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Visual Nutrient Deficiency Symptoms in Plants

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INTRODUCTION

To assess nutrients deficiency in plants, most agriculturists primarily depend on visual symptoms, soil analysis and plant tissue analysis. The seventeen essential plant elements are carbon (C), hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulphur (S), iron (Fe), zinc (Zn), manganese (Mn), copper (Cu), boron (B), molybdenum (Mo), chlorine (Cl) and nickel. Carbon, hydrogen, and oxygen are obtained from air and water. Nitrogen, phosphorus, and potassium are derived from general fertilizers. Calcium, magnesium, and sulphur are variously derived from calcium carbonate (limestone), calcium hydroxide (hydrated lime), dolomite (calcium and magnesium carbonate), epsom salts (magnesium sulphate), elemental sulphur, and sulphate salts. Iron, zinc, manganese, copper, boron, and molybdenum are derived from minor element formulations, including soluble foliar fertilizers.

Generally, a nutrient deficit arises as a result of low soil nutrient levels. However, prevailing environmental conditions, soil properties, growth conditions and root diseases can restrict nutrient uptake and induce deficiencies in crops even if soil nutrient levels are estimated sufficient for optimum yield. For example, low or high soil pH, soil compaction and overly wet or dry soil may prevent nutrient uptake. A helpful diagnostic method to diagnose nutrient deficiency in crops is by visual examination of symptoms. However, this tool does not always provide a definitive diagnosis of the nutrient status of the plant. Keep in mind other conditions are capable of causing symptoms that closely mimic those of nutritional deficiencies. To counter this, visual signs should be corroborated with plant tissue and soil testing, and review of the background of nutrient applications to the field. Adequate knowledge of visual symptoms and tissue testing can help direct corrective actions in-season or preventive action in the following season to avoid yield loss.

Symptoms associated with deficiency can take many forms including chlorosis, necrosis and irregular development. Chlorosis occurs when the production of chlorophyll is reduced which results in a yellow to pale green leaf colour.

Nitrogen (N), magnesium (Mg), sulphur (S), and iron (Fe) are nutrients that play important roles in chlorophyll development and function; thus, their deficiencies tend to trigger chlorosis. Next is W 976 necrosis, which happens when the plant tissue dies. Necrosis is generally associated with N, phosphorus (P), and potassium (K) deficiencies. Abnormal growth occurs when insufficient quantities of a nutrient in the plant inhibit cell elongation and replication resulting in stunted growth, deformation or crinkled leaves. Where the symptomology occurs on the plant depends on the mobility of the nutrient inside the plant. Plant nutrients may be categorised as mobile or immobile within the plant. Mobile nutrients such as N, P, K and Mg can be translocated from the older leaves to the growing plant sections. Hence, deficiency symptoms appear to show on older, lower leaves. On the other hand, immobile nutrients like Calcium (Ca), Sulphur (S), and most micronutrients have restricted mobility within plants and deficiency symptoms occur in younger, upper leaves. Since plant nutrients can be mobile or immobile, it is important to understand how to sample tissue correctly for accurate results. Sampling an older leaf or trifoliate can result in the mobile nutrient concentration being falsely low. Sampling a younger leaf or trifoliate can cause mobile nutrient results to be too high.

Visual assessment of nutrient stress should be used only as a complement to other diagnostic methods (i.e., soil and plant analysis) (i.e., soil and plant analysis). Nutrient deficiency symptoms can be listed as follows:

1. Complete crop failure at the seedling stage.
2. Severe stunting of plants.
3. Specific leaf symptoms appearing at different times throughout the season.
4. Internal anomalies such as clogged conductive tissues.
5. Delayed or irregular maturity.
6. Obvious yield variations, with or without leaf symptoms.
7. Poor quality of crops, including differences in protein, oil, or starch content, and storage quality.
8. Yield differences detected only by careful experimental work.

Each symptom must be linked to some role of the nutrient in the plant. A given nutrient can have many roles, which makes it difficult to understand the physiological explanation for a specific deficiency symptom. For example, when N is deficient, the leaves of most plants become pale green or light yellow. When the quantity of N is restricting, chlorophyll production is decreased, and the yellow pigments, carotene and xanthophylls are seen by a number of nutrient deficiencies formed such as pale green or yellow leaves, and the deficiency must be further linked to a specific leaf pattern or position on the plant.

Precautions in interpreting nutrient deficiency

Apparent visual impairment symptoms can be caused by several causes other than a particular nutritional stress. Precautions in understanding nutrient deficiency signs include the following:

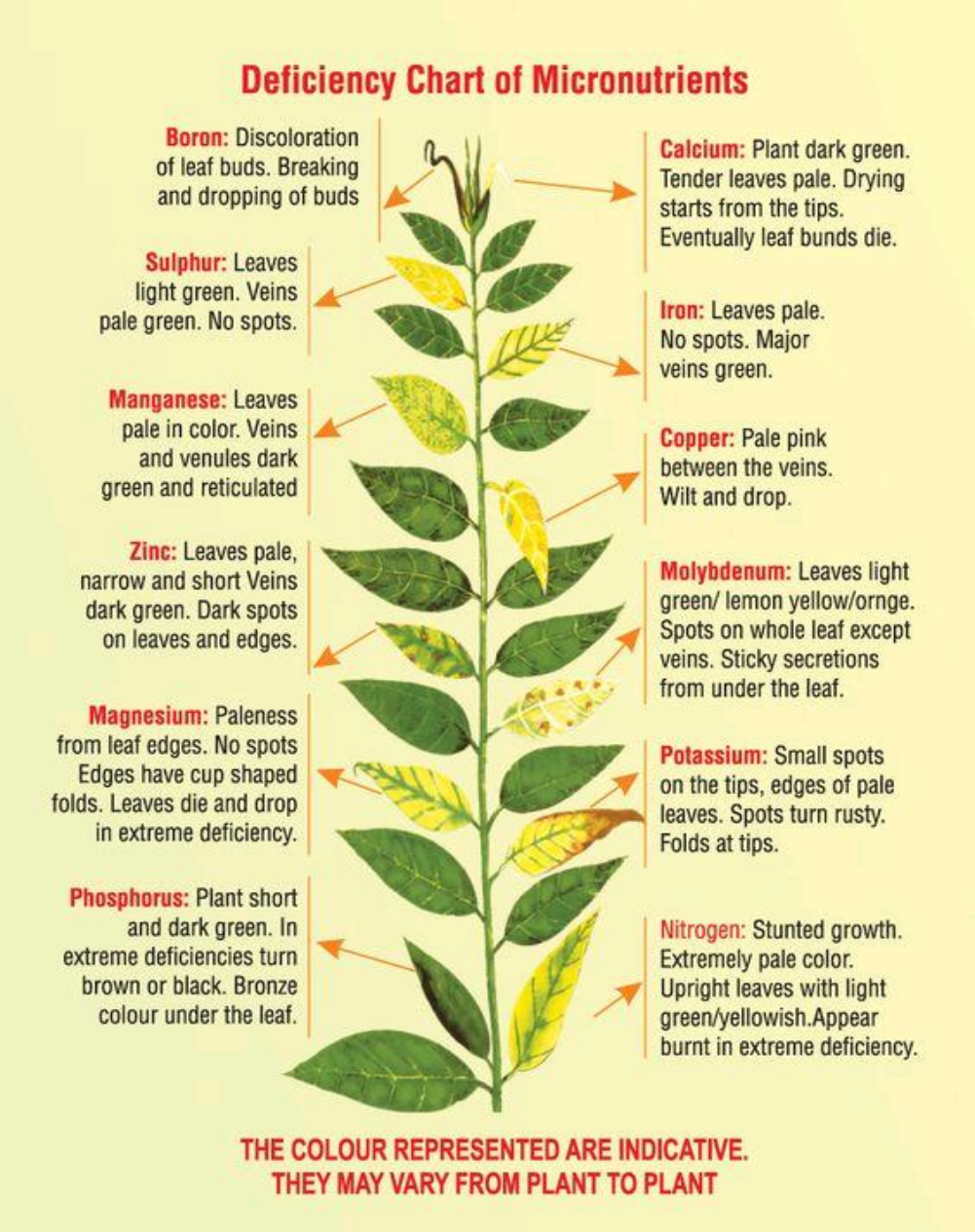
1. The visual symptom may be caused by more than one nutrient. For example, N-deficiency symptoms may be identified, although S may also be deficient and its symptoms may not be readily apparent. B deficiency is accompanied by a red coloration of the leaves near the growing point when the plant is well supplied with K. on the other hand, when the K content is low, yellowing of alfalfa leaves occurs.
2. Deficiencies are actually relative, and a deficiency of one nutrient may be related to an excessive quantity of another. For example, Mn deficiency may be induced by adding large quantities of Fe, provided that soil Mn is marginally deficient. Also, at a low level of P supply, the plant may not require as much N compared to normal or adequate P. In other words, once the first limiting factor is eliminated, the second limiting factor will appear (Liebig's law of the minimum).
3. It is often difficult to distinguish among the deficiency symptoms in the field, as disease or insect damage can resemble certain micronutrients deficiencies. For example, leaf hopper damage can be confused with deficiency in alfalfa.
4. A visual symptom may be caused by more than one factor. For example, sugars in corn combine with flavones to form

anthocyanins (purple, red, and yellow pigments) and their accumulation may be caused by an insufficient supply of P, low soil temperature, insect damage to the roots or N deficiency.

Nutrient deficiency signs occur soon when the nutrient supply is so poor that the plants can no longer function properly. In such situations, it would have been profitable to have applied fertilizer long before the symptoms appeared. If the signs are observed early, it may be corrected during the growing season. Since the goal is to bring the limiting nutrient into the plant as quickly as possible, with some nutrients and under some circumstances this can be achieved with foliar applications or side dressings. Usually the yield is reduced below the quantity that would have been produced if sufficient nutrients had been available at the beginning. However, if the issue is correctly diagnosed, the deficiency can be corrected the following year.

Table 1: Generalized Visual Leaf and Plant Nutrient Element Deficiency and Excess Symptoms

Element/status		Visual symptoms
Nitrogen (N)	Deficiency	Appear first on older (lower) leaves. V-shaped yellowing starting from the tip and progressing down the midrib towards the base of the leaf. Light green leaf and plant colour with the older leaves turning yellow, leaves that will eventually turn brown and die. Plant growth is slow; plants will be stunted, and will mature early.
	Excess	Plants will be dark green in color and new growth will be succulent; susceptible if subjected to disease and insect infestation; and subjected to drought stress, plants will easily lodge. Blossom abortion and lack of fruit set will occur.
	Ammonium toxicity	Plants fertilized with ammonium-nitrogen (NH_4- N) may exhibit ammonium-toxicity symptoms, with carbohydrate depletion and reduced plant growth. Lesions may occur on plant stems, there may be a downward cupping of the leaves, and a decay of the conductive tissue at the base of the stem with wilting of the plants under moisture stress. Blossom-end rot of fruit will occur and Mg deficiency symptoms may also occur.
Phosphorus (P)	Deficiency	Stunted, dark green to bluish-green plants. Appear first on older (lower) leaves. Reddish-purplish leaf tips and margins.
	Excess	Phosphorus excess will not have a direct effect on the plant but may show visual deficiencies of Zn, Fe, and Mn. High P may also interfere with the normal Ca nutrition, with typical Ca deficiency symptoms occurring.
Potassium (K)	Deficiency	On the older leaves, the edges will look burned, a symptom known as scorch. Plants will easily lodge and be sensitive to disease infestation. Fruit and seed production will be impaired and of poor quality.
	Excess	Plants will exhibit typical Mg, and possibly Ca deficiency symptoms due to a cation imbalance
Calcium (Ca)	Deficiency	The growing tips of roots and leaves will turn brown and die. The edges of the leaves will look ragged as the edges of emerging leaves stick together. Fruit quality will be affected with the occurrence of blossom-end rot on fruits.
	Excess	Plants may exhibit typical Mg deficiency symptoms, and when in high excess, K deficiency may also occur.
Magnesium (Mg)	Deficiency	Older leaves will be yellow in color with interveinal chlorosis (yellowing between the veins) symptoms. Plant growth will be slow and some plants may be easily infested by disease.
	Excess	Results in a cation imbalance showing signs of either a Ca or K deficiency.
Sulfur (S)	Deficiency	A general overall light green color of the entire plant with the older leaves being light green to yellow in color as the deficiency intensifies
	Excess	A premature senescence of leaves may occur.
Boron (B)	Deficiency	Abnormal development of the growing points (meristematic tissue) with the apical growing points eventually becoming stunted and dying. Rowers and fruits will abort. For some grain and fruit crops, yield and quality is significantly reduced.
	Excess	Leaf tips and margins will turn brown and die.
Chlorine (Cl)	Deficiency	Younger leaves will be chlorotic and plants will easily wilt. For wheat, a plant disease will infest the plant when Cl is deficient.
	Excess	Premature yellowing of the lower leaves with burning of the leaf margins and tips. Leaf abscission will occur and plants will easily wilt.
Copper (Cu)	Deficiency	Plant growth will be slow and plants stunted with distortion of the young leaves and death of the growing point.
	Excess	Fe deficiency may be induced with very slow growth. Roots may be stunted.
Iron (Fe)	Deficiency	Interveinal chlorosis will occur on the emerging and young leaves with eventual bleaching of the new growth. When severe, the entire plant may be light green in color.
	Excess	A bronzing of leaves with tiny brown spots on the leaves, a typical symptom frequently occurring with rice.
Manganese (Mn)	Deficiency	Interveinal chlorosis of young leaves while the leaves and plants remain generally green in color. When severe, the plants will be stunted.
	Excess	Older leaves will show brown spots surrounded by a chlorotic zone and circle.
Molybdenum (Mo)	Deficiency	Symptoms will frequently appear similar to N deficiency. Older and middle leaves become chlorotic first, and In some instances, leaf margins are rolled and growth and flower formation are restricted.
	Excess	Not of common occurrence.
Zinc (Zn)	Deficiency	Upper leaves will show interveinal chlorosis with an eventual whiting of the affected leaves. Leaves may be small and distorted with a rosette form.
	Excess	Fe deficiency will develop.



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