to the soil in the form of gypsum.
- **Magnesium (Mg):** A central component of chlorophyll, magnesium is crucial for photosynthesis and overall plant health. Deficiencies manifest as interveinal chlorosis. Magnesium sulfate (Epsom salts) or dolomitic lime can be used to correct deficiencies.
- **Sulphur (S):** Important for protein synthesis and enzyme function, sulphur is often overlooked but essential for healthy plant growth. Sulphur can be supplied through gypsum or ammonium sulphate.

2. MICRONUTRIENTS

- **Boron (B):** Essential for cell wall formation and reproductive development, boron deficiencies can lead to poor tuber quality and reduced yields. Apply boron through foliar sprays or soil applications of borax or boric acid.
- **Iron (Fe):** Necessary for chlorophyll synthesis, iron deficiencies cause chlorosis in young leaves. Iron chelates or ferrous sulfate are effective sources.
- **Zinc (Zn):** Important for enzyme function and hormone regulation, zinc deficiencies can cause stunted growth and small leaves. Zinc sulfate or zinc chelates can be used for correction.
- **Manganese (Mn):** Vital for photosynthesis and nitrogen metabolism, manganese deficiencies result in interveinal chlorosis. Apply manganese sulfate or chelated manganese.
- **Copper (Cu):** Essential for various enzymatic processes, copper deficiencies lead to poor growth and reduced disease resistance. Copper sulfate or chelated copper can be used.

II. SOIL MANAGEMENT AND PREPARATION

Proper soil management is critical to ensure that nutrients are available to the potato plants. Here are some key practices:

- **Soil Testing:** Conduct soil tests to determine nutrient levels and soil pH. This information is vital for developing an effective fertilization plan.
- **pH Management:** Potatoes prefer slightly acidic to neutral soil pH (4.5-7.5). Apply lime to raise pH or sulfur to lower pH as needed, based on soil test results.
- **Organic Matter:** Incorporate organic matter such as compost or well-rotted manure to improve soil structure, water retention, and nutrient availability.
- **Tillage:** Proper tillage practices help create a loose, well-aerated seedbed, which is essential for root development and nutrient uptake.

III. FERTILIZATION STRATEGIES

A well-planned fertilization program is essential for high yields and good tuber quality. Here are some recommended practices:

- **Basal Application:** Apply a balanced fertilizer at planting to provide essential nutrients during the early growth stages. A typical basal fertilizer might include NPK at a ratio of 10:20:20.
- **Top Dressing:** Apply additional nitrogen and potassium during the growing season to support ongoing growth and tuber development. Split applications are often more effective than a single large dose.
- **Foliar Feeding:** Foliar sprays can quickly correct nutrient deficiencies during critical growth stages. Use diluted solutions of urea, potassium nitrate, or micronutrient chelates.

- **Fertigation:** In irrigated systems, fertigation allows for the efficient application of soluble fertilizers through the irrigation system, ensuring nutrients are delivered directly to the root zone.

IV. FERTILIZER APPLICATION FOR RAIN-FED CULTIVATION

In Tanzania, the majority of Irish potato cultivation is rain-fed. As such, it is essential for farmers to follow specific fertilizer application practices to maximize crop yield and quality under these conditions.

Diluted fertilization by drenching should be applied according to the project's fertilization program at least once every 15 days. However, for rain-fed farmers unable to adhere to the diluted fertilization schedule, the following granular fertilizer ratios per acre are recommended:

- **At Planting:** Apply 2 bags of DAP (Diammonium Phosphate) as a broadcast application. Never apply DAP in strips.
- **Earthing Up/Hilling (20-25 Days After Planting):** Apply a mixture of 1 bag of Urea and 2 bags of MOP (Muriate of Potash) during the hilling practice.
- **55-65 Days After Planting:** Apply another mixture of 1 bag of Urea and 2 bags of MOP.

Important considerations:

- Ensure all fertilizers applied are covered with soil to prevent nutrient loss.
- Soil moisture should be at field capacity during fertilization to enhance nutrient absorption.
- In the southern highlands of Tanzania, liming is critical due to acidic soil conditions. Regular liming activities help to neutralize soil acidity and improve nutrient availability.

A KTP agronomist conducts a yield test to sample the number of tubers and size of tubers per shoot. *Photo: Fintrac Global Inc.*

V. ENVIRONMENTAL INFLUENCES ON NUTRIENT UPTAKE

Factors such as climate, soil type, and environmental conditions play a significant role in nutrient dynamics and plant health.

- **Climate Factors:** Temperature and humidity can significantly affect the metabolic rates of plants and thus nutrient uptake. Cool temperatures can slow nutrient uptake, while excessively high temperatures can cause nutrient imbalances.
- **Soil Type and Condition:** The texture, structure, and organic content of the soil can influence its water-holding capacity and nutrient availability. Well-structured soils with good

organic matter content provide an optimal environment for root growth and nutrient absorption.

- **Water Management:** Adequate and consistent irrigation is essential for nutrient uptake. Both waterlogged and dry soil conditions can hinder nutrient absorption. Drip irrigation is often recommended to maintain consistent soil moisture levels and prevent nutrient leaching.

VI. INTEGRATED NUTRIENT MANAGEMENT

Combining various nutrient sources and management practices can enhance soil health and crop productivity.

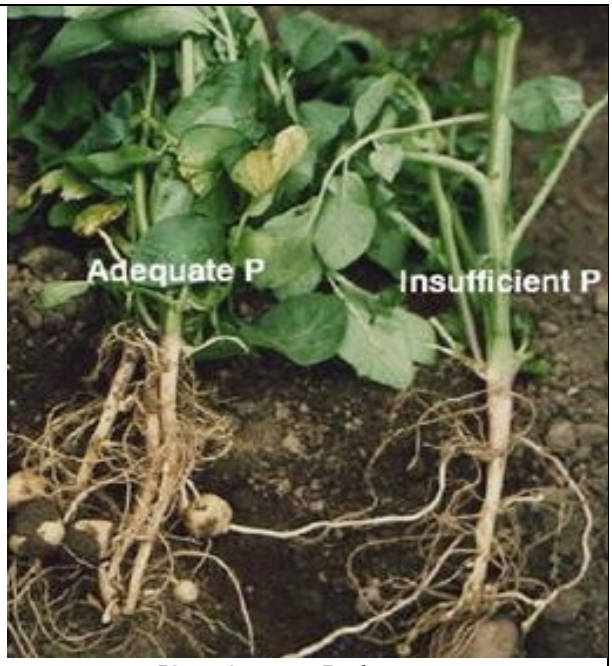
- **Organic Amendments:** Incorporation of organic matter such as compost improves soil health, enhances nutrient availability, and supports beneficial microbial activity. Organic matter also improves soil structure and water retention, which are critical for nutrient uptake.
- **Combination of Nutrient Sources:** Using both inorganic fertilizers and organic amendments ensures a sustained nutrient supply and supports ecological farming practices. For example, integrating green manures and cover crops can help maintain soil fertility and reduce dependency on chemical fertilizers.
- **Balanced Fertilization:** Ensuring a balanced supply of macro and micronutrients prevents deficiencies and toxicities, promoting healthy plant growth and optimal yields. Regular soil and tissue testing can help in making informed decisions about fertilizer applications.

VII. NUTRIENT DEFICIENCY SYMPTOMS

Recognizing and addressing nutrient deficiencies early can prevent yield losses and quality issues. 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 deficiency:

- **Nitrogen (N) Deficiency:** Symptoms include yellowing of older leaves and stunted growth. Correct with nitrogenous fertilizers like urea or ammonium nitrate.
- **Phosphorus (P) Deficiency:** Characterized by dark green or purplish leaves and poor root development. Apply phosphorus fertilizers like superphosphate or DAP
- **Potassium (K) Deficiency:** Causes yellowing or browning of leaf margins and reduced tuber quality. Correct with potassium sulfate or muriate of potash.
- **Magnesium (Mg) Deficiency:** Identified by interveinal chlorosis in older leaves. Use magnesium sulfate (Epsom salts) or dolomitic lime.
- **Sulphur (S) Deficiency:** Symptoms include yellowing of younger leaves and overall stunted growth. Apply sulphur-containing fertilizers like gypsum.
- **Boron (B) Deficiency:** Symptoms include distorted growth, brittle leaves, and blackened growing points. Boron deficiencies can lead to poor tuber quality and reduced yields. Correct with borax or boric acid applications.
- **Micronutrient Deficiencies:** Specific symptoms vary but generally include chlorosis, stunted growth, and poor tuber development. Use appropriate chelated micronutrients or foliar sprays to correct deficiencies.

Nitrogen Deficiency



Phosphorous Deficiency

Magnesium Deficiency

Sulphur Deficiency

Potassium Deficiency

Calcium Deficiency

Boron Deficiency

Manganese Deficiency

Photos showing common symptoms due to various nutrient deficiencies. *Photo credit: www.yara.co.uk*

CONCLUSION

Implementing advanced plant nutrition strategies for Irish potatoes can significantly enhance crop yield and quality. By understanding and applying the principles outlined in this bulletin, growers can ensure their potato crops are healthy, productive, and sustainable. Regular monitoring and adjustments ensure that nutrient needs are met throughout the growing season, contributing to long-term soil health and agricultural profitability.

A harvest of Irish potatoes in Mtwango Ward, Njombe District Council. One bag of Irish potatoes weighs approximately 100kg and sells for around 65,000 TZS to 90,000 TZS ($24.50 to $34.00), depending on market trends. *Photo: Fintrac Global Inc.*