DIAGNOSING NUTRIENT DISORDERS IN GREENHOUSE CROPS

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Nutritional problems in greenhouse crops can be common due to the limited rooting volume of the container and limited nutrient reserve of the medium in which the crop is grown. Both nutrient supply and balance play important roles in the production of high quality container crops. Changing the level of one nutrient in solution will often affect the uptake or transport of another element. Therefore, nutrient interactions, the effect of one element on the uptake or use of another element, also has to be considered. Assessment of nutrient interactions should include the relationship between nutrient supply and plant growth, as well as tissue nutrient concentrations and plant growth. Although interactions between nutrients can be either positive or negative, it is usually the negative interactions that are the most documented.

Nutrient interactions become a factor in plant growth in two situations:

1) when the levels of two elements are near the deficiency range, and
2) when one element is supplied in excessive amounts while another is at levels considered marginally sufficient.

The precise nature of nutrient interactions depends on the nutrients involved and plant species. In many cases, the mechanism for the interaction may not be completely understood. Nutrient interactions may be the result of precipitation reactions occurring in soil solution, or the result of competition during ion uptake, translocation or metabolic function. Changes in pH of the media can also affect the nature of the interaction. Some important nutrient interactions that occur in greenhouse crops include:

* ammonium-calcium
* ammonium-magnesium
* phosphorus-iron
* phosphorus-copper
* phosphorus-zinc
* potassium-magnesium-calcium
* iron-manganese

In most cases, symptoms of nutritional disorders occur in defined patterns and are specific for each nutrient.

Nutrient interactions and proper balance need to be considered in relation to nutrient supply. Nutrient supply is important because "optimum nutrient ratios" in solution or in plant tissue can be obtained when both elements are in the deficient range or the toxic range.

The remainder of this discussion is directed towards describing the symptoms associated with specific nutrient disorders and the conditions that may lead up to the presence of the disorder, including nutrient interactions. While knowing the symptoms associated with nutrient deficiencies or toxicities is essential for every grower, it is important to remember that once visual symptoms are present, marketability of the plants may have already been reduced. Rigorous soil testing programs should be followed to help decrease the incidence of nutritional disorders.

In most cases, symptoms of nutritional disorders occur in defined patterns and are specific for each nutrient. Elements that are mobile in plants generally include deficiencies on the older (lower) leaves first while immobile elements induce deficiencies on the younger (upper) leaves. In some cases, pesticide toxicity or disease symptoms may resemble nutrient deficiencies or toxicities.

In addition, symptoms of nutritional disorders are often species or cultivar dependent. Use of soil and tissue analysis can be used to help confirm whether the symptoms are nutritional.

References:

Marschner, H. 1986. Mineral Nutrition of Higher Plants. Academic Press. London. pp. 399-400.

Robson, A.D. and M.G. Pitman, 1983. Interactions between nutrients in higher plants. In: Encyclopedia of Plant Physiology, New Series (A. Lanchli and R.L. Bielestri, eds.), Vol. 15A pp. 147-180. Springer-Verlog, Berlin.

Nitrogen:

Deficiency-

1. Leaves turn pale green to yellow.
2. Oldest leaves are affected first, but in severe cases the whole plant may be yellow. Growth is usually stunted.

Excess- ammonium:

1. Restriction in plant growth.
2. Leaf yellowing.
3. Marginal necrosis.
4. Death of the growing point.
5. High ammonium will interfere with potassium, magnesium and calcium uptake/translocation.
6. Can induce calcium deficiency and lower potassium and magnesium content in the plant.

Excess- nitrate:

1. Most plants tolerate high levels of nitrate without any symptoms.
2. Nitrate - enhances phosphorus and potassium uptake.

Excessive nitrogen, in general, will induce green vegetative growth and may delay flowering.

Phosphorus:

Deficiency-

1. Leaves appear reddish-purple.
2. Oldest leaves are affected first.
3. Plant growth is stunted.
4. May be induced under high pH (pH>7.4) or low pH (pH<5.0) conditions in soilless media.

Excess-

1. Mainly induces micronutrient deficiency symptoms by inhibiting iron, zinc and copper uptake/translocation possibly due to precipitation of phosphates.

Potassium:

Deficiency:

1. Leaves develop gray or tan areas near the margins.
2. Oldest leaves are affected first with characteristic scorching around the leaf margins.
3. In some plants spotting may occur.

Excess-

1. May cause salt burn at very high rates.
2. If magnesium is not well supplied, excessive potassium will induce magnesium deficiency.

Calcium:

Deficiency-

1. Growing points of plants may die.
2. Youngest leaves are affected first.
3. Root tips die and root growth is slow.
4. In some plants, leaf edges or tips are yellow or scorched (often termed leaf edge or tip burn).
5. Deficiency can be induced by high levels of ammonium in excessively wet or dry conditions.

Excess-

1. Plants can tolerate high levels of calcium without adverse effects.
2. High levels of calcium can cause lower levels of potassium and magnesium in plant tissue.

Magnesium:

Deficiency-

1. Oldest leaves turn yellow between the veins (interveinal chlorosis).
2. In severe cases, younger leaves may be affected and older leaves may drop off.
3. Deficiency can be induced by high potassium level.

Excess-

1. Plants can tolerate high levels of magnesium without adverse effects.
2. High levels of magnesium can cause lower levels of potassium and calcium in plant tissue.

Sulfur:

Deficiency-

1. General yellowing of the plant.
2. Symptoms are similar to nitrogen deficiency.

Excess-

1. Plants can tolerate high levels of sulfur; however, uptake of molybdenum will be reduced with high levels of sulfur.

Boron:

Deficiency-

1. Usually occurs on younger plant tissue.
2. Growing points die and leaves appear distorted.

Excess-

1. Can be highly toxic to some plants.
2. Toxicity usually occurs on oldest leaves as a scorching of the margins.

Copper:

Deficiency-

1. Yellowing or dieback of youngest leaves.
2. Sometimes yellowing between the veins.
3. Distortion of leaves with stunted strap-like growth.
4. High levels of phosphorus may induce copper deficiency.

Excess-

1. May induce iron deficiency and cause stunted root systems.

Iron:

Deficiency-

1. Yellowing between the veins on the youngest leaves; veins remain green (interveinal chlorosis).
2. High levels of phosphorus may induce iron deficiency.
3. High pH conditions will cause iron deficiency.

Excess-

1. Plants can tolerate high levels of iron without adverse effects.
2. High levels may induce manganese deficiency in some plants.

Manganese:

Deficiency-

1. Similar to iron deficiency.
2. Yellowing between the veins of youngest leaves.
3. Usually only the main veins remain green causing a fish-bone like appearance.
4. Occurs under high pH conditions.

Excess-

1. Brown spots on lower leaves between veins and leaf yellowing.
2. Occurs under low pH conditions.

Molybdenum:

Deficiency-

1. Pale, distorted, narrow leaves.
2. Can be similar to nitrogen deficiency.
3. In some plants leaf margins may be scorched.
4. Occurs most frequently under low pH conditions.
5. Phosphorus and magnesium will enhance uptake, while high sulfur will decrease uptake.

Excess-

1. Plants can tolerate high levels of molybdenum without adverse effects.

Zinc:

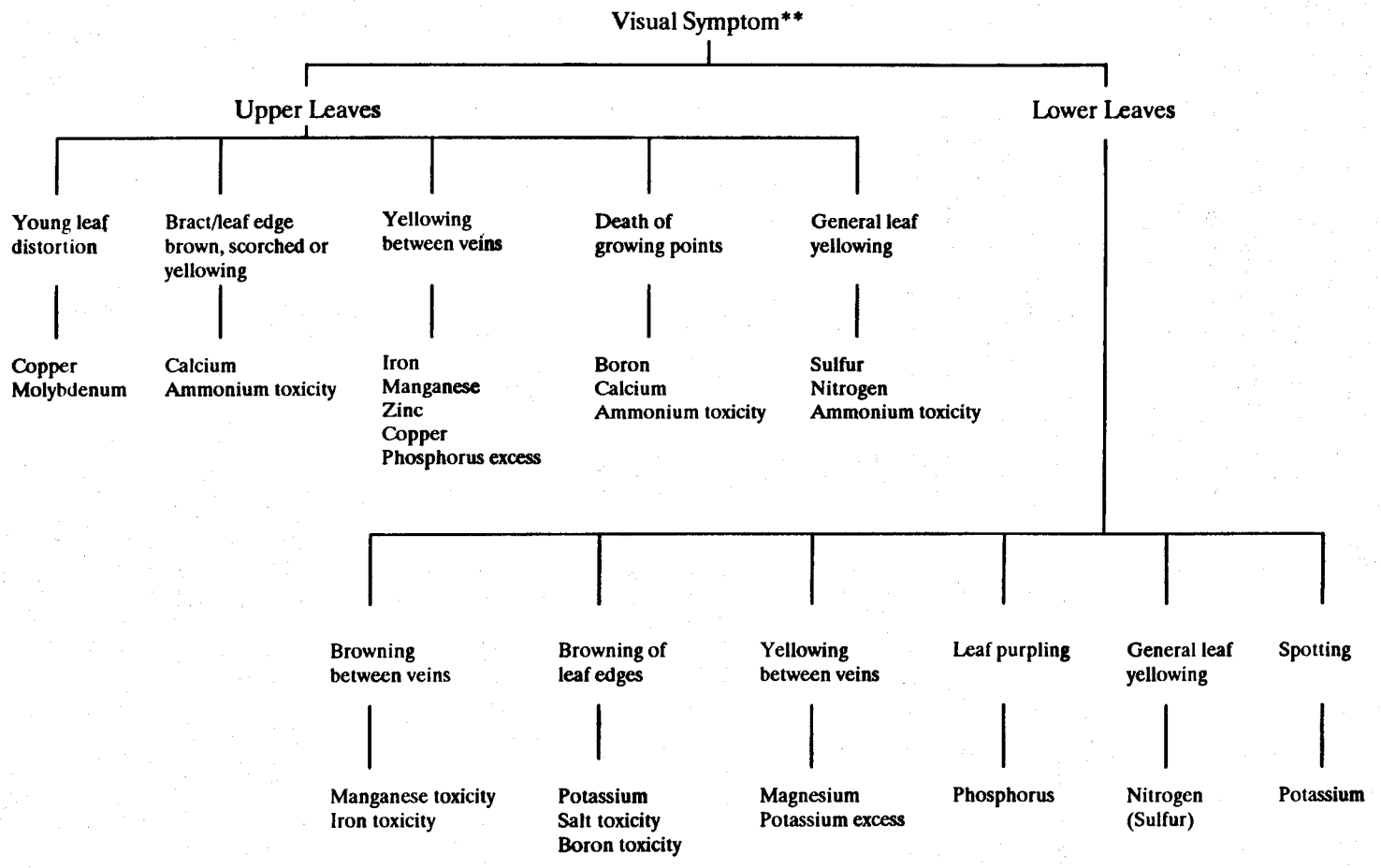
Deficiency-

1. Younger leaves are affected first and may show signs of yellowing between the veins.
2. Other symptoms may include short internodes and rosetting of leaves.
3. High levels of phosphorus may induce zinc deficiency.
4. Occurs under high pH conditions.

Excess-

1. May induce iron deficiency in some plants.

KEY TO DETERMINING NUTRIENT DISORDERS IN GREENHOUSE CROPS



** symptoms refer to deficiency unless otherwise stated