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Nutritional Disorders in Fruit Plants and Their Management in Nursery

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Plant growth, development and quality of fruit plants in nursery are largely influenced by the environmental conditions, soil factors, irrigation water and plant nutrition. Disturbance in plant metabolic activities from an excess or deficit of environmental conditions like light, temperature, aeration, mismanagement of canal irrigation as well as brackish groundwater irrigation, diminishing use of organic manures, unbalanced NPK fertiliser applications etc are resulting in salinity, nutritional imbalances and nutritional disorders. To get high quality nursery plants, correctly diagnosing the nutrient deficiency symptoms through soil or tissue nutrient analysis before visual symptoms are expressed is most important for taking timely corrective measures in nursery.

Introduction

Plant growth, development and quality of fruit plants in nursery are largely influenced by the environmental conditions, soil factors, irrigation water and plant nutrition. Accumulation of excessive soluble salts and/or exchangeable sodium (Na^+) is a characteristic of arid and semi-arid lands and is spreading widely covering the Indo-Gangetic plains, arid regions and coastal areas. Disturbance in plant metabolic activities from an excess or deficit of environmental conditions like light, temperature, aeration, mismanagement of canal irrigation as well as brackish groundwater irrigation, diminishing use of organic manures, unbalanced NPK fertiliser applications etc are resulting in salinity, nutritional imbalances and nutritional disorders. Salt-affected soils differ from the normal soils in many respects and vary from one place to another depending upon climate, topography, land use, hydrology and drainage. Excessive accumulation of salts in the root zone soil is a serious threat to nursery plants since salinity delays and depresses seedling emergence, reduces seedling biomass, photosynthetic capacity, stomata conductance due to alterations caused in the mineral status of young plants. Salinity increases Na^+ and Cl^- contents of roots and aboveground parts, but reduces the P, K^+, $Ca^{2+}$and Mg^{2+}, Cu, Zn, Fe, Mn contents. An imbalance of essential nutrients contributes to the growth reduction in seedling plants and rootstocks. Further salinity and sodicity generally exist in the hyper thermal temperature regime, conducive for rapid decomposition of organic matter; and thus, contain very low organic matter and soil fertility.

Soil pH another important soil factor plays a major role in nutrient availability. Minerals such as iron, zinc, copper, manganese, boron are more available at pH below 5.5 and are less available at pH above 5.5; while nitrogen, potassium, magnesium, calcium, sulphur, molybdenum are more available at pH above 6.5 and are less available at pH less than 6.5. Phosphorus is more available at pH 6-7. Ideal pH for fruit plants in nursery is around 6.5 for

field soil and around 5.5-6.0 for artificial growing media made with coco peat, peat moss or composted bark. When a nutrient is deficient, visible deficiency symptoms appear first on older leaves or new leaves based on their mobility in plants. Some nutrients are highly mobile while some others are immobile or moderately mobile. For example, nutrients like nitrogen, phosphorus, potassium, magnesium, sulphur are mobile and they move up and down the plant in both acropetal and basipetal directions through xylem and phloem. When any of these nutrients are in deficit, deficiency symptoms first appear on older leaves**.** This is because, when a nutrient is deficient in younger leaves, it moves from older leaves to younger leaves. Whereas elements like calcium, iron, zinc, molybdenum, boron, copper, manganese are immobile and they move up the plant only in acropetal direction through xylem. When any of these nutrients are deficit, deficiency symptoms first appear on new leaves**.** When these immobile nutrients are deficient in young leaves, they cannot move from older leaves to young leaves.

Table 1: Mineral nutrients and their functions in plants

Nutrient	Function
Nitrogen	Nitrogen is component of chlorophyll; amino acids, nucleic acids (RNA and DNA); some auxins and cytokinins, proteins and enzymes.
Phosphorus	Phosphorus is component of the high energy compounds ATP, NADPH and NADP; phospholipids and nucleic acids (DNA and RNA).
Potassium	Potassium is needed for photosynthesis, protein and enzyme synthesis and activation, and for maintaining proper water balance.
Magnesium	Magnesium is component of chlorophyll and activates many enzymes.
Calcium	Calcium is required for normal cell division, meristem growth and membrane stability. Component of Ca-pectate in middle lamella of cell wall that cement cells together.
Sulphur	Sulphur is component of several amino acids (methionine, cystine, cysteine).
Iron	Iron is required for chlorophyll synthesis. Component of many enzymes and carriers, especially those of electron transport chain.
Zinc	Zinc is required for tryptophan, hence auxin (IAA), synthesis.
Manganese	Manganese is required for chlorophyll synthesis and for activating many enzymes.
Copper	Copper is component of many enzymes and carriers, especially those of electron transport chain. It is **r**equired for chlorophyll synthesis.
Boron	Boron is required for translocation of carbohydrates and hormones, complete flowering and fruit development.
Molybdenum	Molybdenum is component of enzymes in N metabolism (nitrate to organic N) and nitrogen fixation (N gas to ammonia).
Chlorine	Chlorine is needed for Oxygen evolution in photosynthesis and for stomata functioning.
Nickel	Nickel is component of several enzymes, especially urease that breaks down urea.

Correctly diagnosing the nutrient deficiency symptoms is most important for taking timely corrective measures. To get high quality nursery plants, micronutrient deficiencies have to be detected through soil or tissue nutrient analysis before following visual symptoms are expressed.

- Chlorosis is the yellowing of leaf tissue and can be caused by poor drainage, damaged roots or due to nutrient deficiencies.

- Discolouration manifests as leaf discolouration or distortion as a result of plant nutrient deficiencies.
- Interveinal Chlorosis yellowing of leaves between the veins. The veins remain green. It is observed usually due to nutrient deficiencies.
- Mottling is the appearance of uneven spots, usually yellowish, and is a sign of plant disease or a nutrient deficiency.
- Necrosis due to nutrient deficiency causes leaves, stems and other plant tissue to darken and wilt. Plants become more susceptible to diseases and pests.

To correct both visual and hidden micronutrient deficiencies, appropriate foliar and soil applications are necessary. A check guide to nutrient deficiency symptoms and fertilizer sources for taking corrective measures are given in Table 2.

Table 2: Nutrient Deficiency Symptoms and Fertilizer Sources.

Nutrient	Deficiency Symptom	Chemical Fertilizer Sources
Nitrogen	First observed in older leaves - overall chlorosis	Ammonium nitrate, sulfate, phosphate; Potassium, Sodium or Calcium nitrate; urea
Phosphorus	First observed in older leaves as deep green, purple coloration of petioles	Superphosphate; Ammonium or Potassium phosphate; phosphoric acid.
Potassium	First observed in older leaves as interveinal chlorosis with marginal and tip necrosis.	Potassium nitrate, Potassium chloride, phosphate, or sulfate; Potassium frit
Magnesium	First observed in older leaves as interveinal chlorosis and bronze coloration	Dolomite (Calcium/Magnesium carbonate), Magnesium 3sulphate (Epsom salt)
Calcium	Stem tips – die, leaves are small	Limes (Calcium carbonate/hydroxide); Calcium sulphate (gypsum) or nitrate; superphosphate
Sulphur	Leaves show overall chlorosis first on young leaves and then progresses to old leaves	Sulfate carriers (Copper sulphate, Magnesium sulphate etc); elemental Sulphur; Superphosphate
Iron	First seen in young leaves – severe interveinal chlorosis	Iron chelate; Ferrous sulphate
Zinc	First seen in new growth – 3sulphate growth and small leaves	Zinc chelate; Zinc sulphate
Manganese	First observed in young leaves – interveinal chlorosis with necrosis when severe	Manganese chelate; Manganous sulphate.
Copper	Stem tips – die, stunted; leaves small; multiple buds formed	Copper chelate; Copper Sulphate
Boron	Stem tips – internodes short, thick; leaves thick, brittle, with necrosis	Borax; Boric acid
Molybdenum	Similar to N deficiency, except occurs first on young leaves.	Sodium or ammonium Molybdate

Conclusion

Correctly diagnosing the nutrient deficiency symptoms is most important for taking timely corrective measures. To correct both visual and hidden micronutrient deficiencies, appropriate foliar and soil applications are necessary.