Soil Fertility Management

A fertile soil contains all the nutrients a plant needs. Deficiencies or toxicities in soil result in a meager harvest and poor quality. To ensure that you have fertile soil, send a sample for testing and then follow the recommendations.

Soil fertility is a major factor that affects crop growth and quality. A fertile soil contains all the nutrients a plant needs. The nutrients must also be present in proper concentrations and in a form that makes them available to plants. Plant nutrients are grouped into two categories: macronutrients and micronutrients. Nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg) and sulfur (S) are macronutrients. They are needed by the plant in fairly large quantities. Micronutrients are zinc (Zn), manganese (Mn), copper (Cu), boron (B), iron (Fe), Molybdenum (Mo), Nickel (Ni), and chloride (Cl). Micronutrients are required by the plant in very small amounts. Deficiencies or toxicities (harm due to an excess) of nutrients (micronutrients or macronutrients) result in a meager harvest and poor quality crops (Photo 1).

Photo Courtesy of Allen V. Barker

Photo 1: Tomato plants suffering from calcium deficiency.

Soil testing is very important to assure that all the nutrients in the soil are present in the correct concentrations and in form available to plants. If possible, soil testing should be done in the fall. If not, early spring is the next best time to get your soil tested.

Zigzag pattern for soil sampling.

Photo 2: How to take a soil sample: Take 12 cores of soil by zigzagging to cover as much of the sampling area as possible.

To test soil, you need a soil probe, a bucket, a small plastic bag and an order form from the soil laboratory where you plan to send your sample. In the field, take at least 12 soil cores, about six inches deep, from each uniform area of the field (Photo 2). Mix them in the bucket. Then, take at least a cup of the mixture and put it in the plastic bag. The order form should include your name, address and the crops you intend to grow on the tested soil. This information allows the soil laboratory to give you recommendations on fertilizers and rates that are specific for the crops you intend to

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Table 1. Contact information for laboratories in Missouri approved for soil testing

Source: http://soilplantlab.missouri.edu/soil/msta.aspx

Custom Laboratory Inc.	MU Soil and Plant Testing Lab	Perry Agricultural Lab	Delta Soil Testing Lab
204 C Street Golden City, MO 64748 (417) 537-8337	23 Mumford Hall Columbia, MO 65211 (573) 882-3250	PO Box 418 State Highway 54 East Bowling Green, MO 63334 (573) 324-2931	University of Missouri PO Box 160 Portageville, MO 63873 (573) 379-5431
Cost*: $17	Cost: $15	Cost: $11.20 to $18.90	Cost: $10 to $23

Cost at the time of publication.

grow. Send the soil sample and order form to the laboratory of your choice. (Table 1 above).

The soil analysis results will contain two key pieces of information: the soil pH and the concentration of the nutrients in the soil. The nutrient status indicates the amount of nutrients in the soil. The laboratory uses this information to advise you about which fertilizers and the amount of the fertilizers to add to the soil. The fertilizers will provide the nutrients needed by your plants.

The soil pH indicates the availability of nutrients to plants. In fact, even if a certain nutrient is present in the soil, it might not be available to plants if the pH is not adequate for nutrient availability (fig. 1). For example, even if enough P is present in the soil, it will not be available to plants if the pH is too acidic. At pH below 5.5, the soil concentrations of soluble iron and aluminum are high enough to cause precipitation of P and to make it not available to plants. While many plants can tolerate pH ranges between 5.2 and 7.8, most plants grow best when the soil pH is between 6.0 and 7.0 (slightly acidic to neutral). This general rule applies to most of the commonly grown fruits, vegetables, flowers, trees and shrubs (Havlin et al. 1999).

If the pH is below the normal range, the addition of lime ($CaCO_3$) is generally recommended (table 2 on page 3). Placement is the most important factor

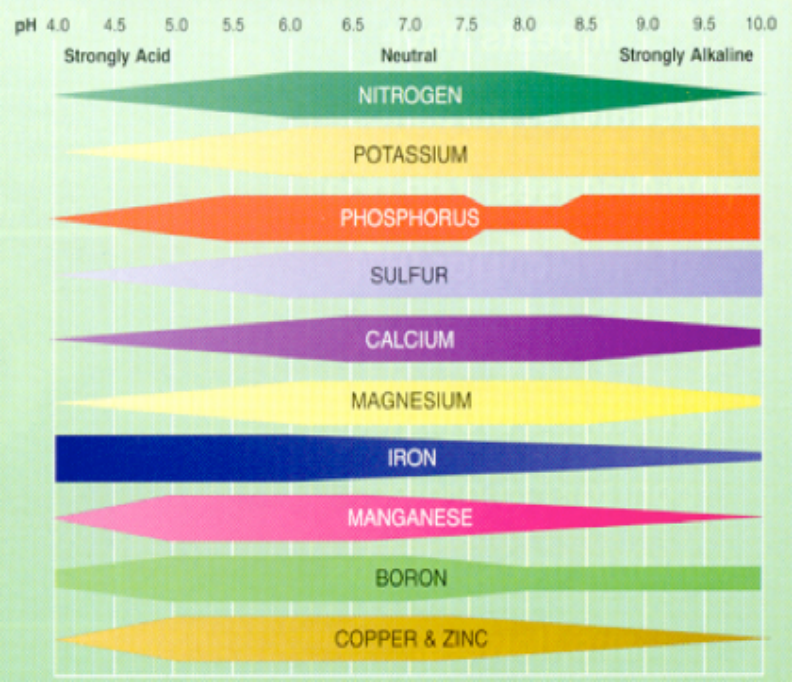

Figure 1. *Nutrient availability in the soil as affected by soil pH; the wider the band, the greater the availability. (Rosen et al. 2014).*

in the effectiveness of lime. Maximum contact of lime with the soil is needed. Most liming materials are only slightly soluble in water; therefore, they must be mixed into the soil to react. Even when properly combined with the soil, lime will have little effect on the pH if the soil is dry. Moisture is required for the lime-soil reaction to occur. In some cases, lime must be applied to the surface. If so, it should be watered into the soil. This is true of perennials (plants with a

Table 2. Lime (CaCO3) needed to raise the soil pH to 6.5 | *Source: Nardozzi 2012*

Pounds of Limestone Needed to Raise the Soil pH to 6.5 (per 1,000 square feet)			
	Soil Texture		
pH	Sandy Soil	Loam Soil	Clay Soil
4.0 – 6.5	60	161	230
4.5 – 6.5	50	130	190
5.0 – 6.5	40	100	150
5.5 – 6.5	30	80	100
6.0 – 6.5	15	40	60

life cycle of two or more years).

If the pH is higher than the normal range, elemental S is often used to lower the pH (table 3). Sulfur, however, requires some time for the conversion to sulfuric acid with the aid of soil bacteria (Rengel, 2005). The conversion rate of sulfur depends on many variables. These include the fineness of the sulfur particles, the amount of soil moisture, the soil temperature and the presence of certain bacteria (Rengel, 2005). The conversion of sulfur might take several months if the conditions are not ideal. For this reason, apply S (if needed) in the fall. This allows time for the soil to acidify.

Table 3. Elemental sulfur needed to lower the soil pH | ***Source: Mullen et al. 2007***

Pounds of Sulfur Needed to Lower the Soil pH (per 1,000 square feet)					
Present pH	**Desired pH**				
	6.5	**6.0**	**5.5**	**5.0**	**4.5**
8.0	30	40	50	60	70
7.5	20	30	40	50	60
7.0	10	20	30	40	50
6.5		10	20	30	40
6.0			10	20	30

Take soil fertility seriously, and get your soil tested. Then follow the soil test recommendations. They will help build the fertility of your soil, which in turn will reward you with increased yields and better quality produce.

References

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