

Nutritional disorders in tropical tuber crops: Diagnosis and management

Tropical tuber crops such as cassava, sweet potato, yams, taro, and elephant foot yam are commonly cultivated in acidic, nutrient-deficient soils, making them vulnerable to nutritional disorders. These disorders arise due to imbalances or deficiencies of essential nutrients, including primary (N, P, K), secondary (Ca, Mg, S), and micronutrients (Fe, Cu, Mn, Zn, B). Diagnosis is primarily through visual symptom observation, soil analysis, and plant tissue analysis. Each nutrient displays characteristic symptoms—such as chlorosis, necrosis, or distorted growth—depending on its mobility within the plant. Management includes soil amendments, foliar applications, and use of customized fertilizers based on crop-specific nutrient requirements. Strategies like foliar sprays of urea, SOP, CaNO₂, and micronutrients (Zn, B, Fe) are used to mitigate acute symptoms. Prophylactic measures, including lime or dolomite application in acidic soils, are also critical. Early detection and targeted nutrient management are essential for maintaining crop health and improving productivity in tropical tuber crops.

Keywords: Micronutrient deficiency, Nutrient management, Nutritional disorders, Soil and plant analysis, Tuber crops

TROPICAL tuber crops such as cassava, sweet potato, yams, taro, and elephant foot yam are vital for food and nutritional security in many developing regions. However, their productivity is often constrained by nutritional disorders arising from imbalanced or deficient soil nutrients. These crops are typically grown in acidic, low-fertility soils where essential nutrients may be inadequate. Understanding the symptoms, causes, and management of these disorders is crucial for improving crop health, yield, and promoting sustainable cultivation practices across diverse agro-ecological conditions.

Essential nutrients and soil constraints in tuber crop cultivation

There are 16 essential elements required for the growth and yield of crops. These are classified as primary nutrients (Nitrogen: N, Phosphorus: P, Potassium: K), secondary nutrients (Calcium: Ca, Magnesium: Mg, Sulphur: S), and micronutrients (Iron: Fe, Copper: Cu, Manganese: Mn, Zinc: Zn, Boron: B). These nutrients play a vital role in the growth and productivity of tuber crops like cassava, sweet potato, elephant foot yam, yams, taro, tannia, and minor tubers such as arrowroot and Chinese potato. All essential nutrients are important for completing a plant's life cycle, and the growth and yield of a crop are affected by the nutrient that is most limiting in the soil.

Tuber crops are mostly cultivated in laterite (Ultisols)

and sandy loam soils (Entisols), which are acidic (pH 4–6), with medium to high organic carbon, low nitrogen, high to very high available phosphorus, low to medium exchangeable potassium, low calcium and magnesium, sufficient sulphur, sufficient levels of Fe, Cu, Mn, and Zn, and low to very low boron. Nutritional disorders are usually diagnosed through visual observation of symptoms, soil analysis, and plant tissue analysis to confirm the deficiency or toxicity of specific nutrients. Some crops and even specific varieties may exhibit sensitivity to certain nutrients, so the manifestation of symptoms may not be consistent across all crops or varieties, even under similar soil conditions.

NUTRIENT DEFICIENCY SYMPTOMS IN TUBER CROPS

The mobility of the nutrient in the plant system decides the leaf position of occurrence of the symptom in the plant. Calcium, boron and sulphur are immobile causing the symptom to occur in the growing tips and iron and manganese are intermediate in mobility and other nutrients are mobile exhibiting the symptom in the old lower leaves.

Nitrogen

General stunted growth and yellowing causing necrosis and drying of the lower leaves initially and in severe cases the whole plant will die.



Cassava Lesser yam Elephant foot yam

margins and tips of the leaves turn necrotic and dry under acute deficiency. Lime and K induced Mg deficiency also can be seen in cassava.



Cassava Sweet potato Tannia Photo Elephant foot yam

Phosphorus

Purplish discolouration of older leaves followed by its yellowing, drying and shedding is the common symptom manifested in P deficient crop.



5 Sweet potato

Sulphur

Yellowing of the younger leaves is commonly seen



Cassava

Potassium

K deficiency symptom is usually seen as drying of the margins and tips of older leaves. In severe cases, there is complete drying of the lower leaves resulting in the destruction of the whole plant.



Cassava Sweet potato Tannia Photo Elephant foot yam

Iron

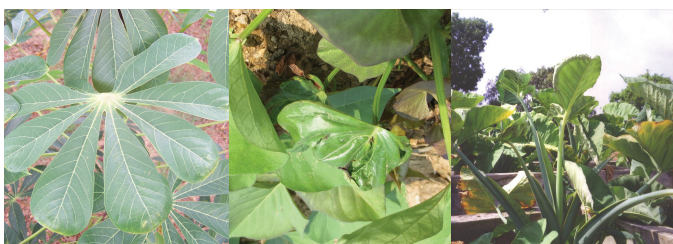
Fe deficiency is associated with high pH alkaline soils (pH above 8) where excess lime induces Fe deficiency symptom (Lime induced Fe deficiency) in the form of uniform chlorosis of the entire leaves of the plant and associated stunted growth. In severe situations, there is drying and complete devastation of the crop.



Lime induced iron chlorosis in cassava

Calcium

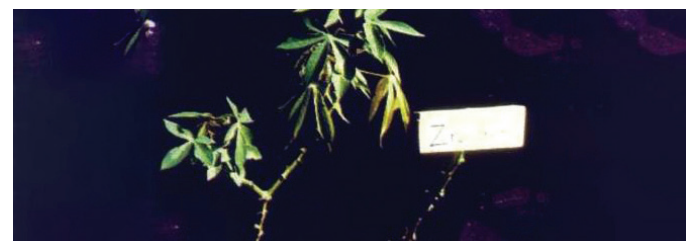
The younger leaves manifest the symptoms as rounding/curling the tip of leaves from middle to top depending on the variety in the case of cassava. Though cassava is acid tolerant, Ca sensitivity is seen only in some varieties. In sweet potato and tannia, the younger leaves show cupping, crinkling and curling followed by yellowing, drying and shedding of these leaves.



Cassava Sweet potato Tannia Photo

Zinc

Usually seen alkaline soils of high pH. Symptoms appear as interveinal chlorosis of the middle to upper leaves and leaflets droop and the petiole become horizontal with widening of the angle between petiole and main stem.



Cassava

Magnesium

The typical symptom of Mg deficiency is interveinal chlorosis of the lower leaves. The lamina area between veins turns yellow with veins remaining dark green. The

Boron

The emerging tip portion shows the symptom as

rosette/broom like. The plant growth is adversely affected as the growing tender portion has small sprouts in clusters or bunches bearing reduced/crinkled leaves giving a distorted appearance to the plant. Tubers show cracking in the skin and rind and the flesh turns woody.



Cassava



Sweet potato

Boron toxicity symptoms also was noticed in crops like cassava and elephant foot yam with excess application of B containing fertilizers either through soil or foliar. In cassava, the symptom is seen as drying and shedding of the leaves. However, it will recoup after 15-30 days if there is sufficient moisture in the soil. Elephant foot yam plant manifest distorted growth as irregular and dwarf crop stature, tapering pseudostem and thin, pale and unhealthy crop stand. Though the plant dry up initially, later, it will continue to grow as a distorted plant yielding very poor.



Cassava

Elephant foot yam

Imbalanced application of nutrients

Under field situation with indiscriminate application of fertilizers like higher levels of N and P without K application can cause shedding of healthy leaves in the

middle part of the plant. The existing leaves droop down with petioles bending down. Leaves above the middle may become yellow, dry and fall down in severe cases.



Cassava

Confirmation of nutrient deficiencies through soil and plant analysis

Soil analysis

The deficiency due to the suspected nutrients is compared with soil critical level of that nutrient to confirm the same. The soil critical level for cassava is reported by Howeler (1983). If specific critical levels as above is not available for the crop, the general critical levels are used to diagnose the deficiency/toxicity of the particular nutrient in the soil.

Plant analysis

If the soil analysis could not give a valid inference on the nutrient disorder, plant analysis is done for the suspected nutrients and nutrient content in the index leaf tissue is used to arrive the conclusion. The index leaf tissues and nutrient concentration in these leaves for all tuber crops (Cassava: Howeler, 1983; Sweet potato: Sullivan et al., 1997; Yams, taro, tannia, elephant foot yam: Kabeerathumma et al., 1987) were reported.

MANAGEMENT OF NUTRITIONAL DISORDERS

Application of recommended dose of nutrients (major, secondary and micronutrients) either as per PoP or as per soil test data needs to be done to avoid the occurrence of symptom. In case of manifestation of the symptom, the following management measures can be resorted to.

Nitrogen

Foliar application of 0.1% urea is useful to save the crop from complete loss when there is severe yellowing and there is not sufficient moisture in the soil.

Phosphorus

Foliar application of 19:19:19 @ 0.5-1% can correct severe occurrence of P deficiency.

Potassium

Application of muriate of potash (MoP) in the soil during initial stages of symptom occurrence if there is soil moisture. Foliar application of potassium sulphate (SOP) @ 0.5-1% can be done in case of severe symptom manifestation.

Calcium

As a prophylactic measure to avoid the symptom manifestation, apply lime/dolomite in acid soils @1-2 t ha⁻¹. Application of calcium nitrate (CaNO₃) as foliar spray @ 0.5-1% can be done to manage the symptoms by preventing the occurrence in the emerging leaves.

Magnesium

In acid soils, basal soil application of dolomite @1-2 t ha⁻¹ can prevent the occurrence of Mg deficiency. Foliar application of MgSO₄@0.5-1% can be done depending upon the sensitivity of the crop to sulphate (SO₄) injury once the symptom appears. In the case of crops like tannia, which are sensitive to Al toxicity, avoid application of MgSO₄.

Lime induced iron chlorosis

The problem usually noticed in alkaline soils can be overcome by basal soil application of S @10-20 kg ha⁻¹ as elemental sulphur or gypsum or use of sulphur containing fertilizers like ammonium sulphate, single super phosphate or potassium sulphate. After the manifestation of the symptom, spraying a mixture of 1% ferrous sulphate along with 1% zinc sulphate can be resorted to.

Zinc

In cassava, the occurrence of Zn deficiency disorders can be prevented by soil application of ZnSO₄ @12.5 kg ha⁻¹ after top dressing and in case of manifestation of

symptom, foliar application of 0.5-1% can manage the problem.

Boron

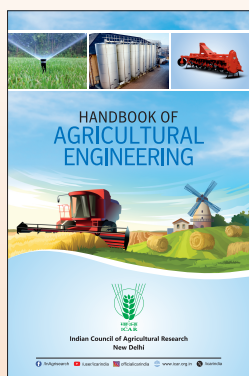
For cassava, the general recommendation is soil application of either borax or boric @ 10 kg ha⁻¹. In case of the manifestation of symptom, combined foliar application of CaNO₃ (0.5%) along with solubor (0.05-0.1%) at fortnightly intervals can be done till the plant recoup. In sweet potato, if B deficiency is suspected in tuber in the previous season crop, basal application of solubor @5 kg ha⁻¹ followed by top dressing @ 2.5 kg ha⁻¹ can be done at 50-60 days after planting (DAP). If B seems to be low in the soil, continuous application of B needs to be done. The same application strategy as in cassava can be resorted to after the appearance of the symptom in sweet potato.

In addition to the above measures, application of customized fertilizers specific to crops and agro ecological units containing the essential nutrients developed based on soil nutrient status and plant nutrient requirement can be a very good option to prevent the occurrence of nutritional disorders in crops.

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