

d. Boron



Symptoms

Management

- Leathery appearance of the young tender leaves
 - Rosette appearance of the apical portion of the vines
 - Black dots on the tuber surface making them not suitable for markets
 - Tubers seen cracked severely with the flesh becoming woody
- If B deficiency is suspected in tubers in the previous season crop, basal application of solubor @ 5 kg ha⁻¹ followed by top dressing @ 2.5 kg ha⁻¹ can be followed at 50-60 days after planting (DAP)
 - If B seems to be low in the soil, continuous application of B need to be done based on soil test
 - After the appearance of symptom, foliar application of CaNO₃ (0.5%) along with solubor (0.05-0.1%) (combined) at fortnightly intervals till the plant recover fully

a. Nitrogen

3. Elephant foot yam

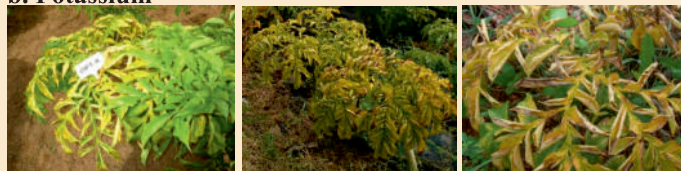


Symptoms

Management

- General yellowing and reduction in plant growth
 - In severe cases, the crop dry up and die
- Application of the recommended dose of FYM @ 25 t ha⁻¹ and NPK
 - After the occurrence of the symptom, foliar application of 0.1% urea may result in regaining the general vigour of the plant

b. Potassium



Symptoms

Management

- Yellowing of the crop with tips and margins of the leaflets gets dried up resulting in the complete death of the crop
- Application of FYM @ 25 t ha⁻¹ along with K @ 150 kg ha⁻¹
 - After the occurrence of the symptom, foliar application of SOP @ 1% can be tried

c. Magnesium



Symptoms

Management

- Interveinal chlorosis of the leaflets later changing to complete drying of the crop
- Application of dolomite @ 2 t ha⁻¹ or MgSO₄ @ 80 kg ha⁻¹ at the time of planting
 - After the occurrence of the symptom, foliar application of MgSO₄ @ 0.5% can help to recover the crop

a. Nitrogen

4. Lesser yam



Symptoms

Management

- General yellowing and reduction in plant growth
 - In severe cases, the crop dry up and die
- Application of the recommended dose of FYM @ 12.5 t ha⁻¹ and N @ 80 kg ha⁻¹
 - After the occurrence of the symptom, foliar application of urea @ 0.1% may help to recover the general vigour of the plant

b. Magnesium



Symptoms

Management

- Interveinal chlorosis of the lower leaves, later gets dried up and shed
- Application of dolomite @ 2 t ha⁻¹ or MgSO₄ @ 20 kg ha⁻¹ at the time of planting
 - After the occurrence of the symptom, foliar application of MgSO₄ @ 0.5% can help to recover the crop

a. Magnesium

5. Tannia



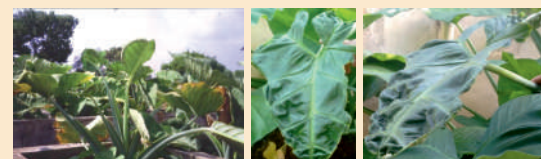
Symptoms

- Interveinal chlorosis of the lower leaves, later spreading to the younger leaves and the entire plant gets dried up resulting in the complete devastation of the crop

Management

- Application of dolomite @ 1 t ha⁻¹ at the time of planting
- After the occurrence of the symptom, foliar application of MgSO₄ @ 0.5% along with ZnSO₄ @ 0.5% can help to recover the crop
- When tannia is grown in acidic soils of Kerala viz., laterite and sandy loam soils, in order to avoid any sort of symptom manifestation in the form of acidity (subsoil acidity) induced Mg deficiency, the following things can be taken care of
- Ensure 25-50% shade (plant under coconut, arecanut, banana, rubber)
- Apply dolomite @ 100 g per plant as basal in the pits
- Ensure good aeration with proper moisture in the root zone
- Avoid using more of urea. Apply 25% of the recommended dose of N (80 kg ha⁻¹) as urea, the remaining as organic manures in the form of FYM, neemcake, green manuring *in situ* with leguminous crops and N use efficient bio fertilizers
- Apply the recommended dose of P @ 50 kg ha⁻¹
- Avoid planting tannia continuously in the same field (follow crop rotation)

b. Calcium



Symptoms

Management

- Cupping, crinkling and curling of the young leaves followed by yellowing, drying and shedding of the leaves
- Application of liming materials like lime/dolomite @ 1 t ha⁻¹
 - After the occurrence of the symptoms, foliar spray with calcium nitrate 0.5% at fortnightly intervals till new leaves without symptoms appear

c. Potassium



Symptoms

Management

- Yellowing of the crop with tips and margins of the leaves turning dry resulting in the complete drying and death of the crop
- Application of FYM @ 25 t ha⁻¹ along with K @ 150 kg ha⁻¹
 - After the occurrence of the symptom, foliar application of SOP @ 1% can be tried

Toxicity disorder in tuber crops due to Boron

1. Cassava



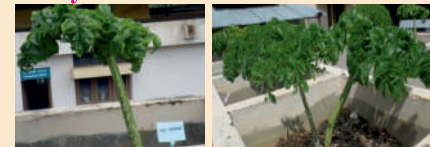
Symptoms

- Drying and shedding of the leaves.
- The plant will recoup after 15-30 days, if there is sufficient moisture in the soil

To prevent B toxicity

- While applying B in both soil and plant, care should be taken to restrict the dosage of foliar spray concentration to maximum of 0.1% and applications should be on the critical growth stages like maximum vegetative growth (4-5 MAP), tuber bulking (6-7 MAP) and one month after the application (7-8 MAP)
- Soil application must be based on soil test data for B

2. Elephant foot yam



Symptoms

- Distorted growth of the plant with irregular and dwarf stature of the crop
- Later, though the plant dry up it will come up and grow as a distorted plant yielding very poor

To prevent B toxicity

- Soil test based need based application of B in soil
- Apply B in soil if the soil status is below 0.5 ppm
- If any visual symptom of B toxicity occur in the plant manifested in the form of reduced growth, tapering of the pseudostem, thin, pale and unhealthy appearance of the crop, apply solubor as foliar spray up to 0.1% during critical growth stages of the crop as described in the case of cassava

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NUTRITIONAL DISORDERS IN TROPICAL TUBER CROPS: SYMPTOMS AND MANAGEMENT



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Plants require 17 essential elements for their growth and yield. Among these, the primary nutrients like nitrogen (N), phosphorus (P), potassium (K), secondary nutrients like calcium (Ca), magnesium (Mg), sulphur (S) and micronutrients like iron (Fe), copper (Cu), manganese (Mn), zinc (Zn) and boron (B) are important for tuber crops namely cassava, sweet potato, elephant foot yam, yams, taro and tannia. In Kerala, tuber crops are mostly grown in laterite (Ultisols) and sandy loam soils (Entisols) which are acidic (pH 4-6) with organic carbon medium to high (>0.5%), N, low (<280 kg ha⁻¹), available P, high to very high (>25 kg ha⁻¹) and exchangeable K, low to medium (<280 kg ha⁻¹). As regards to the secondary nutrients, Ca and Mg are low, less than their soil critical levels of 300 and 120 ppm respectively. Farmers are using factomphos (NPKS @ 20:20:0:13), which contains sufficient S, hence most of the soils are sufficient in S. Micronutrients like Fe and Mn are high in these soils. Cu and Zn are at satisfactory levels. However, B status of these soils are low and below the critical level of 0.5 ppm.

Since the biological efficiency of tropical tuber crops are very high, producing tuber yield of 20-100 t ha⁻¹, the replenishment of the nutrients uptake need to be done through different nutrient management practices. If proper nutrient replenishment is not done, the crop will manifest different types of nutritional disorders in the form of visible symptoms in different plant parts especially leaves and tubers. Usually, in tuber crops, the inadequate availability of nutrients like N, P, K, Ca, Mg, Zn and B in soil could cause nutrient deficiency disorders and are explained in detail with symptoms and their management.

1. Cassava

a. Nitrogen



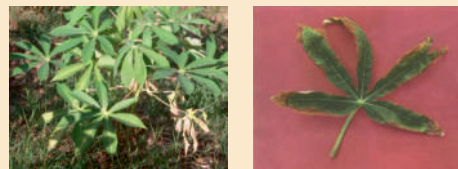
Symptoms

- General stunted growth and yellowing affecting mostly the lower leaves
- In severe cases, necrosis and drying of the older leaves and later the whole plant will die

Management

- Application of organic manures and NPK fertilizers as per the recommended package of practices (PoP) as NPK @100:50:100 kg ha⁻¹ and farm yard manure (FYM) @ 12.5 t ha⁻¹
- If severe yellowing is noticed and if there is not sufficient moisture content in the soil, foliar application of 0.1% urea can be done to save the crop from complete loss

b. Potassium



Symptoms

- Symptoms appear in the old lower leaves as drying of the margins and tips
- In severe cases, complete drying of the lower leaves resulting in the death of the plant

Management

- Application of organic manures and NPK fertilizers as per the recommended PoP
- In the case of symptom initiation, apply muriate of potash (MOP) in the soil provided there is moisture
- In later stages of symptom manifestation, foliar application of potassium sulphate (SOP) @0.5-1% can be done

c. Calcium



Symptoms

- Ca being immobile in the plant system, symptoms occur only in younger leaves
- The tip of leaves from middle to top of the plant turn round in appearance with slight curling of the leaflets depending upon the variety

Management

- Application of lime/dolomite in acid soils @1-2 t ha⁻¹ to avoid the symptoms to manifest
- If symptoms appear, apply calcium nitrate (CaNO₃) as foliar spray @ 0.5-1% to manage the symptoms so that the new emerging leaves can be saved from the deficiency

d. Magnesium



Symptoms

- Interveinal chlorosis of the lower older leaves is the typical symptom of Mg deficiency
- Symptom appear as yellow discolouration of the lamina area between veins where the veins remain dark green
- In severe cases, the margins and tips of the leaves turn necrotic and dry

Management

- Basal soil application of dolomite @1-2 t ha⁻¹ or magnesium sulphate (MgSO₄) @ 20 kg ha⁻¹ after top dressing
- In severe cases of symptom manifestation, foliar application of MgSO₄@0.5-1% can be done depending upon the sensitivity of the variety to sulphate (SO₄) injury

e. Imbalanced nutrient application



Symptoms

- Application of higher levels of N and P without K application result in situation similar to above
- Shedding of healthy leaves at the middle of the plant and drooping down of the leaves with petioles bending down
- In severe cases, leaves above the middle portion may become yellow, dry and fall down

Management

- Balanced application of NPK as per PoP or soil test data
- Soil application of MOP at the initial stages of symptom manifestation
- Foliar application of sulphate of potash (SOP) @ 0.5-1% to save the new emerging leaves from symptom manifestation

f. Boron



Symptoms

- Boron being immobile, symptom manifestation is seen on the emerging tender top portion
- Appear as rosette/broom like with small sprouts in clusters or bunches bearing reduced/crinkled leaves giving a distorted appearance to the plant adversely affecting the growth of the plant
- In tubers, cracking of the skin and rind of the tubers with the flesh turning woody

Management

- Soil application of either borax or boric acid based on soil test data (general recommendation of borax @ 10 kg ha⁻¹)
- Once the symptom is seen, foliar application of CaNO₃ (0.5%) along with solubor (0.05-0.1%) (combined) at fortnightly intervals till the plant recoup

g. Lime induced iron chlorosis



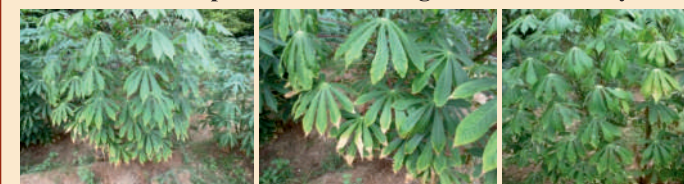
Symptoms

- Usually seen in alkaline soils with high pH (above 8)
- The symptom is manifested as iron deficiency induced through excess lime (Lime induced Fe deficiency)
- Uniform chlorosis of the entire leaves of the plant with stunted growth and drying in severe cases
- Extreme situations result in complete devastation of the crop

Management

- On visual observation of the same, spraying a mixture of 1% ferrous sulphate along with 1% zinc sulphate can rectify the problem
- 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 as basal application can prevent the manifestation of the same in alkaline soils

h. Lime induced potassium and magnesium deficiency



Symptoms

- Usually encountered in alkaline soils of high pH
- The antagonistic interaction of Ca with K and Mg due to high Ca in alkaline soils can cause the deficiency of K and Mg.
- K deficiency is manifested as marginal and tip drying of the lower leaves with slight chlorotic appearance and in severe cases, the plant will dry and die.
- Lime induced Mg deficiency appear as interveinal chlorosis of the lower leaves

Management

- Manage the alkalinity of the soil through 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
- Soil application of MOP at the recommended dose
- In severe K deficient plants, foliar application of SOP @0.5-1% can rectify the emerging leaves from manifesting the same
- In the case of Mg deficiency, soil application of MgSO₄ @ 20 kg ha⁻¹ as basal or after top dressing can prevent the symptom manifestation
- In cases of symptom expression, foliar application of 0.5-1% MgSO₄ can prevent further symptom manifestation

i. Zinc



Symptoms

- Usually seen in alkaline soils of high pH
- Interveinal chlorosis of the middle to upper leaves
- Leaflets droop and the petiole become horizontal with widening of the angle between petiole and main stem

Management

- Soil application of ZnSO₄ @12.5 kg ha⁻¹ after top dressing to prevent the occurrence
- Foliar application of 0.5-1% ZnSO₄ in case of occurrence of the symptom to prevent further manifestation

2. Sweet potato

a. Phosphorus



Symptoms

- Symptom manifested as purplish discolouration of older leaves
- These discoloured leaves will turn yellowish and later dry and shed

Management

- Application of recommended dose of P (25 kg ha⁻¹) or as per soil test data even in high P soils as basal application
- In severe P deficiency, foliar application of 19:19:19 @ 0.5-1% can correct the symptom manifestation

b. Potassium



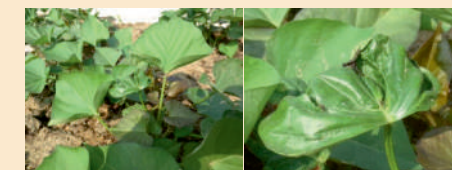
Symptoms

- Marginal curling inward and drying of the older leaves followed by yellowing of the leaves and complete drying and death of the plant

Management

- Application of K as per POP (50 kg ha⁻¹) or soil test data in two splits and if the soil is too deficient, the K rate can be increased to 25-50% more of POP
- After manifestation of the symptom, further expression can be prevented by foliar application of SOP @0.5-1% at fortnightly intervals till the symptom disappear

c. Calcium



Symptoms

- Cupping, crinkling and curling of the young leaves followed by yellowing, drying and shedding of the leaves

Management

- Application of liming materials like lime or dolomite @ 2 t ha⁻¹
- After the occurrence of the symptom, foliar spray with 0.5% CaNO₃ at fortnightly intervals till new leaves without symptoms appear