Diagnosing Nutrient Deficiencies in Ornamental Plants

When your plants start to look bad, there are many possible causes. One common culprit is a nutrient deficiency. Nutrient deficiencies happen when a plant lacks one of the many "essential nutrients." This is similar to a vitamin deficiency in people.
This publication is intended to help homeowners and landscape managers diagnose common nutrient deficiencies in ornamental plants.

Essential Nutrients

Before we discuss how to determine which nutrients your plants need, it is important to understand a few terms:

Essential plant nutrients – Nutrients that all plants require for healthy growth and reproduction.
Macronutrients – Nutrients that are needed in greater quantities and make up a large portion of the plant.
Micronutrients – Nutrients that are needed in smaller amounts and make up a small portion of the plant.
Mobile nutrients – Nutrients that plants move from one part to another, as they are needed for growth and development.
Immobile nutrients – Nutrients that cannot move within the plant.

Growth is generally more limited by the availability of macronutrients than by micronutrients. Most fertilizers contain relatively large amounts of one or more of the macronutrients.

Nutrient mobility dictates where deficiency symptoms appear on the plant. Symptoms for *mobile* nutrients appear first in older parts of the plant, while symptoms for *immobile* nutrients are seen in new leaves first.

Table 1 provides a list of plant essential nutrients, whether they are macro- or micronutrients, their mobility, and the available form that plants can take up from the soil.

Table 1. Essential plant nutrients, their available forms, and mobility.

	Essential Nutrient	Chemical Symbol	Plant Available Form	Mobile or Immobile
Micronutrients	Nitrogen	N	Nitrate (NO_3^-) & Ammonium (NH_4^+)	mobile
	Phosphorus	P	Phosphate (HPO_4^{2-} & $H_2PO_4^-$)	mobile
	Potassium	K	Ionic Potassium (K^+)	mobile
	Calcium	Ca	Ionic Calcium (Ca^{2+})	immobile
	Sulfur	S	Sulfate (SO_4^{2-})	partly immobile
	Magnesium	Mg	Ionic Magnesium (Mg^{2+})	mobile
Macronutrients	Iron	Fe	Fe^{2+} form	partly immobile
	Zinc	Zn	Zn^{2+} form	partly immobile
	Manganese	Mn	Mn^{2+} form	partly immobile
	Copper	Cu	Cu^{2+} form	partly immobile
	Molybdenum	Mo	Molybdate (MoO_4^{2-})	partly immobile
	Boron	B	Borate ($H_2BO_3^-$)	immobile
	Chlorine	Cl	Ionic Chlorine (Cl^-)	mobile

Diagnosing Nutrient Deficiencies

Determining which plant nutrient is missing can be a challenge. The first step is to rule out any other potential causes of the symptoms you see. Below is a list of common causes of symptoms similar to plant nutrient deficiency.

- Insects/mites
- Nematodes
- Diseases
- Too much water
- Not enough water
- Cold damage
- Pesticide damage
- Soil compaction
- Air pollution

Plan A: Soil and Tissue Tests

The best way to find out what your plants lack is through soil and tissue testing. Soil tests are a good way to determine which nutrients are available to your plants and identify other factors that might cause nutritional problems (ex. pH and salinity). The Mississippi State University Extension Service offers affordable soil testing services.

Plant tissue tests will tell you how much of each nutrient is in the plant. This shows you what the plant lacks and which nutrients are too high, possibly causing nutrient toxicity.

Having both the soil and plant tissue tested will give you the most complete picture of what is going on with your plant. This is the most accurate way to determine what nutrient is missing from your plants and what to do about it.

Soil Test Tips

1. For areas that were recently limed or fertilized, wait at least 6–8 weeks before testing the soil.
2. Each sample should represent **only one soil type or area** (for example, lawn, vegetable garden, landscape beds). See **Figure 1** for an example.
3. Place **four to six small samples** from *each area* in a bucket and mix thoroughly. See **Figure 2** for an example of how to take a sample.
4. Take samples from **healthy and unhealthy areas separately**. Testing both areas allows for a comparison.
5. Take samples from the **top 4–6 inches** of the soil.
6. Your sample needs to be about **1 pint** in volume.

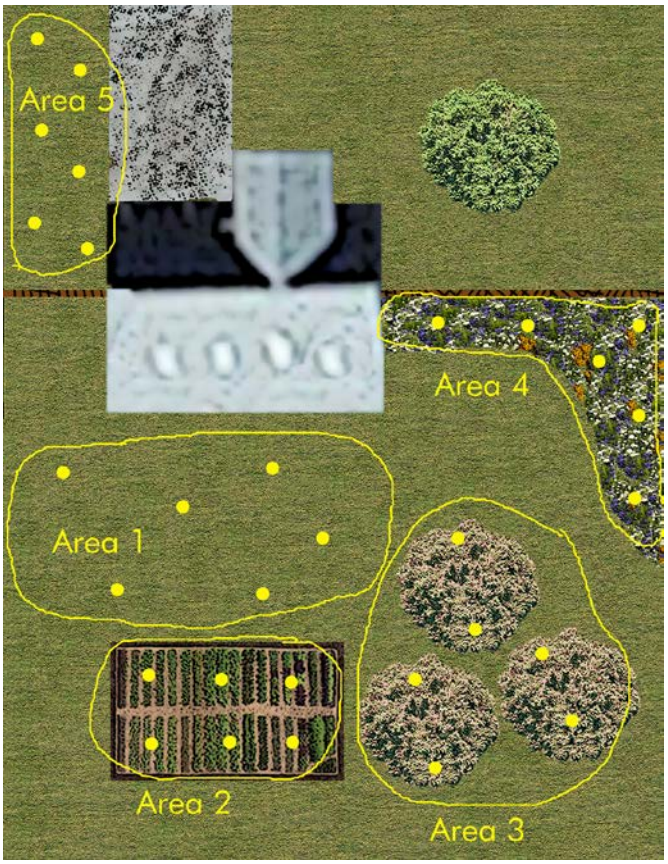

Figure 1. Example of locations to take different samples.

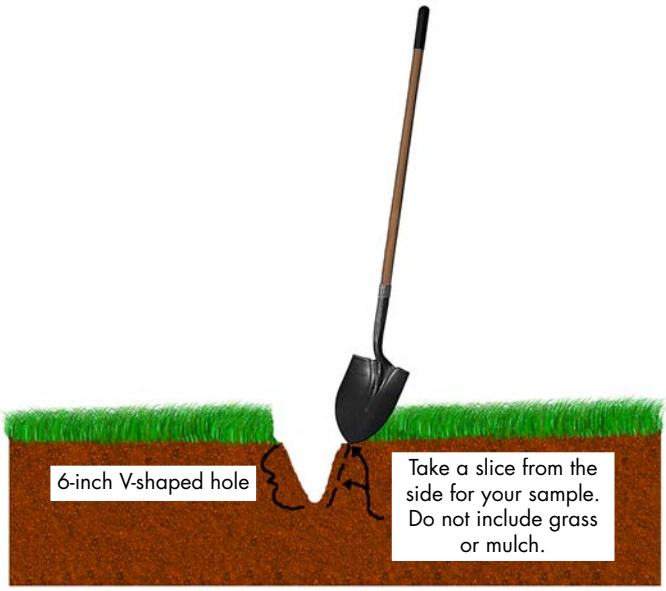

Figure 2. An example of how to take a soil sample.

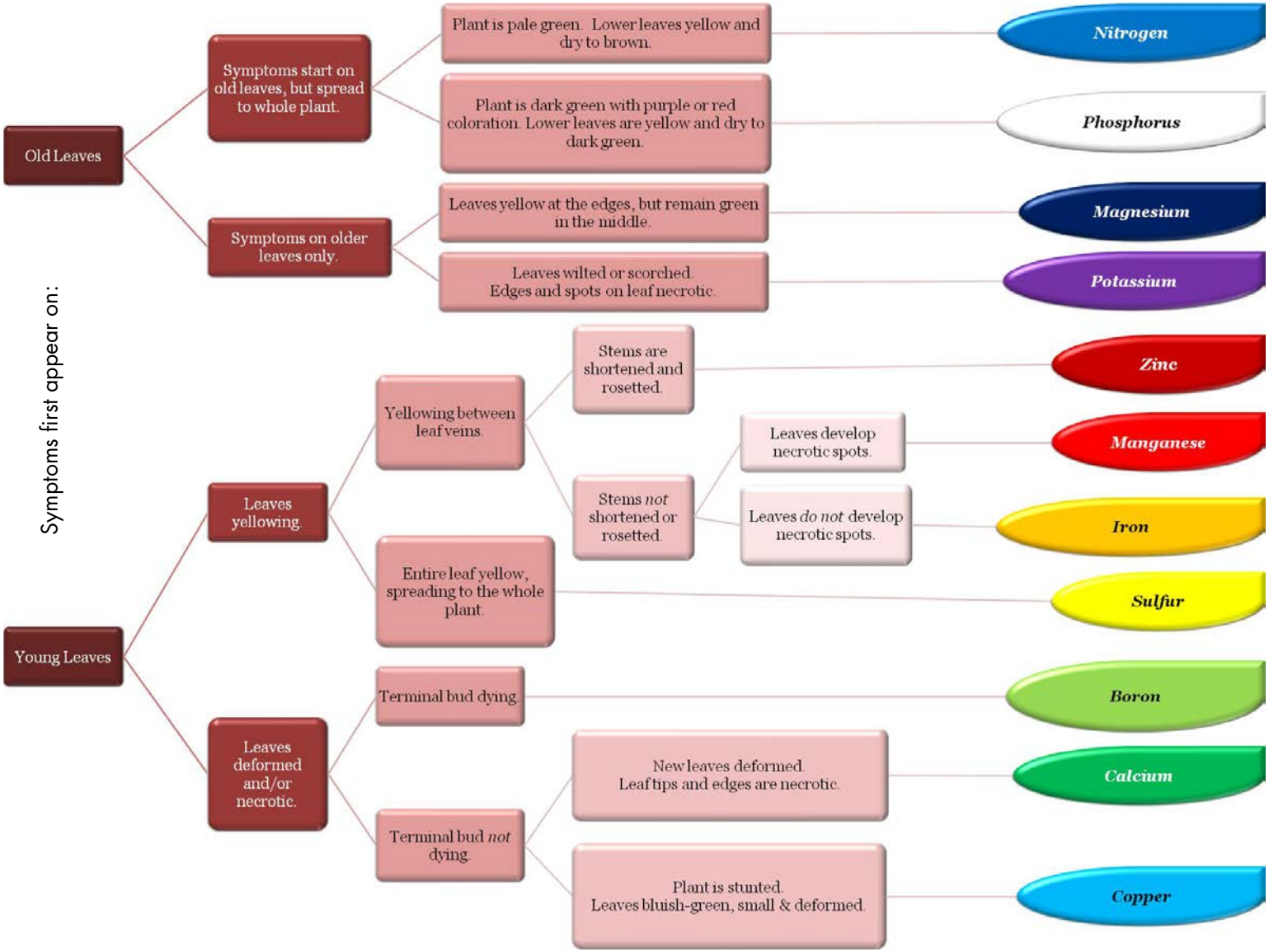

Figure 3. Key for identifying ornamental plant nutrient deficiencies based on visual symptoms. Redrawn from Shober & Denny, 2010.

Plant Tissue Test Tips

1. What to sample
   a. Select the closest fully expanded leaf below the growing point. These leaves will not be dull from age nor shiny green from immaturity.
   b. Plants less than 4 inches tall; take whole plants from 1 inch above the soil line.
   c. Taking a sample that represents the entire plant is the key to reliable plant tissue test results. A common-sense approach works well.
   d. Take separate samples from both "good" and "bad" plants, leaves, or areas. This will allow you to compare results and pinpoint the missing nutrient.
   e. Take samples from a uniform area (see Soil Test Tip #2).
   f. Keep samples free of soil and other contaminants that can alter results.
2. When to sample
   a. Take samples whenever you suspect the problem.
   b. The best time to collect samples is between midmorning and midafternoon.
3. How much to sample
   a. A good sample contains enough leaves to represent the area sampled.
   b. Plants with large leaves—3 to 4 leaves.
   c. Plants with small leaves—25 to 30 leaves
   d. For most plants—8 to 15 leaves
4. Ship the tissue sample in a paper envelope or cardboard box so it can begin drying during transport. Do not ship samples in plastic bags because they will rot, and decomposition may alter test results. If samples are very wet, allow them to air-dry to a workable condition before packaging.

For more information on these tests, contact your county Extension office or visit ***http://msucares.com/crops/soils/testing.html***.

Plan B: Use Visual Symptoms to Diagnose Deficiency

Many plant nutrient deficiencies can be diagnosed based on their visual symptoms. This is a convenient method, but it is not as accurate or dependable as soil and tissue testing. Some symptoms take longer to develop than others, and if more than one nutrient is deficient, it can be difficult to tell what is missing.

This method is not intended to replace tissue and soil tests, but it can be used when testing is impractical. Figure 3 will help you determine which nutrients your plants lack based on visual symptoms.

To use **Figure 3**, follow these steps:

1. Begin on the left side.
2. Select the option that matches the plant's symptoms.
3. Move to the next choice.
4. Do this until you reach one of the plant nutrient deficiencies on the right side.

Remember, using visual symptoms to diagnose nutrient deficiencies should only be used for preliminary planning purposes.

References

Shober, A.L. & G.C. Denny. 2010. "Identifying Nutrient Deficiencies in Ornamental Plants." UF-IFAS Extension Publication SL 318.

Publication 2760 (POD-05-16)

By **Dr. Geoffrey C. Denny**, Assistant Extension Professor, and **Dr. Karl K. Crouse**, Associate Extension Professor, Plant and Soil Sciences. Figures by G.C. Denny.