

Down To Earth: Reports from the Field

Innovative Small Farmers' Outreach Program (ISFOP)



Maintain Your Soil Fertility: Crop Yield and Quality Depend on It

By Dr. Touria Eaton, State Extension Specialist - Horticulture

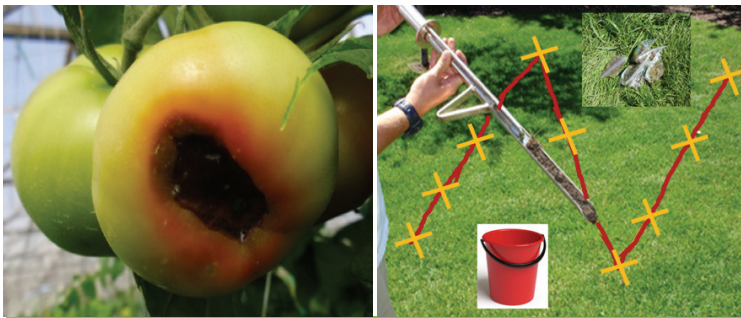


Figure 1 (on left): Tomato plants suffering from calcium deficiency.
Figure 2: Take 12 cores of soil by using a zigzag pattern to cover as much of the sampling area as possible.

Soil fertility is a major factor that affects crop growth and quality. Fertile soil contains all the nutrients a plant needs. The nutrients must also be present in the 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, such as zinc (Zn), manganese (Mn) and copper (Cu), are required by the plant in very small amounts. Deficiencies or toxicities (harm due to an excess) of nutrients result in a meager harvest and poor quality crops (fig. 1).

Soil testing is very important to assure that all the nutrients in the soil are present in the correct concentrations and in

an available form for plants. If possible, soil testing should be done in the fall. If not, the spring is the next best time to test your soil.

To test soil, you need a soil probe, a bucket, a small plastic bag and an order form from the soil laboratory where you intend to send your sample. In the field, take at least 12 soil cores from each uniform area of the field (fig. 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 grow. Send the soil sample and order form to the laboratory (table 1).

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 Bowling Green, MO 63334 (573) 324-2931	PO Box 160 Portageville, MO 63873 (573) 379-5431
Cost*: \$17	Cost: \$15	Cost: \$11.20 to \$19	Cost: \$10 to \$23

Table 1. Soil Testing Laboratories

*Cost at the time of publication. Source: <http://soilplantlab.missouri.edu/soil/msta.aspx>.

The soil analysis results will contain two key pieces of information: the soil pH (a measure of acidity) and the concentration of the nutrients in the soil. The nutrient status indicates the presence and amount of nutrients in the soil. The pH tells whether the soil is acidic or basic (alkaline), with numbers from 0 to below 7 being acidic, 7 being neutral and above 7 being basic. The laboratory uses this information to advise you about which fertilizer(s) to add to the soil; the fertilizer(s) will provide the nutrients needed by your plants.

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Soil Fertility (continued from page 1)

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. 3).

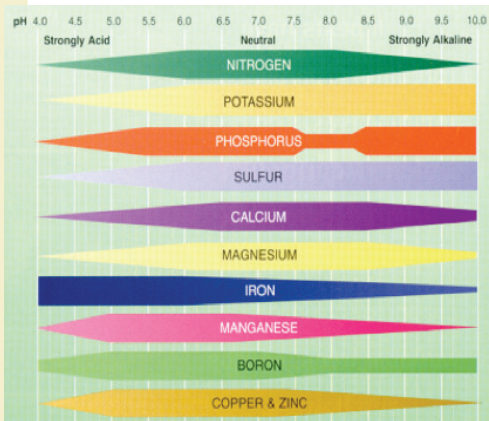


Figure 3: Nutrient availability in the soil as affected by soil pH; the wider the band, the greater the availability. (Rosen et al. 2014).

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 a pH below 5.5, the soil concentration of the hydrogen ion (H⁺) (an ion is an atom with an electrical charge) is high enough to cause the precipitation (formation of an insoluble solid) of P; this makes it unavailable 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 (CaCO₃) is generally recommended (table 2). Placement is the most important factor in the effective-

Pounds of Limestone Needed to Raise Soil pH (per 1,000 square feet)			
pH	Soil Texture		
	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

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

ness 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. Even when properly combined with soil, lime will have little effect on 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 life cycle of two or more years). Lime (CaCO₃) is needed to raise soil pH to 6.5. If the pH is higher than the normal

range, sulfur is often used to lower the pH (table 3). Sulfur, however, requires some time to convert to sulfuric acid with the aid of soil bacteria. The conversion rate of sulfur depends on many variables. These include the fineness of the sulfur particles, the amount of soil moisture, soil temperature and the presence of certain bacteria. The conversion of sulfur might take several months if the conditions are not ideal. For this reason, apply sulfur (if needed) in the fall; this allows time for the soil to acidify. See Table 3 on the previous page:

Pounds of Sulfur Needed to Lower 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

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

Soil Fertility (continued from page 2)

Elemental sulfur needed to lower soil pH.

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.

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IPM Corner

Understanding Water, Plant and Disease Relationships

By Dr. Zelalem Mersha, State Extension Specialist - Plant Pathology Program

When offered at the right time and in the right quantity, water is vital to plant life. It helps plants to grow and produce food. Water is needed for many metabolic activities (vital chemical processes used by living organisms). It also transports nutrients and dissolved substances. An excess or a lack of water from a natural cause or from poor watering practices can directly or indirectly have a harmful effect on plants.

Problems Caused by Lack of Water

An example of an indirect effect of lack of water is blossom end rot (BER). BER, a common problem in gardens and on farms, is associated with a calcium deficiency. Even if calcium is available in the soil, BER can still occur when roots fail to transport calcium to the maturing fruits due to lack of water. Or,

roots become choked and rotten by pathogens (agents that cause disease).

Problems Caused by Excess Water

Excess water can trigger problems, too, especially after a long dry period. It causes disorders such as cracking, splitting fruit or edema (blisters on leaf surfaces). Free moisture on plant surfaces, such as the leaf, root, stem, flower head and fruit, makes it easy for plant pathogens to thrive. They are likely to germinate (start developing), grow and complete their life cycle. Then they can spread and survive, causing problems from season to season.

The Water-Plant-Disease Relationship

A sound understanding of the water-plant-disease relationship will save

time and resources. Otherwise, money, time and effort will need to be spent to control plant ailments.

Prolonged leaf wetness and high relative humidity help fungi to germinate and penetrate plants through the epidermis (plant skin) or other natural openings. Many plant pathogenic fungi need free moisture to transport enzymes

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Figure 1. Germinating sporangium (structure where spores are produced) of basil downy mildew (*Peronospora belbahrii*).

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Figure 2. Powdery mildew is a disease less affected by moisture once the pathogen infects.

(substances that help a reaction occur more quickly in a living thing) into the leaf or root tissues. This causes the plant cells to soften. At this point, nutrients released from the plants can be conveyed to the germinating organ of the fungus (see fig. 1 on page 3). The motile zoospores (moving spores) of water molds (like *Pythium* and *Phytophthora*) cause damping-off diseases. Damping-off diseases cause seedlings to die in nurseries due to fungi. These zoospores use water to swim towards healthy stems and roots. Pathogens causing other common diseases, such as cedar-apple rust, tomato leaf mold and downy mildew, germinate and penetrate plants when the humidity is high or when the leaves are kept wet for a long time. Unlike many other fungi, those that cause powdery mildews (fig. 2) do not normally require a moist condition after the pathogen releases spores, germinates and infects a leaf. On the contrary, a rain shower or sprinkling of water on the affected leaves helps to wash away

the white powdery fungal spores. Rain could also help lessen other problems, such as spider mites, during the hot summer months.

Bacterial Pathogens and Guttation Fluid

Unlike fungi, bacterial pathogens commonly enter plants through natural openings and wounds. They can also enter with the help of guttation fluid. Guttation fluid is just water from within the plant that moves outside due to root pressure. This occurs at the edge of leaves in a special tissue called a hydathode. Most pathogenic bacteria are flagellated, meaning they move using a whip-like motion. These bacteria also need moisture to swim toward a healthy plant and infect it. Common bacterial diseases include leaf and fruit spots, blights and cankers. With enough wetness and

humidity, they will easily infect plants and spread. To avoid infection through guttation, do not enter nurseries, gardens, greenhouses or the field while plants have dew on their leaves. Disinfect pruners and any equipment that could potentially spread bacterial diseases. Also, it helps to cover the soil with mulch.

Summary

As winter nears and we prepare for next spring, it is a good time to think about watering practices. Keep in mind to water only when needed. Plan ahead to use methods that avoid long periods of humidity and to find ways to curb long intervals of leaf wetness. ■



Figure 3. Optimum spacing, mulching and drip irrigation are some of the best management practices to reduce diseases.

Culling the Herd

By Susan Jaster, Farm Outreach Worker – West Central Region



Culling is an exercise of judgment in herdsmanhood or herd management. By learning about culling, you can improve your herd or flock. Culling is the removal of a substandard animal from the flock or herd. How do you know an animal is substandard? You set the criteria to manage your animals for efficiency, low input and cost savings based on your business plan goals. Setting standards will lead you to keep records. The numbers and data you collect on individual animals will help you make the culling decision.

Individual animal records are very important. You can make or buy this type of record system. It can be simple or complex, but it has to be something you will use. Smart phones have a spreadsheet and a word processing program for keeping records. As long as you have a sturdy case on your device, it will be tough enough to keep with you while observing or while working animals through the chute. However, you can also use paper records on cardstock printed at home. No matter what style of recordkeeping system you use, you must write down the animal's name or number, United States Department of Agriculture (USDA) Scrapie tag num-

ber, birthdate or purchase date, sex, medical treatments, vaccinations, deworming dates and dewormers, kidding/lambing dates, sex of offspring and offspring herd tag numbers, as well as the USDA Scrapie tag number of any offspring.

Before you can keep records, you have to learn how to tag animals with a permanent identification. If you plan to sell the animals at a livestock auction, you will have to attach a Scrapie tag to each animal; or, the auction house will do it for you for a fee. You can learn how to tag an animal, age an animal by looking at its teeth, learn about Scrapie disease and the USDA Scrapie tags at <http://www.slideshare.net/schoenian/teeth-tags-and-a-tse>. One suggestion for tagging is to start your numbering system with a number code that tells you the age of the animal; for example, all animals born in 2014 could have a tag with "14" as the first two digits. After your animals are tagged and their individual information is recorded, you can make decisions based on the data and according to the goals in your business plan.

Here is a sample set of four goals for sheep. Goal 1 is to have healthy

animals that look good when taken to others' property to clean up anything from brush to a fire hazard, poison ivy and/or other weeds. Goal 2 is to have a finished meat lamb by the time it is 12 months old and also sell it by that time. Goal 3 is to have ewes that are very healthy and not too old. They must be able to carry a pregnancy well, give birth to one or two live lambs in each pregnancy and raise them. The ewes must also be able to shed their winter hair by the first week of July and breed back in a timely manner. It is a good idea to have the ewes dewormed shortly before they lamb; also trim their feet, if needed, and give an annual booster of CD/T (Clostridium Perfringens Type C & D-Tetanus Toxoid); this vaccine is needed to prevent the serious bacterial disease enterotoxemia. Goal 4 is to sell ewes when they are six years old. Ewes that do not meet the first three goals get strikes against them.

These goals might seem harsh. However, keeping an older animal entails risk. As a producer, you need to keep your costs down. For that purpose, a young ewe is a healthy ewe. By the time a ewe is six years old, you will have several very high-quality improved genetic copies of her in the flock. And you will be able to get a good price for her because she is not old. She has the potential to fit into another herd because she still has a good body condition score (BCS; see <http://www.uaex.edu/publications/pdf/FSA-9610.pdf>). Or, if she goes to the packer, a good BCS will bring in more dollars per pound. A thrifty (strong and healthy) ewe is the payback for the flock in many ways. Top dollar
(continued on page 7)

Kansas City Feasibility Study Finds Demand for Food Hub

By Katie Nixon, Small Farm Specialist, West Central Region

In September 2014, the results of a nine-month regional food hub feasibility study were released to the public. A food hub is a facility that collects, stores, processes, distributes and/or markets locally produced food. There were positive findings for the growth of the local food industry in the Kansas City area. The study was commissioned by the Kansas City Food Hub Working Group (KCFHWG). This dynamic group of people represents all sectors of the community, including food distribution and small farming. The Health Care Foundation of Greater Kansas City and the Kansas Health Foundation funded the study. For over two years, the KCFHWG has worked to make a food hub a reality for the Kansas City region.

The goals of this group were defined as follows:

- Provide a place for local producers to bring their food, spurring increased production of fresh produce
- Provide a market with competitive prices for small- to medium-sized producers
- Enable regional institutions, such as hospitals and schools, to consistently and reliably secure local food
- Increase food security and healthy eating in the region

The question that brought the KCFHWG together was “How can we help farmers make a better living from farming?” Knowing that local food is in high demand, the KCFHWG brainstormed and considered the best ways that small- to medium-sized farmers might benefit from this trend. A farmer-owned and run food hub was the idea that received widespread support. As a first step, the group ordered a feasibility study.

Many of the study’s findings and recommendations were based on the

There are many reasons for this short supply. One is that expanding a produce operation takes time and capital, which are also lacking. Pricing is another problem. The biggest barrier for interested farmers was concern about fair pricing when selling wholesale.

As a small- to medium-sized grower, there are a few issues around price and production that the food hub would strive to improve:

Marketing: The food hub would make the most of the local food demand and take care of marketing for the farmers, freeing them to focus on production.

Volume: A single farm can find it hard to reach the kind of volume most institutions want to purchase. With many farms working together, much more produce can be moved. With good pre-season crop planning, the food hub can sell a lot more than individual farms on their own.

Market price: The wholesale market is driven by terminal market prices (the prices at a city market where a lot of agricultural produce or animals are sold). However, there is often a five to 10 dollar difference in the average case price of produce. Having more volume to bargain with, the food hub can negotiate for the upper end of the market prices.

Moving “seconds” into the market: Seconds can be sold by the food hub to schools and other institutions;



grower and buyer survey conducted by the consulting team. Of the 197 farmer respondents, 58 were very interested in selling to a local food hub. This equaled 215 acres of vegetable and fruit production. Of the 121 buyers surveyed, 46 were very interested in purchasing from the food hub. As such, the demand far outweighs the supply. The total unmet supply for local food in this region is around \$156 million annually.

Culling (continued from page 5)

this raises the profit margin per acre.

Fuel and efficiency: With an excellent logistics plan, farmers can save time and fuel. The food hub would pick up from the farms efficiently, increasing the profit margin of each case.

To be financially feasible, the food hub must take a percentage of each case of produce sold. The food hub will have to be diligent and work constantly on issues of efficiency and price so that farmers will get as much as possible for each case sold. Fortunately, in a farmer-owned food hub, the farmers make these decisions. They have control over the direction of their business.

The feasibility study showed that for the food hub to be successful, farmers must own it. Also a greater supply of produce will be needed to be financially viable. In the next phase of planning, the KCFHWG will be collaborating with the Douglas County Food Policy Council, from Douglas County, Kansas; their study had findings similar to the Kansas City study. This stage will develop the producer network and help interested producers scale-up production and form a food hub business, potentially as a cooperative.

The 40-page “Kansas City Food Hub Feasibility Study” contains much more information about the survey results and food hub recommendations. The full report can be found here: <http://www.lincolnu.edu/web/programs-and-projects/innovative-small-farmers-outreach-program> ■



from your ewes will pay for a very good ram from a clean flock.

One reason for good recordkeeping is that animals can be culled before the time you have planned to sell them. It is a good idea to operate on a “three strikes, you’re out” rule, realizing that not every problem an animal has counts as a strike. Each time you do anything to a ewe, record it in your flock journal and on her individual record. For example, sheep occasionally step on thorns that get stuck in their hooves. After you pull out a thorn, treat it and trim a ewe’s feet, if needed, be sure to record this. An issue like this is not something to count against her as a strike.

When deciding to give an animal a strike against staying on your farm, it should be because money or extra effort is involved. You might also have a full-time job, a family and want to engage in more than taking care of animals. You might decide that you should not have to trim feet more than twice per year. Perhaps you do not want to bottle-feed lambs. It might be a strike against a ewe if she cannot lamb by herself. If good meat is one of your goals,

you will not want any scarring; therefore, you will not give medications that require injection into a muscle. Another strike might relate to ewes that need extra medication. Having to deworm frequently can also be considered a strike against an animal. Animals that tear up equipment or injure you or other animals should get a strike. This type of policy gives you a chance to review your recordkeeping so that you are sure about each strike. In this way, you will only go to the livestock auction with a full load of animals and when prices are up. And, as the quality of your animals improves, you might even decide to make your culling criteria tighter.

Set your goals, build your program and keep good records so you know where the “strike zone” is on your farm. By culling your flock or herd well, you will see better profits. ■

About Our Program...ISFOP

If you are a small farmer and need information, please contact an ISFOP Farm Outreach Worker (FOW). FOWs live and work in your community. They can provide information on ways to better manage your resources, reduce expense and increase income. They can also provide information on other programs and resources that may increase your income and the overall quality of life for you and for your family.

You are eligible to participate if you meet the following requirements:

- Your family lives on a farm, rural or urban.
- Farm products or income from the farm are necessary for you to live where you do.
- Your family provides the management and most of the labor for your farm.
- Your total annual family income is less than \$50,000.

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