Nutrient Management for Fruit and Vegetable Crop Production

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DIAGNOSING NUTRIENT DISORDERS

Soil testing on a regular basis and fertilizing according to soil test recommendations are critical parts of a sound nutrient management program, but nutrient disorders (deficiencies or excesses of specific nutrients) can still occur for a variety of reasons. In addition to nutrient amounts, the balance between different nutrients can play an important role in the development of nutritional problems in a crop. Tools for diagnosing nutrient disorders in growing crops include plant tissue analysis and visual symptoms of nutrient deficiency and toxicity.

Nutrient Interactions

Both nutrient supply and nutrient balance play important roles in plant nutrition. Changing the level of one nutrient in the soil will often affect the uptake or transport within the plant of another nutrient. Therefore, the effects of one nutrient element on the uptake or use of another nutrient element, nutrient interactions, also have to be considered in a complete nutrient management program. Assessment of nutrient interactions should include the relationship between nutrient supply in the soil and plant growth, as well as between nutrient concentrations in plant tissue 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 can become a factor in plant growth in two situations: 1) when the levels of two nutrients are both near the deficiency range, and 2) when one nutrient is supplied in excessive amounts while another is at a level considered only marginally sufficient. The precise nature of nutrient interactions depends on the nutrients involved and can vary for different 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 the soil solution, which reduces availability for plant uptake, or the result of competition during nutrient uptake, translocation, or metabolic function within the plant. Some important nutrient interactions include ammonium-calcium, phosphorus-iron,

phosphorus-copper, phosphorus-zinc, and potassium-magnesium-calcium. Specific nutrient interactions and their effects are discussed in the "Visual Deficiency Symptoms" sections in the *Fertility Recommendations* documents for different crops ("Sweet Corn", "Peas", "Snap Beans"). ***(need to make links to this section in these documents)***

Nutrient interactions and proper nutrient balance need to be considered in relation to nutrient supply – the actual amounts of plant-available nutrients in the soil. Nutrient supply is important because "optimum nutrient ratios" in soil or in plant tissue can still be obtained even when nutrient amounts are not in the sufficiency range. Two nutrients could both be in the deficient range, or both could be in the toxic range, yet the ratio between them could be in optimum balance.

Plant Tissue Analysis

Tissue analysis is useful for diagnosing many suspected nutrient disorders and determining the efficiency of a fertilizer program. Plant tissue analysis is not a substitute for soil testing, but should be used in conjunction with a routine soil-testing program. Many of the laboratories that do soil testing also do plant tissue analysis. For information on soil testing laboratories, refer to the sections on "Soil Sampling and Soil Testing" in the *Fertility Recommendations* documents for different crops (*Sweet Corn*, *Peas*, *Snap Beans*). ***(need to make links to this section in these documents)*** Nutrient deficiencies detected through tissue testing may permit corrective action to be taken before visible deficiency symptoms appear or to help prevent nutrient deficiencies during the next growing season. Results of plant analysis are also useful to diagnose nutrient toxicities and to reveal imbalances between nutrients that can cause unfavorable nutrient interactions.

Nutrient concentrations within plants are not uniform and they also vary with time through the growing season. Nutrient sufficiency levels have been developed for specific plant parts that are sampled at specific growth stages, so accurate interpretation of tissue analysis depends on proper sampling. If a suspected nutritional problem occurs at a different stage of growth, collecting samples from both healthy and affected plants, and comparing their nutrient concentrations, is useful to diagnose a possible nutrient deficiency as the source of the problem. For information on plant tissue sampling and nutrient sufficiency ranges for *Sweet Corn*, *Peas*, and *Snap Beans*, refer to the sections on "Plant Tissue Analysis" in the *Fertility Recommendations* documents for these crops. ***(need to make links to this section in these documents)*** For information on plant tissue sampling and nutrient sufficiency ranges in other vegetable (as well as fruit) crops, refer to *Nutrient Management for Commercial Fruit & Vegetable Crops in Minnesota* (BU-5886), pages 27-31.

Visual Deficiency and Toxicity Symptoms

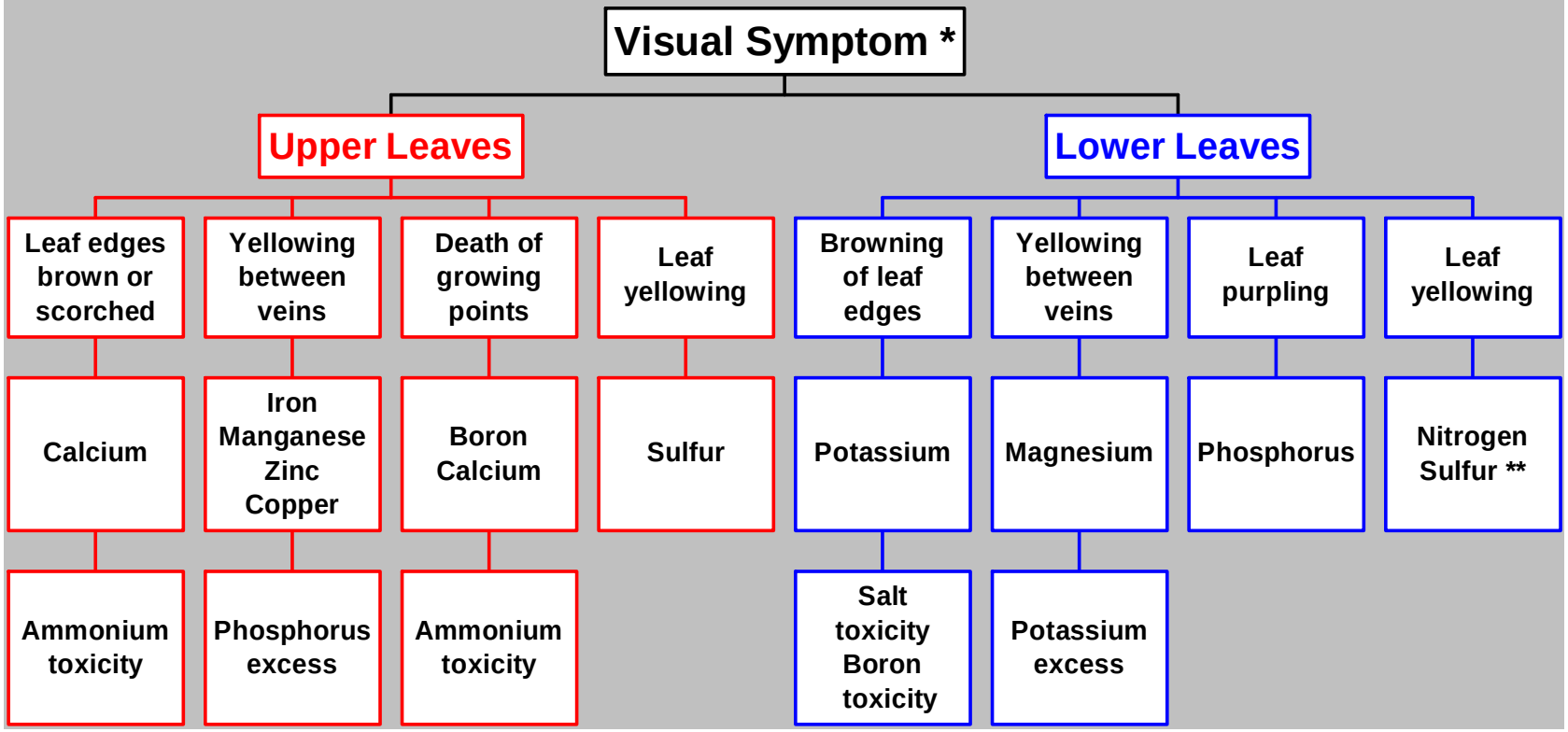
Although knowing the symptoms associated with nutrient deficiencies or toxicities is essential for every grower, it is important to remember that once visual symptoms are present reductions in crop yield or quality have often already occurred. Rigorous soil testing programs should be followed to help 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 induce deficiencies on the older (lower) leaves first, while immobile elements induce deficiencies on the younger (upper) leaves first. In some cases, pesticide toxicity or disease symptoms may resemble nutrient deficiencies or toxicities. In addition, symptoms of nutritional disorders are often species or variety dependent. Use of soil and plant tissue analysis should be used to help confirm whether the symptoms truly are nutritional.

Key to Visual Diagnosis of Nutrient Disorders

The "Key to Visual Diagnosis of Nutrient Disorders" (below) is a useful tool that can help diagnose specific nutritional problems in crops. The Key first asks you to choose whether the Visual Symptom you observed was on Upper Leaves or Lower Leaves. Below each of these first two choices are four boxes with descriptions of different visual symptoms that may appear on unhealthy-looking plants. If you find a box that matches the problem you see on your plants, look at the box below it for the nutrient or group of nutrients that can cause those symptoms when they are deficient. The bottom row of boxes, which aren't present for three of the visual symptoms, lists nutrients that can cause the same or similar symptoms when they are present in excessive or toxic amounts. By clicking on boxes in the key, you can access links that provide additional information on the symptom or nutrient, including pictures of some of the nutrient disorders on sweet corn, peas, and snap beans.

KEY TO VISUAL DIAGNOSIS OF NUTRIENT DISORDERS



* Symptoms refer to deficiency unless otherwise stated.

** Symptoms of sulfur deficiency usually occur on upper leaves first, but a general yellowing of the entire plant may occur under prolonged deficiency conditions.