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Amaryllis after the Holidays *by David Trinklein*

Among indoor flowering plants, few can match amaryllis in grandeur. Its blooms are spectacular in size and come in many colors including bright, cheerful red. In addition to being very colorful, it has the added attraction of being relatively easy to re-bloom and can continue to give pleasure to its recipient for many years. For those who might have received an amaryllis for Christmas, now is the time to start the care it needs to provide beauty next year.

The plant commonly sold as amaryllis actually is misnamed and is a member of the genus Hippeastrum, not Amaryllis. Hippeastrum is native to the tropical Americas whereas the true Amaryllis is native to Africa. Both are members of the Amaryllidaceae plant family. "Hippeastrum" comes from the Greek word meaning "horseman's star"; a name most likely selected for this plant because of the resemblance of its flowers to a star-shaped medieval weapon used by horseman. For simplicity's sake we will continue to refer to the plant as amaryllis in this article.

Most of the amaryllis sold today are hybrids developed by the Dutch and were selected for their huge, showy flowers and forcing ease. It is not unusual for a vigorous bulb to produce up to six flowers, four to six inches in diameter, per scape (flower stalk). Since amaryllis is native to the subtropical and tropical Americas, their tender nature forces us to treat them as greenhouse or house plants here in the Midwest.

If you received a flowering amaryllis plant during the holidays, keep its growing medium uniformly moist. Small bulbs may produce only one scape, while large bulbs may produce two or three. After the last flower fades, cut off the scape(s) and place the plant in a bright location, if you are interested in having it bloom again next year. Fertilize the plant with a houseplant fertilize according to label directions and allow the leaves to continue to grow.

If a bulb was received instead of a flowering plant, amaryllis production for the hobbyist is relatively straight-forward. Plant the bulb in a well-drained, highly organic potting mix that retains adequate moisture. A mixture of sphagnum peat, vermiculite and perlite works well. Maintaining this medium in a slightly acid state is desirable. Containers often are furnished with the amaryllis bulb in a kit. If such was not the case, choose a container at least two inches wider than the diameter of the bulb.

The bulb received as a gift already will have a scape formed inside. Exposure to moisture and proper temperatures will cause this scape to elongate, mature and flower. Since amaryllis is tropical by nature, plants respond well to high temperatures (both day and night). A minimum of 70 degrees F. during the day and 60 degrees at night is ideal during the growth cycle of the plants. Temperatures lower than 50 degrees can be injurious and should be avoided. Amaryllis requires, on the average, from six to eight weeks from the beginning of growth to the production of flowers.

Re-blooming amaryllis is relatively easy, but the plant must be allowed to manufacture and store food in its bulb in preparation for the process. This is accomplished by exposing the plant to light as bright as possible during the growth period that occurs after flowering has ended. Adequate water and fertilizer are essential for maximum food production during this period. After the danger of frost has past, moving the plant outdoors into a lightly shaded setting will facilitate growth and improve subsequent blooming.

In September, the plant should be brought indoors and water withheld. This will induce dormancy, which should be maintained for several months. During its dormant phase, an amaryllis should be kept on the cool side and should not receive water. The leaves will wither and dry during this phase and may be removed.

The growth cycle (along with blooming) can be repeated by forcing the plant out of dormancy by watering and subjecting it to warm temperatures as described above. Repotting may be necessary if the bulb has outgrown its original container.

Failure to flower one season does not necessarily mean the plant will not produce flowers the next season. However, failure to flower does mean that growing conditions were not adequate and corrective steps must be taken. Elongated, pale-looking leaves on a flowerless plant is indicative of inadequate light intensity, temperatures that are above optimum or, perhaps, a combination of both.

Amaryllis is a bit easier to re-bloom later in the winter. If there is no need or desire to have the plant in flower for the holidays, allow it to grow outdoors as late as possible in the fall. Do not, however, allow it to be exposed to cold temperatures. Bring the plant indoors before frost, withhold water and allow the leaves to fall off. Place the dormant plant in a bright location and start watering again in January or February for late-winter or early spring flowers.

Organic Management Options for the Japanese Beetle at Home Gardens *by Jaime Pinero and James Quinn*

Introduction

Japanese Beetles were accidentally introduced to the east coast in 1916 in a shipment of iris bulbs. Since then they have slowly and steadily made their way westward. The Japanese beetle has become a major pest of crops, lawns, and ornamental plants in Missouri. In fact, 2017 was the year when the highest populations were recorded thus far. To control this invasive pest, many people are interested in using less or no insecticides, and other control options that are safer for home-owners and also compatible with organic production.

Seasonal Activity of Japanese Beetles

In mid-Missouri, significant numbers of Japanese beetles begin emerging in mid to late June, the population peaks the second week of July, and declines by early August. The timing of the onset and end of Japanese beetle adult activity may vary by a couple weeks depending on weather. For instance, if warm, humid conditions occur – they will emerge earlier. If it's cold and rainy, they may not become active until late June.

Daily feeding behavior is also subject to weather. If you are checking your plants, you might not see any beetles on a cold, rainy day – but don't assume your pest problems are over! Thousands of Japanese beetles may burst from the ground on the very next day if it's warm and sunny. Feeding damage to plants can happen within 48 hours. Your pest management strategy should be "proactive" not "reactive." Don't wait to see catastrophic damage before acting.

Feeding frenzy

Feeding on plant tissue by adult Japanese beetles causes the release of plant volatiles from the damaged sites, and of additional pheromones from females. This results in aggregations of beetles, triggering a feeding frenzy. If you are able prevent beetle aggregations by dislodging or killing the first arrivers, you may be able to limit the damage. Conversely, if a feeding frenzy starts, it will be difficult to remove the beetles unless insecticides are applied.

Organic Management Options for the Japanese Beetle

Biological Control

Japanese beetles are not native to the U.S.A., so there are very few natural enemies that could keep them in check. Some species of parasitic wasps that attack Japanese beetles in the grub and adult stages have been introduced into the country, but they are not commercially available. However, there are some pathogens (organisms that cause diseases) that attack the grubs in the soil.

One naturally occurring bacterium that is commercially available is called Milky Spore®, which is an option for controlling grubs in the soil that damage the lawn. When spores of Milky Spore are ingested by Japanese beetle grubs, they die and in the process they release billions of new spores into the surrounding soil. One example of a commercially-available formulation of Milky Spore is produced by St. Gabriel Organics. Cost to treat 2,400 square feet is about $30. This product is most effective when applied in early- or mid-August, when the grubs are actively feeding. The soil must be above 65 degrees F. It works best to apply it just before rainfall, or consider watering in lightly after application to soak into soil. The number of applications recommended by the label should be considered, applying Spring, Summer, and Fall for two consecutive years (six total). While this significantly increases the expense, it is claimed to give faster control, for up to 20 years.

Japanese beetle larvae killed by Heterorhabditis bacteriophora next to two healthy larvae. Picture by Whitney Cranshaw, Colorado State University, Bugwood.org

There are also several species of nematodes (tiny round worms) that attack Japanese beetle and other soil-dwelling grubs. NemaSeek® consists

of live beneficial nematodes that actively search for grubs in the soil. Cost to treat 1,600 square feet is about $30. Nematodes need to be mixed with water to apply using a backpack sprayer. Usually, two applications—7 days apart, are recommended. Soil temperature needs to be at least 44 degrees F and it needs to stay moist (water every 3–4 days). Nematodes mostly die in winter so they will need to be reapplied annually.

For both milky spore and nematode applications, be cautious with your expectations! Reduced numbers of adult beetles emerging in 'your' yard doesn't prevent them from flying in from areas that aren't treated.

Insecticides

Application of insecticides to control pests including Japanese beetles should be considered the last resort. When exploring chemical control options, farmers/gardeners should select the lowest risk and the most effective products. While many synthetic insecticides are available to control Japanese beetle in the adult stage, there are very few materials approved for organic pest control. As a general rule, organic insecticides are more expensive than their synthetic counterparts and their residual effect is much shorter. This can actually lead to applying more product on a given area because of the tighter treatment intervals. For example, the cost of spraying PyGanic® 5.0 EC (an OMRI-listed insecticide that is based on pyrethrins) against adult Japanese beetles in one-acre plot is approx. $77.00 per application, using the high label rate. If a person sprays PyGanic twice a week for six weeks then the season-long cost of spraying organic insecticides would amount to $924. In addition, most organic insecticides are no safer to non-target organisms (e.g., pollinators) than synthetic materials.

Before applying a pesticide, always thoroughly read the label and make sure to use the proper personal protective equipment.

Mass Trapping

Mass trapping is a topic surrounded by controversy. Research done at some universities has shown that in certain situations, the powerful lures used in Japanese beetle traps actually attract many more beetles than are caught, which can increase plant damage in the nearby areas. Research done over six years in central Missouri by the Lincoln University Integrated Pest management program has shown that blueberry and elderberry plantings can be protected from Japanese beetles by using a mass trapping system involving a double lure system comprised of a floral-based lure and the Japanese beetle sex pheromone, and a modified catching device. The mass trapping system is deployed outside the cropped area. For blueberries, 7 traps per acre have proven to be effective at suppressing beetles from the cropped area. By using mass trapping, over 15.5 million Japanese beetles have been killed in a 6-year period in two farms without spraying the crop with insecticide.

While mass trapping of Japanese beetles is a practical option for farms, mass trapping for residential areas needs to be carefully considered before implementing. A single trap in most situations will be inadequate. Four traps or more are likely needed to establish a perimeter to prevent them from moving into your landscape. One also needs to consider that emptying the traps takes time and should be done at least weekly, more often if needed to keep from overflowing. Disposing of them is unpleasant, as they have a rather foul 'fish-like' odor (due to proteins breaking down). While chickens and pond fish will

Mass trapping designs developed for Japanese beetle control.
Left: Mass trapping design made of an aluminum mesh sock 4 feet long by one foot in diameter. Right: High-capacity mass trapping system intended to be used by farmers on farms or in rural areas. Japanese beetle lures are always used in conjunction with trap tops that consist of yellow panels that intersect at 90° with a funnel underneath ending in a wide rim. Beetles hitting the vane fall through the funnel into the collecting device.

eat them, if given too many for too long, will either get too full or lose interest. Some unwanted wildlife e.g. raccoons may be attracted to the traps or dead beetles. Whether or not to use mass trapping depends on several factors including costs, value of the crop, other options available, time commitment, and type of setting (farm / rural areas versus urban neighborhoods). Consider, the entire trapping period may last for 6 to 8 weeks!

If you are interested in learning more about mass trapping, check out the IPCM Newsletter: Mass Trapping as an Organic Management Option for the Japanese Beetle on Farms.

Cultural Controls

In agricultural settings Japanese beetles numbers can be reduced by tillage, groundcovers and, to some extent, by managing irrigation regimes. For example, researchers from Michigan State University found that Japanese beetle numbers drastically increased with buckwheat planted between rows of blueberry as compared to clover, ryegrass, or bare soil. Another study found that female Japanese beetles choose to lay their eggs more often and in higher numbers in fescue vs. warm season turf grasses. Females also choose to lay their eggs in moist soil, so withholding irrigation during peak egg-laying season can help reduce grub populations as well.

Careful selection of Plant Varieties

Many plant varieties are not favored by Japanese beetles and therefore are unlikely to suffer significant feeding damage (see table below).

Plant Varieties Least Favored By Japanese Beetles	Plant Varieties Most Favored by Japanese beetles
Arbovitae	American and English elm
Boxelder	Birch
Boxwood	Black walnut
Clematis	Elm
Dogwood	Grape
Euonymus sp. (burning bush, etc.)	Hawthorn
Forsythia	Hollyhock
Hemlock	Horse-chestnut
Hickory	Japanese and Norway maple
Holly	Larch
Juniper	Linden
Lilac	London planetree
Magnolia	*Malus* spp. (crabapple, apple etc.)
Mulberry	Mountain ash
Northern red oak	Pin oak
Pine	*Prunus* spp. (flowering cherry, etc.)
Red and silver maples	Pussy willow
Redbud	Rose Spruce
Sweet gum	Raspberry
Tulip poplar (tuliptree)	Virginia creeper
Yew	Willow

The above information was taken from Iowa State University, with permission.
http://www.ipm.iastate.edu/ipm/hortnews/2010/7-14/japanesebeetle.html

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Cleaning and Disinfecting Pruning Tools for Orchard Crops *by Michele Warmund*

Winter is a perfect time to inspect and clean shears, loppers, and saws before pruning shrubs and trees. If blades on pruning equipment were dull and nicked or tore plant tissue after cutting when they were last used, consider sharpening them or purchasing new blades. Replacement blades for Felco brand hand shears can be purchased at a fraction of the cost of new pruners. Even if blades of pruning equipment are sharp, they may need to be thoroughly cleaned to remove soil or sap left from their last use. Use a damp cloth or paper towel or simply soak blades in warm water for a short time to loosen debris. Make sure to dry the blades after washing them. For plant sap that is hard to remove, paint thinner can be applied to pruning blades and rinsed off after its use to prevent corrosion.

Pruning tools should also be disinfected to prevent the spread of pathogens among plants. Although it is not always practical to handle disinfectants when making multiple cuts on the same tree or pruning several trees or shrubs, it will minimize plant loss. Disease organisms may not be visible on tools, but they can be spread from plant to plant during pruning. Several products are available for disinfecting pruning equipment, including alcohol, chlorine bleach, trisodium phosphate (TSP), pine oil, or other household products.

Ethanol or isopropyl alcohol are ideal for sanitizing pruning equipment because blades can simply be wiped or dipped into disinfectant without a prolonged soak. Products sold as rubbing alcohol usually contain 70% isopropyl alcohol and can be used directly from the container. Ethanol can also be used without dilution. Both types of alcohol can be purchased at drugstores or variety stores. Like other flammable products, they should be stored away from heat sources.

Unlike alcohol, chlorine bleach should be diluted to a 10% solution before disinfecting blades of equipment. To prepare a 10% solution, mix one part bleach (using any brand available) to nine parts of water. When preparing a bleach solution, avoid inhalation of fumes, wear rubber gloves to prevent skin contact, and protect your clothing from bleaching. Use the bleach solution within two hours after it was prepared and soak blades of pruning equipment for 30 minutes. Because bleach solutions become 50% less effective as a disinfectant after two hours, make a new solution after this time. After soaking blades in bleach, rinse tools with clean water to prevent corrosion. Although chlorine bleach is inexpensive and readily-available, it is not as effective against viruses as some other disinfectants.

Household disinfectants, such as Lysol or household wipes can be used to sanitize pruning blades, but their effectiveness against plant pathogens has not been widely evaluated. While most household products are commonly available and are not generally corrosive, they are relatively expensive compared with other disinfectants.

Pine oil is available as a multi-purpose household cleaner at some retail outlets. Blades of pruning tools can be soaked in a 25% solution (one part pine oil to three parts water). While not as corrosive as chlorine bleach or TSP products, pine oil is also not as effective as bleach for disinfecting pruning equipment. Pine-Sol products currently sold in stores do not contain pine oil and their usefulness as a disinfectant for pruning tools is unknown.

Products containing TSP are relatively inexpensive when purchased at hardware, home-improvement, or other retail stores, but are corrosive to pruning blades. Products containing TSP are often sold as all purpose or heavy-duty cleaners for decks, siding, or for surfaces in preparation for painting. Like chlorine bleach, TSP products should be diluted to a 10% solution, using gloves to prevent skin contact with undiluted granular material. To disinfect blades of pruning shears, soak them in the 10% solution for at least three minutes before rinsing with water and drying them. While TSP products may be useful before pruning, the time required for soaking limits their usefulness during pruning.

Several multipurpose disinfectant products can be purchased from horticultural suppliers for greenhouse and field use. Some of these products, including Physan, Kleengrow, GreenClean, Greenshield, and MicroBLOC are labeled specifically for ornamental crops, non-food surfaces, packing lines (SaniDate), or cutting tools (ZeroTol). Some products require a ten minute waiting period after application, but do not require rinsing afterwards. Carefully read and follow label precautions when using these disinfectants.

Regardless of the disinfectant used, sanitizing tools during pruning is beneficial to minimize the spread of hard to control disease organisms that have few pesticides available for their control. Since there are many disinfectants available, chose the product that is most practical for your situation.

Recycling Wood Ashes *by David Trinklein*

Cold winter nights make the warmth of a crackling fireplace or a cozy wood stove particularly pleasant. However, after the fire subsides the task of disposing of the ashes may be a problem. For gardeners, wood ashes spread on garden soils are an excellent and free source of calcium and other essential plant nutrients, if not overdone. An understanding of the action of wood ashes on soil will help to determine when to stop.

Ashes represent the organic and inorganic remains after the combustion of wood. For centuries they have been used for various purposes. Most gardeners are familiar with the term potash when used to describe nutrient forms of the element potassium. The term comes from an early production procedure where potassium was leached from wood ashes and concentrated by evaporating the leachate in large iron kettles or pots. As early settlers cleared land for agriculture and burned the wood, potash sales because an important source of income.

Wood ashes contain other minerals in addition to potassium. Their composition varies due mainly to the species of wood burned. As a rule, hardwood species produce three times more ashes and five times more nutrients than softwood species. Additionally, wood ashes contain few if any elements that represent environmental hazards.

Since carbon, nitrogen and sulfur are the elements primarily oxidized in the combustion process, wood ashes contain most of the other essential elements required for the growth of the tree used as fuel. As an average, wood ashes contain (by weight) 1.5 to 2 percent phosphorous and 5 to 7 percent potassium. If listed as a fertilizer, most wood ashes would have the analysis of 0-1-3 (N-P-K). Not implied in the preceding is the fact that the calcium content of wood ashes ranges from 25 to 50 percent.

The calcium in wood ashes is in the oxide form. When wood ashes are placed outdoors and weathered, the calcium oxide changes to calcium hydroxide, and finally to calcium carbonate. Therefore, because of their high calcium content, it's probably best to think of wood ashes as a liming material to adjust soil pH rather than a regular fertilizer to supply a wide array of nutrients.

The ideal pH range for most garden plants is about 6.0 to 6.5. When soil pH readings fall below this range, certain essential mineral elements become less available to the plant. Since garden soils tend to become more acid as plants take up nutrients, periodic pH adjustment to decrease soil acidity (increase pH readings) is necessary.

Most wood ashes have an acid neutralizing equivalent of about 45 to 50 percent of calcium carbonate (limestone). In other words, it takes about twice the weight of wood ashes compared with limestone to cause the same change in soil acidity. For example, if soil test results indicate your soil needs five pounds of limestone per 100 square feet of garden area to raise the soil pH to an acceptable level, it would require 10 pounds of wood ashes to make the same change.

If small amounts of wood ashes are applied to the garden on a yearly basis to supply other nutrients such as phosphorus and potassium, a soil test every two to three years is recommended. Excessive application of wood ashes can lead to a buildup of pH above the optimum range. This can result in other nutritional problems because of reduced nutrient availability at high pH values.

What constitutes a reasonable application of wood ashes? Five to ten pounds per 100 square feet of garden soil is considered average. If applied as a pre-plant it is best to thoroughly incorporate this amount into the soil three to four weeks in advance of planting. Alternatively, wood ashes can be used as a sidedressing around growing plants. Keep in mind, however, that they are not a rich source of any of the major essential mineral elements other than calcium.

Excess wood ashes not applied to the garden immediately should be stored under dry conditions. Ashes piled outdoors lose most of their potassium content in a year's time due to leaching from rains. Additionally, weathered wood ashes' ability to act as a liming agent also is greatly reduced.

Even though they do contain some carbon, because of the fine nature of wood ashes, they have little effect on soil structure. Therefore, they are not considered to be a soil conditioning agent. The carbon compounds that act as a soil conditioner when sawdust, leaf mold or compost are applied to garden soil, for the most part, have been consumed by the fire that created the ashes.

Wood ashes are highly alkaline. As a safety precaution, wear protective glasses, gloves and a dust mask when spreading them on the garden. Additionally, ashes that result from burning cardboard, trash, coal or treated wood of any type should not be used on the garden, since they make contain potentially harmful materials.

Common Spiders of Missouri: Identification, Benefits, and Concerns *by Austen Dudenhoeffer & Jaime Pinero*

Introduction

While many people have "Arachnophobia" (an instinctive or learned fear of spiders), the vast majority of arachnids are actually harmless to us. Spiders are very sensitive to vibration and their first instinct is typically to run and hide when disturbed. The majority of accidental bites occur when spiders in clothing or shoes are squished by the wearer. Usually, this only results in temporary redness and itching. Only two species of spider in Missouri are considered medically significant: the brown recluse and female "black widow."

True spiders are members of the order Araneae. They have 8 walking legs with tiny retractable claws on each foot. Most have a cluster of 6-8 eyes on the top of their head. These eyes provide them with great depth perception since they combine multiple layers of vision into one–like 3D glasses. Orb weavers build elaborate hanging webs with sticky silk. However, not all spiders build traditional webs, some are opportunistic ambush predators. They sometimes make "web carpet" security systems with vibration alarm "trip wires." Sitting quietly on the silk–their body, covered in sensitive hairs, tells them when a potential meal is walking by.

Benefits

Spiders are beneficial because they feed on many common insect pests including aphids, caterpillars, leafhoppers, grasshoppers, mosquitoes, and flies. A recent study estimated arachnids consume 400-800 million metric tons of prey each year and over 90% of that biomass is invertebrates. According to Lund University, "Spiders eat more insects than people eat meat and fish." Without these important biological control agents, pest numbers would increase exponentially.

"Daddy Long-Legs"

One of the most easily recognized "spiders" is the "daddy longlegs" or "harvestman" (Leiobunum ventricosum). Contrary to popular myth, "daddy longlegs" have no venom and no fangs, nor can they produce silk! In fact, the harvestman has only one body segment, instead of two, so it's not a "true spider" at all. They belong to the order Opiliones, not Araneae. They are omnivorous scavengers that feed on decaying organic matter or small insects. People often handle daddy longlegs with their bare hands, knowing they are completely harmless.

Common Missouri Spiders

Common house spiders (Parasteatoda tepidariorum), cellar spiders (Pholcus spp.), crab spiders (Xysticus spp.), and yellow garden spiders (Argiope aurantia) are frequently seen in gardens or residential areas. While the common house spiders may look scary with a body shape similar to the infamous black widow, its grey coloration, white marbling and banded legs make it easy to distinguish. It feeds on flies, crickets, wood louse, and other household pests. Cellar spiders have tiny tan bodies, long hair-like legs, and black-spotted knees. Often, they are seen hanging from loose strands of silk on the ceiling--waiting to catch a house fly. Crab spiders have a unique ability to change color like an octopus–camouflaging themselves to blend in with flower petals as they await their next meal. The yellow garden spider is perhaps the largest and most beautiful orb weaver in the state. Females with striking yellow, black, and blue coloration are easily spotted resting in the center of their giant web.

Ambush Spiders

Common species of spiders that ambush their prey include jumping spiders, wolf-spiders, and the Missouri tarantula. Adult jumping spiders are typically black in color and 1 inch (2.54 cm) in length. They have green pedipalps and a white patterned abdomen that resembles a face. As the name implies, they can "jump" (up to 50 times their body length!).

Harvestmen (*Leiobunum* spp.) Photo credit: Edward L. Manigault, Clemson University Donated Collection, Bugwood.org

LEFT American house spider (*Parasteatoda tepidariorum*, formerly known as *Achaearanea tepidariorum*). Photo credit: Joseph Berger, Bugwood.org. **RIGHT** Cellar spiders (*Pholcus spp*). Photo credit: Joseph Berger, Bugwood.org.

LEFT Ground crab spiders (*Xysticus* spp.) Photo credit: Joseph Berger, Bugwood.org **RIGHT** Yellow garden spider (*Argiope aurantia*). Photo credit: David Cappaert, Bugwood.org.

Spiders from the "wolf" family (Lycosidae) received their name because they are frequently seen prowling the ground in search of bugs to eat. They can attain sizable leg spans of 4 inches (or more) and are often mistaken for tarantulas.

There is one species of tarantula found in Missouri, Aphonopelma hentzi. It is brown in color, lives in burrows, and grows to leg spans of 6 inches. A docile new world species found in the Ozarks (southern Missouri), it poses no harm to humans. If provoked to bite, it would only hurt like bee sting. Nobody in history has ever died from a tarantula bite.

Daring jumping spider (*Phidippus audax*). Photo credit: Joseph Berger, Bugwood.org.

Wolf spider (*Rabidosa rabida*). Photo credit: Karan A. Rawlins, University of Georgia, Bugwood.org.

The Missouri Tarantula (*Aphonopelma hentzi*), also known as Texas Brown, is the only tarantula species inhabiting Missouri. Photo credit: Jon Hill.

Brown Recluse

Loxosceles reclusa is commonly found throughout Missouri. It's called the "brown recluse" for obvious reasons and most easily recognized by the distinct violin shaped marking on its carapace. Although this spider has received a lot of negative publicity for having necrotic venom that "rots flesh"–bites from this species are very rare. Only 10% of brown recluse bites are medically significant. About 90% heal on their own.

Brown recluse (*Loxosceles reclusa*). Photo credit: Lisa Ames, University of Georgia, Bugwood.org.

black widow

There are multiple species of black widow spiders in the U.S. This spider is regarded as the most venomous spider in North America. Females are easily recognized by their black color, large abdomen, and a red hourglass pattern underneath. They build loose, scraggly webs in sheltered places that look like a tangled ball of yarn. While accidental bites may be very painful and require medical attention, nobody has ever died from a North American black widow.

Black widow (*Latrodectus mactans*). Photo credit: Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org.

Conclusion

While they are often demonized and misunderstood, arachnids certainly benefit us in many ways. For instance, they serve a vital role in the environment by consuming a large number of insects they prey on, including a number of pest species. While many people respond with fear at the sight of a spider, understanding that the vast majority of them are harmless and actually beneficial may help us gain a new appreciation for them.

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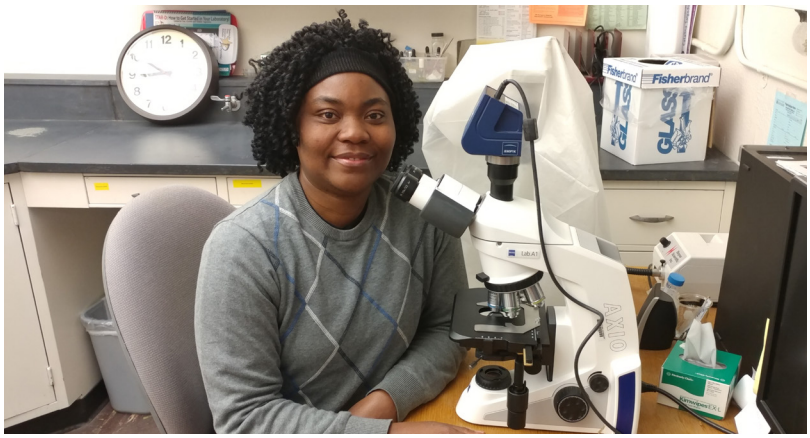
Reopening of the Plant Diagnostic Clinic 2018

Josephine Mgbechi-Ezeri



Hurray! The Plant Diagnostic Clinic is back again. The clinic was established to provide answers to plant health problems faced by the citizens of Missouri. The mission of the clinic is to provide accurate, timely answers and management recommendation that reflects research-based results and an integrated pest management (IPM) philosophy. Besides answering plant disease problems, the clinic also handles samples submitted for identification of weeds, mushroom, insects or arachnids. Starting January 8th, Josephine Mgbechi-Ezeri will serve as the new clinic Director. Josephine's role is to coordinate the daily operations of the laboratory, provide diagnostic services to clients and disease management training to the agricultural stakeholders in Missouri. When necessary, the clinic can utilize the expertise of University of Missouri State Extension Specialists and faculty in the Division of Plant Sciences who specialize in Agronomy, Entomology, Horticulture or Plant Pathology to ensure accurate and effective diagnosis and reporting. We welcome samples from government agencies, growers, industries and homeowners throughout the state.

Please visit the Plant Diagnostic Clinic website for:

- Information on how to collect and ship a sample
- Submission forms (types of samples accepted)
- Plant Disease Identification
- Turfgrass Disease Identification
- Insect / Arachnid Identification
- Plant / Weed Identification (to include mushrooms)
- Clinic hours for dropping off a sample
- Fees associated with services

Contact information:
University of Missouri–Plant Diagnostic Clinic
28 Mumford Hall
Columbia, MO 65211

Phone: 573-882-3019
Email: plantclinic@missouri.edu
Web: http://plantclinic.missouri.edu/

Minimizing Apple Tree Loss by Choosing a Fire Blight Tolerant Cultivar and Rootstock

Michele Warmund

Fire blight is a devastating bacterial disease in Missouri. It commonly causes loss of apple trees under favorable conditions. Young apple trees are particularly susceptible to fire blight. In young tissue, bacteria can spread from the upper branches through the graft union and into the rootstock in 21 days. Infection during the first three years after planting can cause tree mortality. After this age, it is less likely that fire blight will kill the apple tree by progressing into the rootstock.

Erwinia amylovora, the pathogen that causes fire blight, overwinters in cankers (sunken diseased areas) on the bark. When humidity is high in the spring, the pathogen oozes out of cankers and insects carry the bacteria from the cankers to flowers. Bacteria multiply rapidly in the blossom nectar and infect the flowers through natural openings called nectaries. Infected blossoms turn brown and die, usually with the flower parts remaining attached.

Bacterial infections on new shoots of apple trees occur in the spring and early summer when foliage is wet and temperatures are between 60 to 75°F. Infected leaves and terminal shoots turn black and often form a shepherd's-crook of dead tissue (Figure 1). Often the pathogen moves from the infected shoot tissue into older parts of the tree, including the trunk and rootstock, and forms cankers. The pathogen can also colonize natural openings in the bark, such as lenticels, and areas where the bark is wounded from pruning cuts, hail, or mechanical damage. During pruning, the disease can be spread from tree to tree on the blades of shears.

Because fire blight is one of the most difficult diseases to control, select a resistant apple cultivar for planting (Table 1). When possible, also choose a rootstock with high resistance to fire blight, such as G.16, G.30, G.202, or G.41. Avoid highly susceptible rootstocks such as M.9 and M.26. When highly or moderately susceptible apple cultivars and rootstocks are planted, fire blight control will be necessary when conditions are optimal for disease development. For more information regarding fire blight control options, refer to MU Extension Guide G6020.

Figure 1. A terminal shoot infected with fire blight has the typical "shepherd's crook" symptom with dead leaves remaining on twigs.

Table 1. Fire blight susceptibility of selected apple cultivars.

Highly susceptible	Moderately susceptible	Least susceptible
Ben Davis	Cortland	Arkansas Black
Braeburn	Enterprise	Delicious
Fuji	Golden Delicious	Empire
Gala	GoldRush	Freedom
Ginger Gold	Honeycrisp	Liberty
Granny Smith	Jonafree	
Jonagold	McIntosh	
Jonathan	Pristine	
Lodi	Redfree	
Pink Lady	Winesap	
Suncrisp	York Imperial	

Hydrangea: The chameleon of plants *David Trinklein*

From the Easter season through Mother's Day, hydrangea is one of the most sought-after flowering plants from retail florists and garden centers alike. It's huge, globe-like clusters of blooms impart a regal elegance that is uncommon among potted plants. Unlike other flowering plants, however, the flower color of most hydrangeas can be changed from year-to-year, with a little help from their caregiver. Many gardeners, therefore, consider hydrangea to be the chameleon of the plant world.

Hydrangea is a genus in the plant family Hydrangeaceae. The genus contains nearly 75 species of shrubs or small trees, most of which arenative to the region of Asia now occupied by China, Korea and Japan. The word, hydrangea, is derived from the Greek hydro meaning "water" and angeion meaning "vessel". Although the name was given to the plant because of the shape of its seed pods, it is fitting in another way. Hydrangea plants have a very high water requirement and should never be allowed to dry out.

Florists' hydrangea (Hydrangea macrophylla var. macrophylla) has been an important greenhouse crop for decades. It produces flowers in flowerheads that (botanically) are classified as either corymbs or panicles. Individual flowers of florists' hydrangea contain large, showy sepals which surround a center core of smaller, less conspicuous flowers. The color of hydrangea flowers can be controlled by altering the plant's soil environment. Flowers are pink if the plant is growing at a soil pH that is nearly neutral. Blue flowers can be produced by acidifying the soil with aluminum sulfate. It actually is the element aluminum which turns the flowers blue. However, aluminum is more readily available for plant uptake at low pH values, hence the need to keep pH low. The color of white hydrangea flowers cannot be changed.

When grown as a potted plant, as mentioned above, it is essential to keep hydrangea moist at all times. Given adequate amounts of water, potted hydrangeas may be kept attractive indoors for several weeks. If the plants are allowed to dry out, the flowers will collapse quickly, even before the leaves show any sign of wilting. Once flowers become badly wilted, they will never recover.

After potted hydrangeas have finished flowering, one of several choices must be made. The plant may be discarded, kept for reblooming or planted outdoors in the garden. Your choice might depend upon your geographical location as well as your interest in gardening. If you have little or no gardening interest, then enjoy the plant until the flowers wither and then discard it. If you like a challenge, you might want to attempt to rebloom the plant.

To rebloom a hydrangea indoors, cut its shoots back after the plant has finished flowering so that two pairs of leaves are left on each shoot. If necessary, repot using a soilless growing medium containing a high percentage of peat moss. After the danger of frost has past, move the plant outside and sink the pot into the soil where it gets full morning sun but light afternoon shade. Water the plant regularly and fertilize with a complete liquid fertilizer about every two weeks. For extra-large flower heads, allow only about three stems to develop. When removing extra shoots, take out those that grow toward the center of the plant. Lift the pot occasionally during the summer to keep root growth from moving outside the pot. To keep shoots from becoming too long, pinch them back during the summer. The last pinch should be made no later than July.

Keep the plant outdoors as long as possible in the fall, but bring it indoors before a hard freeze. Allow

the plant to retain its leaves until about November 1st. Then, pick off all the leaves by hand or put the plant in total darkness until all leaves drop naturally. The leafless plant must be vernalized (exposed to cool temperatures) in order to induce subsequent flowering. This involves keeping it at temperatures from 35 to 40 degrees F for about six weeks. During this time, the plant can be kept dry since it has no leaves.

After the cooling period, move the plant to a sunny, cool room, with night temperatures of 55 to 60 degrees F. Water it well and fertilize about every two weeks. It should flower in about four months.

Alternatively, if you live in the southern third of Missouri (hardiness zone six) potted hydrangeas can be planted in the garden for years of enjoyment. Wait until the danger of frost has past and make sure to water the plant regularly until it is established in the garden.

In the garden, hydrangea is prized both for its foliage and its flowers. Flower buds form on the plants in the fall; therefore, these buds must survive the winter if they are to flower the following summer. Keep in mind that the flower buds are not as cold hardy as the remainder of the plant. During severe winters protection from the cold might become necessary.

Large baskets or boxes may be inverted over the plants to help protect the tender buds. Alternatively, a wire cylinder filled with a loose mulch can be place over the plants. Evergreen boughs work well. Loose mulch is important since a dense mulch that retains moisture can promote disease infestation of the flower buds. In milder winters, protection is not necessary.

Other types of hydrangeas are more suitable for outdoor, garden conditions. One of these is 'Hills-of-Snow' hydrangea (Hydrangea arborescens). Unlike florists' hydrangea, this plant is able to flower on new growth. Therefore, plants can be pruned more severely and still flower well. Although available only in white, it bears large flower clusters that are very attractive.

'Pee Gee' hydrangea (Hydrangea paniculata) is a woody, tree-like hydrangea that produces white flowers in large clusters that are somewhat pyramidal in shape. In mild climates, it may eventually reach a height of 25. Somewhat tender, 'Pee Gee' may suffer from winter damage at our latitude which tends to keep plants smaller.

Oak-leaf hydrangea (Hydrangea quercifolia) is very attractive and well adapted to our climate. It has large, showy leaves which turn red in the fall. It grows and flowers well in shade and is a good choice for difficult, low-light areas. It produces white flowers in early summer which gradually change color to pinkish-purple. The latter color is maintained until the flowers turn brown in the fall. Oak-leaf hydrangea is a shrub with relative few problems and deserves more attention than it currently receives.

Whatever the species, it must be noted that hydrangea tissue contains cyanogenic glycosides and is considered moderately toxic. Therefore, hydrangea should be handled with proper care and kept away from children and pets.

Guidelines for Soil Sampling Vineyards *Manjula Nathan*

Nutritional needs of grapevines are assessed by a combination of soil testing, and plant tissue analysis. Soil testing helps in monitoring changes in the soil pH, nutrients, and organic matter levels over time. To compare soil nutrient changes over time, it is best to soil sample at the same time of the year. Spring is a good time to test the nutrient levels in your vineyards.

Soil sampling before planting and after establishing vineyards are essential for establishing good nutrient management plan. Test your soil at least about three to six months in advance before planting so that there will be sufficient time to apply fertilizer and lime treatments to provide a favorable environment for grapevine growth and establishment. Lime takes about three to six months to react with the soil to raise the soil pH. Likewise, if your soil has very high pH you may have to apply elemental sulfur to reduce the pH. This is a biological reaction and will take about the same time like lime to make changes in soil pH.

Soil testing on a regular intervals following establishment (once in three years) is important in determining and maintaining desirable soil pH in the upper few inches of soil. At pre planting, it is recommended to take a separate sample at 6 inch depth and another sample from 6 to 12 inch depth. As roots will explore larger volume of soil it is important that the second depth is used to make sure sufficient nutrients and lime are applied before planting. On established vineyards, taking the surface 6 inch depth sample is sufficient.

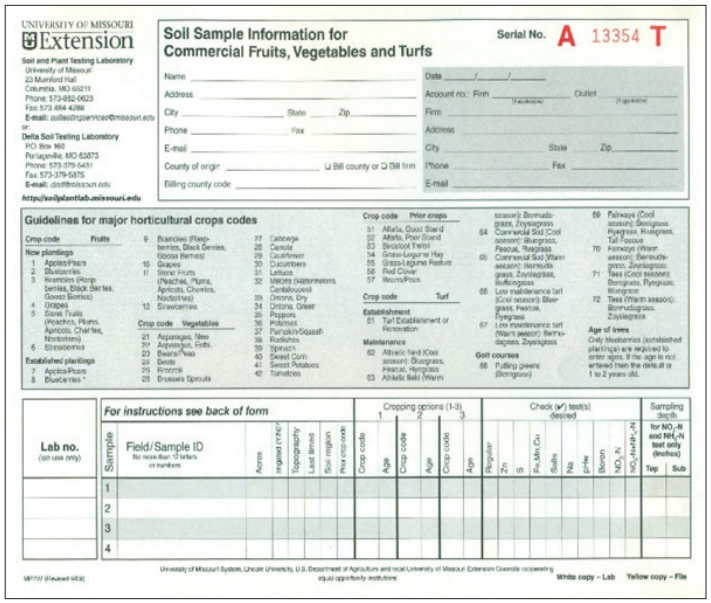
Taking a representative sample from the vineyards is an important step in soil testing. Use a soil probe, trowel or spade to take sample. First use the map of your vineyard to divide the area into smaller sections with similar soil texture, color, drainage, slope and prior cropping history. When sampling, avoid bunds, big stones, ends of the rows, and boundary area of the field. Mark the areas you are sampling in the map so that you can sample the same areas to monitor the nutrient status over time.

Take a minimum of 10 to 15 cores in a zigzag fashion from every five acres. If your vineyard is uniform you can take 15 to 20 cores per every 10 acres. Make sure to collect samples at 6 -inch depth by taking multiple cores as recommended from each area, collect it in a clean bucket, mix the samples very well and take one and a half cup full of the homogenized sample and submit to the lab. A regular fertility test package that includes pHs, P, K, Ca, Mg, organic matter, neutralizable acidity, estimated CEC with recommendations should be selected for analysis.

University of Missouri Soil and Plant Testing lab provides soil, plant, water, compost, greenhouse media and manure analysis. Sample submitted to the lab should be accompanied a by a duly filled soil sample submission form for "Commercial Fruits, Vegetables and Turf" (MP 727). Samples can be submitted via County Extension Centers or directly to the lab. When submitting samples directly to the lab, payment by check for the amount due written in favor of "MU soil testing lab" should be mailed along with the sample. Information on taking a representative sample, sample submission forms, and how to submit samples to the lab can be found at the lab's website at: http://soilplantlab.missouri.edu/soil/.

MU Soil and Plant Testing Lab
23 Mumford Hall
University of Missouri
Columbia, MO 65211
Email: soiltestingservices@missouri.edu
Phone at 573-882-0623

Sample soil submission form



UNIVERSITY OF MISSOURI Extension

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University of Missouri
23 Mumford Hall
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or:
Delta Soil Testing Laboratory
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Portageville, MO 63873
Phone: 573-379-5431
Fax: 573-379-5875
E-mail: dstl@missouri.edu
http://soilplantlab.missouri.edu

Soil Sample Information for Commercial Fruits, Vegetables and Turfs

Serial No. A 13354 T

Name
Address
City State Zip
Phone Fax
E-mail
County of origin ☐ Bill county or ☐ Bill firm
Billing county code

Date
Account no.: Firm Outlet
Firm
Address
City State Zip
Phone Fax
E-mail

Guidelines for major horticultural crops codes

Crop code Fruits
New plantings
1 Apples/Pears
2 Blueberries
3 Brambles (Rasp-berries, Black Berries, Boysen Berries)
4 Grapes
5 Stone Fruits (Peaches, Plums, Apricots, Cherries, Nectarines)
6 Strawberries
Established plantings
7 Apples/Pears
8 Blueberries

9 Brambles (Rasp-berries, Black Berries, Boysen Berries)
10 Grapes
11 Stone Fruits (Peaches, Plums, Apricots, Cherries, Nectarines)
12 Strawberries

Crop code Vegetables
21 Asparagus, New
22 Asparagus, Exits
23 Beans/Peas
24 Beets
25 Broccoli
26 Brussels Sprouts
27 Cabbage
28 Canola
29 Cauliflower
30 Cucumbers
31 Lettuce
32 Melons (Watermelons, Cantaloupes)
33 Onions, Dry
34 Onions, Green
35 Peppers
36 Potatoes
37 Pumpkin/Squash
38 Radishes
39 Spinach
40 Sweet Corn
41 Sweet Potatoes
42 Tomatoes

Crop code Prior crops
51 Alfalfa, Good Stand
52 Alfalfa, Poor Stand
53 Bermudagrass Hay
54 Grass-Legume Hay
55 Grass-Legume Pasture
56 Red Clover
57 Prairie/Grass

Crop code Turf
Establishment
61 Turf Establishment or Renovation
Maintenance
62 Athletic field (Cool season): Bluegrass, Fescue, Ryegrass
63 Athletic field (Warm season): Bermuda-grass, Zoysiagrass
64 Commercial Sod (Cool season): Bluegrass, Fescue, Ryegrass
65 Commercial Sod (Warm season): Bermuda-grass, Zoysiagrass, Buffalograss
66 Low maintenance turf (Cool season): Blue-grass, Fescue, Ryegrass
67 Low maintenance turf (Warm season): Bermu-dagrass, Zoysiagrass
Golf courses
68 Putting greens (Bentgrass)
69 Fairways (Cool season): Bentgrass, Ryegrass, Kinagrass, Tall Fescue
70 Fairways (Warm season): Bermuda-grass, Zoysiagrass
71 Tees (Cool season): Bentgrass, Ryegrass, Bluegrass
72 Tees (Warm season): Bermudagrass, Zoysiagrass
Age of trees
Only blueberries (established plantings) are required to enter ages. If the age is not entered then the default is 1 to 2 years old.

Lab no. (lab use only)	Sample	Field/Sample ID (no more than 10 letters or numbers)	Acres	Irrigated (Y/N)	Topography	Last limed	Soil region	Prior crop code	Cropping options (1-3) 1 Crop code	1 Age	2 Crop code	2 Age	3 Crop code	3 Age	Check (✔) test(s) desired: Regular	Zn	S	Fe, Mn, Cu	Salts	Na	pHw	Boron	NO_3-N	NO_3-N/NH_4-N	Sampling depth for NO_3-N and NH_4-N test only (inches) Top	Sub
	1																									
	2																									
	3																									
	4																									

For instructions see back of form

University of Missouri System, Lincoln University, U.S. Department of Agriculture and local University of Missouri Extension Councils cooperating
equal opportunity institutions

MP727 (Revised 9/03)

White copy – Lab Yellow copy – File

Soil testing: an essential tool for healthy lawns and gardens *Manjula Nathan*

The MU Soil and Plant testing labs are busy with spring rush! Have you tested your soil? If not, go-ahead and take a representative sample from your lawn and gardens and submit for testing. The soil test provides an excellent idea about the nutrient status and pH of your soil. It provides you unbiased research based fertilizer and lime recommendations to manage your soil to grow greener lawns and healthy gardens. It is an inexpensive way to maintain good plant health and maximum productivity without polluting the environment by over application of nutrients.

Soil fertility fluctuates throughout the growing season each year. The amount and availability of nutrients varies with addition of fertilizers, manure, compost, mulch, lime or sulfur and by leaching. Also, nutrients are removed from soils as a result of plant growth and by harvesting of crops. A soil test will determine the current fertility status of your lawn and gardens.

Some plants grow well over a wide range of soil pH, while others grow best within a narrow range of pH. Most turf grasses, flowers, ornamental shrubs, vegetables and fruits grow best in slightly acid soils (pH 6.1 to 6.9). Plants such as rhododendron, azalea, pieris, mountain laurel and blueberries require a more acidic soil to grow well. A soil test is the only precise way to determine whether the soil is acidic, neutral or alkaline.

A soil test takes the guesswork out of fertilization and is extremely cost effective. It not only eliminates the expense of unnecessary fertilizers but also eliminates overuse of fertilizers and helps to protect the environment.

When is the best time for a soil test?

Soil samples can be taken in the spring or fall for established sites. For new sites, soil samples can be taken any time when the soil is workable. Most people conduct their soil tests in the spring. However, fall is a preferred time to take soil tests if one suspects a soil pH problem and wants to avoid the spring rush. Fall soil testing will allow you ample time to apply lime to raise the soil pH. Sulfur should be applied in early spring if the soil pH needs to be lowered.

How to take a soil sample?

Most errors in soil testing occur when the sample is taken. Potential sources of errors include the following

- Too few cores per sample
- Failure to properly divide the area to be sampled
- Failure to cover the whole area
- Contaminated sample

Taking a representative sample is important in soil testing. Use a trowel, spade and sampling tube/core samplers.

- For garden and lawn establishment or renovation, take a 6-inch sample.
- For established lawns, take a 3- to 4-inch sample after removing thatch.
- Sample from five or more scattered/random spots in the test area.

What soil sampling tools do I need?

A soil sample is best taken with a soil probe or an auger. Samples should be collected in a clean plastic pail or box. These tools help ensure an equal amount of soil to a definite depth at the sampling site. However, a spade, knife, or trowel can also be used to take thin slices or sections of soil.

Push the tip of a spade deep into the soil and then cut a 1/2-inch to 1-inch slice of soil from the back of the hole. Be sure the slice goes 6 inches deep and is fairly even in width and thickness. Place this sample in the pail. Repeat five or six times at different spots over your garden. Thoroughly mix the soil slices in the pail. After mixing thoroughly, take out about 1-1/2 cup of soil and mail or, preferably, take it to your University Extension center. You can also mail or deliver it to the MU Soil and Plant Testing Laboratory in Columbia or at the Delta Research Center in Portageville. It is important that you fill out the soil sample information form (Figure 5) completely and submit it with your sample. By indicating on the form the crops you wish to grow, you can get specific recommendations.

How often should I test my soil?

Soil should be tested every two to three years. In sandy soils, where rainfall and irrigation rates are high, samples should be taken annually.

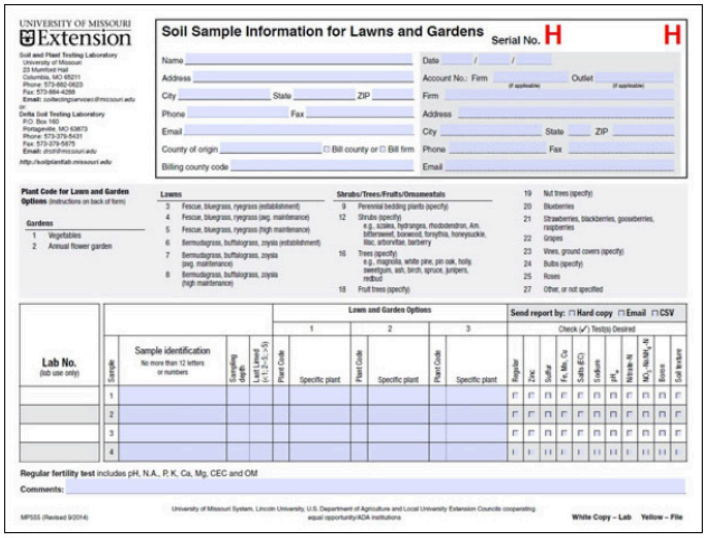
What tests should be run?

In general a regular fertility test is sufficient. This includes measurement of pH, neutralizable acidity (NA), phosphorus, potassium, calcium, magnesium, organic matter (OM) and cation exchange capacity (CEC).

What do the test result numbers mean?

Some labs report soil test values as amounts of available plant nutrients, and others report extractable nutrients that will become available to the plants (Figure 6). Fertilizer rates are given in pounds of actual nutrient (as distinct from pounds of fertilizer) to be applied per 1,000 square feet.

The MP555, Soil Sample Information for Lawn and Garden form for MU soil testing laboratories is available online.



Soil Sample Information for Lawns and Gardens

Serial No. H H

SOIL TEST RESULTS			RATING					
			Very low	Low	Medium	High	Very high	Excess
pHs	7.0		**********					
Phosphorus (P)	39	lbs/a	**********					
Potassium (K)	339	lbs/a	**********					
Calcium (Ca)	6420	lbs/a	**********					
Magnesium (Mg)	584	lbs/a	**********					
Organic Matter:	6.5 %		Neutr. Acidity: 0.0 meq				CEC: 18.9 meq	

Fertilizer & Limestone Recommendations (lbs/1000 sq ft)

Crop	Nitrogen (N):	Phosphorus(P_2O_5)	Potash (K_2O)	Zinc(Zn)	Sulfur(S)	LIME
9 HOSTA perennial bedding plants	0.0	1.5	0.0			0
						0
						0

Comments: ---Some herbicide labels list restrictions based on soil pH in water. Use the estimated pH in water of 7.5 as a guide to the label. If you wish to have soil pH in water analyzed, contact your dealer or local Extension specialist listed below.
---The soil should be tested every 2 to 3 years to determine the effects of your fertilization practices and to develop a new set of fertilizer and limestone guidelines.
***The soil has adequate calcium and an adequate pH for perennial bedding plants. Application of lime, wood ashes, or calcium rich fertilizer is not recommended.

Figure 6. A soil test report from MU Soil and Plant Testing Laboratory shows the results of soil analysis and recommends fertilizer and limestone needs to improve plant health and productivity.

Apply fertilizers as recommended by soil test

All fertilizer recommendations given in a soil test report are based on the amount of nutrient (N, P2O5, and K2O) to apply for a given area. Lawn and garden recommendations are given in pounds per 1000 sq. ft. From the given recommendations it is necessary to select an appropriate fertilizer grade and determine how much of this fertilizer to apply to the garden area. Numbers on fertilizer bags indicate the exact percentages of nutrients by weight: 100 lb of 5-10-10 fertilizer contains 5 lb of nitrogen (N), 10 lb of phosphate (P2O5), and 10 lb of potash (K2O). Because it is difficult to achieve the exact amount of all recommended nutrients from the garden fertilizer blends available in the market, it is important to match the nitrogen requirement.

Example

A soil test recommendation for your vegetable garden calls for 2 lb of N/1000 sq. ft, 0 lb of P2O5 /1000 sq. ft and 1 lb of K2O. The garden is 40 ft by 10 ft.

- **Step 1:**
  Calculate the area to be fertilized. Multiplying length by width, the area of the garden is 40 x 10 = 400 sq. ft.
- **Step 2:**
  Select the fertilizer to be used. Match the ratio of nutrients recommended to the fertilizer grades available. The N-P-K nutrient ratio based on the soil test is 2-0-1. Ideally, a fertilizer such as 10-0-5 or 20-0-10 or 30-0-15 should be selected. At the local garden store, fertilizer bags marked 20-10-10, 27-3-3 and 25-0-12 are available. The one marked 25-0-12 best matches the ratio of 2-0-1 recommended by soil test.
- **Step 3:**
  Determine the fertilizer amount to apply: Divide the recommended amount of nutrient by the percentage of the nutrient (on a decimal basis) in the fertilizer.
  - First calculate the fertilizer recommendation for the garden area: 2 lb of N/1000 sq. ft x 400 sq. ft/ garden = 0.8 lb of N per 400 sq. ft garden. 100 lb of the 25-0-12 garden fertilizer blend will have 25 lb of N and 12 lb of K2O.
  - To provide 0.8 lb of N for the 400 sq. ft garden you would require: 100 lb for fertilizer blend /25 lb of N x 0.8 lb of N = 3.2 lb of the fertilizer blend required to provide the N requirement of the garden. Since the fertilizer blend ratio is almost the same as the recommended ratio, it will provide the required amount of K (1.6 lb of K2O) to the garden.

Note
The weight of 2 cups of dry fertilizer is approximately 1 pound. Therefore to meet the garden fertilizer recommendation, you will need about 6 cups of the fertilizer blend (25-0-12) material for the 400 sq. ft area.
Recommended application rate for various granular fertilizers to apply one pound of nitrogen.

	Application rate		
	Per 1000 square feet		Per 10 square feet
Source	Pounds	Cups	Tablespoons
10-10-10	10	20	4
8-8-8	12.5	25	5
12-4-8	8	16	3
16-4-8	6	12	2
20-10-10	5	10	2
12-6-6	8	16	3

Submitting Samples to the MU Soil and Plant Testing Labs

Samples can be submitted through the County Extension Centers or directly to the lab.

To get information on submitting samples duly filled to the MU Soil and Plant Testing lab, visit the lab's website at http://soilplantlab.missouri.edu/soil/ or email soiltestingservices@missouri.edu or call 573-882-0623. Samples submitted directly to the lab should be accompanied by a duly filled sample submission form and check written in favor of "MU Soil Testing" for the amount due.

Address

- MU Soil & Plant Testing Lab, 23 Mumford Hall, University of Missouri, Columbia, MO 65211
- MU Soil & Plant Testing Lab, PO Box 160, Portageville, MO 6387

Related MU Extension publications

CB19, Missouri Master Gardener Core Manual – http://extension.missouri.edu/p/CB19
G6950, Steps in Fertilizing Garden Soil: Vegetables and Annual Flowers – http://extension.missouri.edu/p/G6950
G6954, Soil Testing for Lawns – http://extension.missouri.edu/p/G6954

Rainfastness of Pesticides *Michele Warmund*

Unpredictable weather often makes pest control difficult in Missouri during April, May, and June. Even with good planning, unexpected showers may occur after a pesticide application. Rainfall or irrigation soon after application can dilute or remove the pesticide from the targeted plant surface. The decision to re-spray a pesticide depends on its rainfastness, which is the ability of the product to remain effective after rainfall or irrigation.

Product labels generally list the amount of time needed before rainfall or irrigation, but rainfastness can vary, depending on the time, amount, and duration of the precipitation, as well as formulation and chemistry of the product. Generally, rain immediately after application removes much of the pesticide. The longer the time before precipitation, it is more likely that the pesticide will remain on the plant surface or will be absorbed into the tissue. After a product dries on the plant tissue or is absorbed, it will perform as expected in spite of rainfall or irrigation.

Many fungicides and insecticides are effective when one inch of rain occurs at 24 hours after application. However, heavy rainfall (two inches or more) within 24 hours of application generally requires reapplication of fungicides and insecticides. Also, one inch of rainfall during a one hour period results in greater loss of pesticide efficacy than a slow drizzle lasting several hours.

Pesticides are formulated as dusts, wettable or soluble powders, granules, emulsifiable concentrates, or flowable liquids. Some products include adjuvants, which are ingredients added to the formulation to improve their efficacy and rainfastness. Dusts are the most prone to wash-off during precipitation. Wettable powders or granules are generally more rainfast than dusts, but pesticides formulated as emulsifiable concentrates are usually more rainfast. When a pesticide such as Sevin is available in multiple formulations, choose the more rainfast formulation when rainfall is unpredictable

Systemic fungicides, which are absorbed by the foliage, perform better than contact products during rainy weather. Common systemic fungicide products for fruit crops include Abound, Propimax, Quadris, Topsin M). Contact fungicides, such as Captan and Daconil protect against infection on leaf surfaces.

Organophosphate insecticides, such as Diazinon, Imidan, Supracide, and Lorsban, have contact activity and are susceptible to wash-off. However, immediate re-application is rarely needed after light rainfall due to the high toxicity of organophosphates. Products such as Delegate, Entrust, Agri-Mek, Confirm, and Esteem penetrate the leaf cuticle and are less susceptible to wash-off after drying. Systemic neonicotinoid products (Actara, Admire Pro, and Assail) are highly rainfast after plant absorption, but are moderately susceptible to wash-off when rainfall occurs in less than 24 hours after application. Rainfastness ratings of several insecticides can be found at http://msue.anr.msu.edu/news/rainfast_characteristics_of_insecticides_on_fruit.

The rainfastness of herbicides varies considerably among products. For example, older formulations of glyphosate (Roundup) require application 6 to 12 hours before rainfall or irrigation. However, new formulations of glyphosate that include an adjuvant require application 30 to 60 minutes before precipitation. Other herbicide products applied to actively-growing weeds may be rainfast with an hour, while others require up to 6 to 8 hours after application. In contrast, pre-emergent herbicides applied to bare soil require rainfall within a few days after application to become active against germinating weeds.