Integrated Pest Management
University of Missouri

Oct/2015

Missouri Environment & Garden

Healthy Houseplants

by David Trinklein

As the outdoor gardening season draws to a close, avid gardeners often turn their attention to caring for those plants growing in their homes. Attractive and constantly changing, plants add a softness of line and provide a bit of nature indoors during the dormant months of winter. Fall is an ideal time of the year to add to one's collection of houseplants, since many retail outlets offer very attractive prices on them at this time of the year.

The fact is there are no houseplants in nature. All plants in nature grow out-of-doors and have basic needs for light, water, carbon dioxide, temperature and plant nutrients. Correct amounts of each are needed for maximum growth and varies according to species. Horticulturalists have selected certain species of plants that are able to withstand the austere, low-light and arid conditions characteristic of indoor settings and named them "houseplants."

Let's look more closely at those environmental parameters needed to keep the average houseplant healthy.

Water

More house plants are killed from over-watering than from any other reason. That said, a very common question asked by house plant owners is, "How often should I water my plants?" The answer to this question is very difficult and varies from situation to situation. Light, temperature and relative humidity all affect the rate of water use by house plants. Higher amounts of light, warm temperatures and low relative humidity will dictate a need for more frequent watering than the opposite.

The frequency also will vary according to the age/size of the plant and the size/type of container in which it is growing. Containers that "breathe" (e.g. clay) will require more frequent watering than those that do not. The roots of most potted plants are in the bottom two-thirds of the pot and it is this area that should feel dry to the touch before watering, not the surface of the growing medium.

When water is needed, apply it until excess water drains from the bottom of the container. This will help to leach excess fertilizer residue out of the growing medium and give assurance the bottom two-thirds of the container has received water. Most people use some sort of saucer or "carpet saver" to collect the excess water that drains from the pot. This excess water should be discarded soon after it is collected to prevent the growing medium from remaining overly moist by taking the water back up by capillary or "wick" action.

Water quality also must be considered when watering houseplants. Any potable water is considered safe and satisfactory to use unless it has been soften by a contact-process water softener. The latter imparts a high degree of salinity to irrigation water which can damage roots and harm growing medium structure.

Light

Since "light is life" to green plants, improper light intensity ranks close to improper watering as a frequent cause for failure with houseplants. A plant in proper light is better able to withstand the high temperature and low humidity commonly found in homes. The amount of light necessary for good growth varies with different species of plants.

Houseplants grown for their foliage plants are generally divided into those suitable for low-light areas, moderate-light areas and bright-light areas. Only a few plants can tolerate dimly lit rooms. Most foliage plants do well with light at a north window, daylight with no direct sun, or sunlight diffused through a lightweight curtain. Plants that require full sunlight should be put in a south window.

Plants need to become acclimated to a new location. An abrupt move from a low-light to a bright-light location may result in bleaching or "burning" of foliage. Therefore, any lighting changes should be made gradually.

continued on pg. 2

In This Issue

Healthy Houseplants 1
Brown Marmorated Stink Bug in Missouri 3
Late Onset of Cucumber Downy Mildew in Central Missouri 4
November Gardening Calendar 6
Three Gall-Inducing Mites Recently Described on Black Walnut Trees. 8
Nitrogen Rate Enhances Chestnut Yield and Tree Growth 9

(continued from page 1)

The leaves of houseplants gradually orient themselves toward light for maximum light absorption, especially in low-light areas. Most plants can be kept from getting one-sided by turning them once a week.

Temperature

Proper temperatures for plants are often hard to find in the average home, since thermostats are set for "people comfort" instead of plant well-being. Since temperatures fluctuate in nature, most houseplants are able to tolerate modest fluctuations in temperature. Providing indoor temperatures between 65 and 70 degrees F is considered ideal for most species. In winter, the temperature near windows may be cooler than elsewhere in the house. If drapes are drawn around a plant placed near a window, the temperature may be too cool. On cold nights, check temperatures close to windows. Some tropical houseplants can suffer "chill injury" if the temperature falls below 40 degrees F.

In contrast, avoid placing houseplant near windows that have hot air registers or radiators directly below them. Hot air blowing on a plant often causes leaves to brown on the edges and, occasionally, to drop or die.

Relative humidity

Perhaps the biggest change houseplants must adapt to from the outside world is the extremely low relative humidity characteristic of most indoor settings. Many house plants are native to tropical rainforests where the relative humidity is quite high. In contrast, the relative humidity in the average home during the winter months of the year is actually lower than that of the Sahara Desert.

A relative humidity between 40 and 60 percent is best for most plants but is difficult to attain indoors. Furnace or room humidifiers can help achieve that goal. If a humidifier cannot be used, watertight trays placed beneath the plants and filled with sand or gravel kept constantly moist can help increase humidity around the plants. Pots must be placed on, not in, the wet sand or gravel. Although many references recommend hand misting of houseplants, the practice is of dubious value. Misting plants with a spray bottle has a positive effect on increase the relative humidity only for about 30 minutes. After that, the plant is exposed to the ambient relative humidity in the room in which it resides. I question whether or not even the most avid plant lover would have the dedication needed to mist their plants by hand every half-hour.

Fertilization

Newly purchased plants have been well-fertilized in the production greenhouse or outdoor nursery. They seldom need additional fertilizer for a several weeks. However, when required, fertilizing once a month is adequate for most houseplants that are located in ideal conditions and producing new growth. Most often, this is during the spring, summer and fall months. Houseplants do not need fertilizer in winter when no new growth is apparent. Do not use fertilizer in an attempt to stimulate new growth on a plant located in poor growing conditions. Lack of growth is more often due to improper light or watering than to nutritional deficiencies. In such cases, adding fertilizer may actually cause additional injury by increasing the salt content of the growing medium.

When fertilizer is needed, a water-soluble fertilizer containing nitrogen, phosphorus and potassium is preferred over slow-release types. The latter can be erratic in the release of their nutrients, depending on temperature and state of hydration. Some fertilizers are formulated to be applied at a very dilute concentration each time plants are watered; others are applied in a more concentrated solution at intervals of two weeks or longer. Always read and follow label directions when applying fertilizer.

Repotting

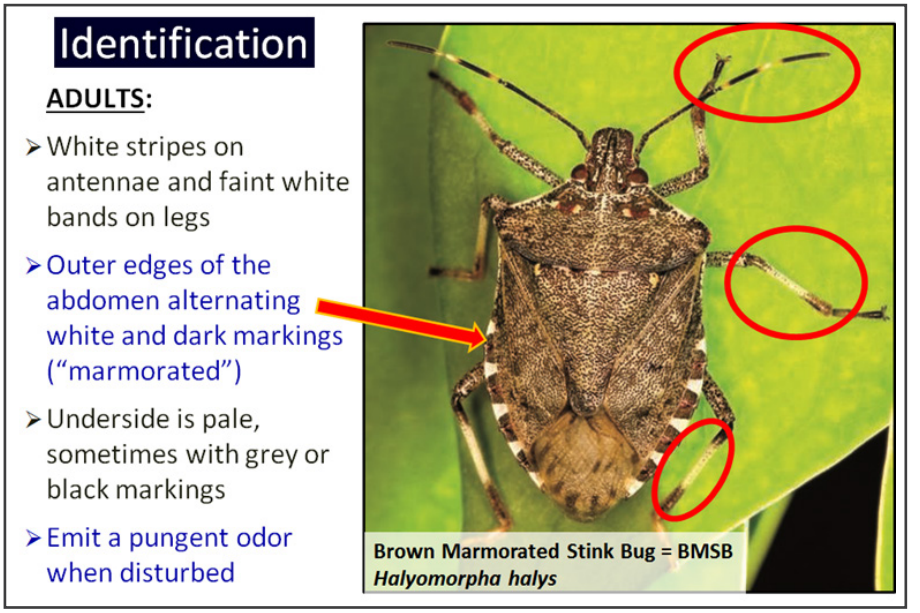
Plants just brought home from the greenhouse seldom eed immediate repotting. Many will not require potting for quite some time. A newly acquired plant must make adjustments to its new environment, and repotting immediately puts added strain on the plant. The time to repot is when the plant becomes pot-bound, this is, when the plant's roots are too extensive for its container. Pot-bound plants may need to be watered more frequently and may grow poorly. When repotting is called for, a soilless growing medium should be used. The latter often consist of blends of sphagnum peat, vermiculite and perlite. There are many commercially available peat-lite mixes that are ideal for houseplants.

In closing, houseplants are popular indoor decorations. Having plants in the home is a good way for gardeners to counter the doldrums of winter as they await another growing season. With a bit of effort and reasonable care, houseplants will remain welcome attractions to the home for many years.

Presence of breeding populations of the invasive Brown Marmorated Stink Bug in Missouri

by Jaime Pinero

The invasive insect pest Brown Marmorated Stink Bug (BMSB), Halyomorpha halys, was recently introduced into the United States from its native range in Japan, Korea, and China. BMSB is a voracious plant eater that can cause serious economic damage to fruits and vegetables, and to some agronomic and ornamental crops. Preferred fruit crops are peach, Asian pear, pear, apple, cherry, raspberry, grape, and currant. Some agronomic crops that can be damaged by this pest are soybean and corn. Among vegetables, BMSB seems to prefer green beans, asparagus, and peppers. Crabapple, persimmon, catalpa, walnut, maple, basswood, sweet gum, redbud, honeysuckle, and American holly are only some of the ornamental trees / shrubs that can be used by BMSB to feed and reproduce.



Has BMSB become established in Missouri?

The answer to this question seems to be yes, at least for one region in Missouri. As part of a monitoring system deployed by the Lincoln University IPM program, on August 24th, 2015, one BMSB nymph (immature stage) was collected near St. Louis (Ferguson area) using sweep nets. No BMSB adults were recorded on that date in pheromone-baited traps.

On September 28th, 2015, 26 adult BMSB were captured in two pheromone-baited traps in the same location. The presence of both adults and immature stages at a single location is strong evidence that BMSB has become established at least near the St. Louis area. We suspect this might be the case in other regions but pheromone-baited traps have not been deployed state-wide.

Previously, live BMSB had been reported in a few isolated locations. In September, 2014, one live BMSB was captured with net sweep in one farm in Jefferson City, and at about the same time numerous live BMSM adults were reported in urban areas (Chesterfield and St. Louis). In the spring of 2015, a couple of live BMSB individuals were also found in two separate occasions in Springfield, MO.

Our monitoring traps will be removed by early November given that at that moment BMSB will be getting ready to overwinter. BMSB overwinters as adult in natural and human-made structures. In the spring, BMSB adults emerge from overwintering sites (houses, barns, storage buildings, and dead trees) and become active on nearby crops during warm sunny days. Adult BMSB have the capacity to fly more than a mile and some have been shown to have the ability to fly over 31 miles. In the spring and throughout the summer, BMSB adults feed, mate, and lay eggs.

If you spot any suspect BMSB indoors, please make sure to let us know, as this is an indication they may be established in your area.

This message will be posted in the LU IPM program website and MU IPM MEG and IPCM Newsletters.

More information about BMSB identification, monitoring, and management is available at: http://www.stopbmsb.org ■

Missouri Environment & Garden (MEG) newsletter is published by the MU Integrate Pest Management Program of the Division of Plant Sciences Extension. Current and back issues are available on the Web at http://ipm.missouri.edu/meg/. Mention of any trademark, proprietary product or vendor is not intended as an endorsement by University of Missouri Extension; other products or vendors may also be suitable. Designor/Editor: Amy Hess (hessa@missouri.edu)

Late Onset of Cucumber Downy Mildew in Central Missouri in 2015 and its Implications

by Zelalem Mersha

Cucurbit Downy Mildew (CDM) (Pseudoperonospora cubensis) was confirmed on cucurbits sampled from the Sentinel plots located at Lincoln University's George Washington Carver Farm in Jefferson City, Missouri. After the Labor Day weekend, angular, yellowish lesions were seen on 'Straight Eight' cucumbers, 'Walthrum' butternut squash and 'Hale's Best' cantaloupe. Althought the Sentinel plots started in the summer of 2013 and continued annually, this is the first time that CDM was seen in these plots.

In addition to the 'Straight Eight,' other cucumbers such as 'Cobra,' and 'Dasher II', which have shown a relative resistance to powdery mildew, were also infected with ***P. cubensis***. Basil plants on the sentinel plots were free of downy mildew infection. Nonetheless, an organic grower from Holt, Missouri, reported a high level of basil downy mildew disease in the summer and fall of 2015.

Vein bounded angular lesions on the upper side of a cucumber leaf.

Symptoms and Signs

In an attempt to isolate the casual organism, leaves with angular, yellowish lesions were placed in ZiplocÂ® plastic bags and were kept moist overnight for diagnosis. Under a stereoscope, vein-bounded fuzzy and blackish sporulation was clearly visible on the lower side of the leaves. In addition, the lemon shaped sporangia and dichotomously branched sporangiophores (the sporangia-carrying organ) of the oomycete causing CDM (P. cubensis), were seen under a microscope.

Most field production of cucurbits will end soon in Missouri. Even so, growers who produce cucurbits in protected systems such as greenhouses or tunnels may still experience the consequence of this aggressive disease which may cause severe damage to their crop in a short time. The first action, as listed below will be to monitor, detect, and report the disease to prevent and curb its further spread.

Vein bounded angular lesions on the lower side of butternut squash.

The 2015 growing season has been unique compared to the past few years in terms of weather. According to the Missouri Climate Center, the total precipitation in Missouri from May to July was at least seven inches higher than the average. While optimum moisture is critical for plants, too much of it harms them in many ways. Extra leaf wetness usually favors this group of microbes, water molds including P. cubensis. This could partly be the reason for the early detection of CDM in Michigan, Ohio, Indiana and Illinois in 2015.

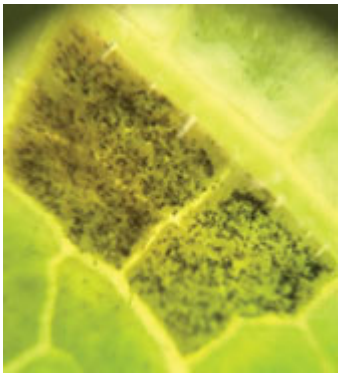
Epidemiology

Pseudoperonospora cubensis is an obligate pathogen. This means that a host plant needs to be present for it to survive. The pathogen alone will not live through the cold winter unless it is shielded in protected systems such as greenhouses and tunnels. In most years, under normal weather conditions, the cold fall and winter will arrive before the pathogen makes its way to Missouri. It is most likely that the spores of P. cubensis are carried from neighboring states. The spores can travel long distances by strong winds and storms. In some instances, spores of this pathogen are reported to have been blown as far as 600 miles in 48 hours! Alternatively, they might have reached Missouri through transplants from areas with a heavy CDM infection. Very often, the disease is reported in Kentucky, Tennessee, Oklahoma and Illinois. Key weather parameters that favor the disease are a relatively mild temperature (59 - 68 °F), high humidity and long hours of leaf wetness.

(continued on page 5)

(continued from page 4)

Management of Cucurbit Downy Mildew



Sporulation on the lower leaf side.

Sporangia and Sporangiophore.

Early planting and other best management practices

In most years, CDM may not usually migrate and reach to Missouri from the southern states owing to the long distance. Even in exceptional years like 2015, it arrived late and may only affect fall crops. Planting cucurbits as early as possible will greatly avoid downy mildew disease. Optimal distance between plants, trellising, avoiding overhead irrigation, and improved ventilation to reduce relative humidity are some of the best management practices to prevent the disease.

Monitor and report downy mildew as early as possible

Please contact your county Extension office, University of Missouri's Plant Diagnostic Clinic or Lincoln University's Plant Pathology Program if you see a symptom similar to what is pictured above. Once confirmed, the disease can easily be reported on a website (http://cdm.ipmpipe.org/). This will keep other growers informed of the prevalence of the disease. Then they can be alerted and prepare to take actions to prevent this disease and/or cure affected plants.

Fungicide sprays

The Midwest Vegetable Production Guide for Commercial Growers 2015 is a very good resource to find best-performing products against cucurbit downy mildew. In addition, Dr. Mary Hausbeck's group at Michigan State University has issued a recent report and advice based on an ongoing research project. More information can also be found from an extension publication of the Ohio State University.

View MEG Publications on the web
http://ipm.missouri.edu/meg/

NOVEMBER GARDENING CALENDAR

Category	Week				Activity
	1	2	3	4	
Ornamentals	x	x	x	x	Continue watering evergreens until the ground freezes. Soils must not be dry when winter arrives.
	x	x	x	x	Now is the ideal time to plant trees and shrubs. Before digging the hole, prepare the site by loosening the soil well beyond the drip line of each plant. Plant trees and shrubs at the depth they grew in the nursery and not deeper. Remove all wires, ropes and non-biodegradable materials from roots before back filling. Apply a 2-3 inch mulch layer, but stay several inches away from the trunk. Keep the soil moist, not wet, to the depth of the roots.
	x	x	x	x	Remove the spent flowers and foliage of perennials after they are damaged by frost.
	x	x	x		Newly planted broad-leaf evergreens such as azaleas, boxwood and hollies benefit from a burlap screen for winter wind protection. Set screen stakes in place before the ground freezes.
	x				Now is a good time to observe and choose nursery stock based on fall foliage interest.
	x				Plant tulips now.
			x	x	Mums can be cut back to within several inches of the ground once flowering ends. After the ground freezes, apply a 2 to 3 inch layer of loose mulch such as pine needles, straw or leaves.
			x	x	Mulch flower and bulb beds after the ground freezes, to prevent injury to plants from frost heaving.
			x	x	Roses should be winterized after a heavy frost. Place a 6 to 10-inch deep layer of mulch over each plant. Top soil works best. Prune sparingly, just enough to shorten overly long canes. Climbers should not be pruned at this time.
			x	x	Take steps to prevent garden pools from freezing solid in winter. Covering pools with an insulating material or floating a stock tank water heater in the pond will lessen the chance of ice damage.
			x	x	Covering garden pools with bird netting will prevent leaves from fouling the water. Oxygen depletion from rotting organic matter can cause winter kill of pond fish.
Vegetables	x	x	x	x	Fall tilling the vegetable garden exposes many insect pests to winter cold, reducing their numbers in next year's garden.
	x	x	x	x	Any unused, finished compost is best tilled under to improve garden soils.
	x	x	x	x	To prevent insects or diseases from overwintering in the garden, remove and compost all plant debris.
	x	x	x		Overcrowded or unproductive rhubarb plants can be divided now.
			x	x	Root crops such as carrots, radishes, turnips and Jerusalem artichokes store well outdoors in the ground. Just before the ground freezes, bury these crops under a deep layer of leaves or straw. Harvest as needed during winter by pulling back this protective mulch.

Gardening Calendar supplied by the staff of the William T. Kemper Center for Home Gardening located at the Missouri Botanical Garden in St. Louis, Missouri. (www.GardeningHelp.org)

NOVEMBER GARDENING CALENDAR

Category	Week				Activity
	1	2	3	4	
				x	For Thanksgiving, weave a holiday wreath of garlic, onions, chili peppers and herbs. It will make a gourmet gift for a lucky friend.
Fruits	x	x	x	x	Keep mulches pulled back several inches from the base of fruit trees to prevent bark injury from hungry mice and other rodents.
	x				Harvest pecans when they start to drop from trees. Shake nuts onto tarps laid on the ground.
	x				Fallen, spoiled or mummified fruits should be cleaned up from the garden and destroyed by burying.
			x	x	A dilute whitewash made from equal parts interior white latex paint and water applied to the southwest side of young fruit trees will prevent winter sun scald injury.
			x	x	Commercial tree guards or protective collars made of 18-inch high hardware cloth will prevent trunk injury to fruit trees from gnawing rabbits and rodents.
			x	x	Mulch strawberries for winter with straw. This should be done after several nights near 20 degrees, but before temperatures drop into the teens. Apply straw loosely, but thick enough to hide plants from view.
Miscellaenous	x	x	x	x	Now is a good time to collect soil samples to test for pH and nutritional levels.
	x	x	x	x	Roll up and store garden hoses on a warm, sunny day. It's hard to get a cold hose to coil into a tight loop.
	x	x	x	x	To prevent injury to turf grasses, keep leaves raked up off of the lawn.
	x	x	x	x	Continue mowing lawn grasses as long as they keep growing.
	x	x	x	x	A final fall application of fertilizer can be applied to bluegrass and fescue lawns now.
		x	x	x	Clean house gutters of leaves and fallen debris before cold wet weather sets in.
		x	x	x	Set up bird feeders. Birds appreciate a source of unfrozen drinking water during the winter.
		x	x	x	Be sure to shut off and drain any outdoor water pipes or irrigation systems that may freeze during cold weather.
			x	x	For cyclamen to bloom well indoors, they need cool temperatures in the 50-60 degree range, bright light, evenly moist soils, and regular fertilization.
			x	x	Reduce or eliminate fertilizing of houseplants until spring.

Three Gall-Inducing Mites Recently Described on Black Walnut Trees

by Michele Warmund

The incidence of galls, which are plant growths caused by another organism, often increases as trees mature. Three types of galls have been identified on black walnut trees at the University of Missouri Horticulture and Agroforestry Research Center near New Franklin, MO. The black walnut petiole gall, also known as the velvet gall, first appears in April in Missouri and has green densely-matted hairs called erinea. As the growing season progresses, erinea become magenta in color by June (Figure 1), fade to dark red in July, and turn brown by September.

Figure 1. Black walnut petiole galls induced by Aceria caulis.

Figure 2. Black walnut hairy leaflet gall.

Figure 3. Black walnut smooth leaflet gall.

These galls cause twisting of the petioles, deform and inhibit leaflet growth, and limit nut production. Petiole galls are induced by feeding of Aceria caulis, which is an eriophyid mite. Within minutes after feeding, cellular changes occur within the plant tissue to sustain the developing mite colony. The gall also protects the eriophyid mites from some predators and provides shelter during the growing season. Overwintering female mites, known as deutogynes, exit the galls usually in early September before the other types of black walnut gall mites.

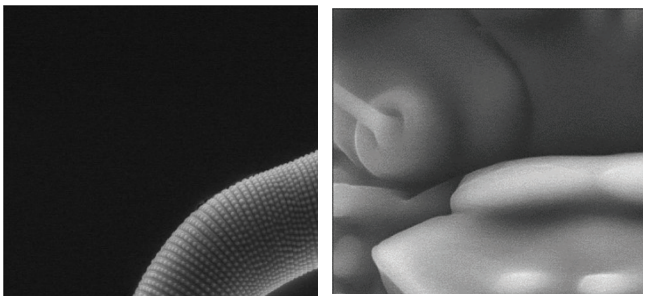


Figure 4. Overwintering female deutogyne of Aceria caulis and her genital coverflap.

A second type of gall, called the black walnut hairy leaflet gall is often found on trees (Figure 2). This gall is visible by May on both the upper and underside of leaflets and green or magenta-tinged. When examined closely, the gall interior contains erinea-lined chambers containing another type of eriophyid mite. These galls appear later in the spring than the petiole galls and the deutogynes of this species exit the galls later in the fall.

The smooth leaflet gall is the latest gall to develop in May on black walnut trees (Figure 3). It lacks hairs on the outer green surface of the gall, but inside is a mass of twisted and tightly-matted white erinea. However, in the summer when the mite colony is at its peak, the interior of the gall appears pink or red from many highly-colored mites feeding on the gall wall. These galls and the hairy leaflet galls are much smaller (2 to 3 mm) than petiole galls and may not be not as injurious to the black walnut trees. Deutogynes of this mite species inhabit their galls until October, which is usually later than the other eriophyid species on black walnut.

Because these eriophyid mites are microscopic, scanning electron microscopy has been used recently to examine the anatomical features of larvae, male and female nymphs (protogynes) and the deutogynes (Figure 4). Studies conducted at the University of Missouri revealed that each of the three black walnut galls is induced by three unique species with varying anatomical structures. While these anatomical features are subtle, they are distinguishing features for the species. These newly-described mite species that induce the leaflet galls will be named in the near future. ■

Nitrogen Rate Enhances Chestnut Yield and Tree Growth

by Michele Warmund

Like all orchard crops, annual applications of nitrogen are needed to optimize chestnut production. Before trees are planted, a soil test is recommended to estimate the nutrients available to the tree. Some nutrients, such as phosphorus and potassium, do not readily move from soil surface into the soil profile with water where they are available to tree roots. Thus, these nutrients must be incorporated into the soil before trees are planted. Soil samples can be submitted to the University of Missouri Soil and Plant Testing Laboratory where they are evaluated for nutrients and pre-plant recommendations are provided.

During the first three growing seasons, nitrogen is important for establishing a strong tree structure before it begins to produce a chestnut crop. Because nitrogen moves into the root zone with rainfall or irrigation, it can be applied to the soil surface. A general recommendation is to apply 0.1 pound of actual nitrogen per tree in a ring around the tree (about six inches from the trunk) about one month after planting in the spring. In the second and third growing season, apply 0.2 and 0.3 pound of actual nitrogen per tree, respectively, just before buds start to produce leaves. A quick way to assess the nitrogen status of chestnut trees is to check leaf color during the growing season and shoot growth in October. If non-bur bearing shoots are yellowish or have less than 20 inches of new growth, the amount of nitrogen applied to trees should be increased by 10% the following spring.

In the fourth growing season, grafted trees will generally begin bearing a small nut crop, which requires additional nitrogen. In the past, recommendations for Chinese chestnut trees have been a "best guess" since a nitrogen response hadn't been tested in Missouri. Thus, in 2009, Chinese chestnut trees with 'Peach' as the scion cultivar grafted onto Auburn Super seedling rootstock were planted in an established sod cover crop at the MU Horticulture and Agroforestry Research Center near New Franklin, Missouri to determine the rate of nitrogen needed to enhance nut production and tree growth. All major nutrients were in the sufficient range as determined by a soil test before planting. The first three growing seasons, the rates of nitrogen as described above were applied to the trees. In 2012 to 2015, chestnut trees were treated with 50, 75, 100, 125, or 150 pounds per acre applied annually as split applications just before budbreak and on June 15. A three foot-wide strip of killed sod was maintained underneath trees during this study.

American Chestnut. Photo by: David J. Moorhead, University of Georgia, Bugwood.org

Shoot growth, trunk circumference, nut numbers, and nut weights were recorded and foliar nitrogen content was determined from tissue analysis for each tree annually. Tree growth, measured by annual increase in trunk circumference, generally increased with higher rates of nitrogen. By 2015, cumulative yields for the lowest to highest rates of nitrogen were 11.3, 11.2, 13.1, 16.1 and 16.5 pounds per tree. Thus, 125 pounds of nitrogen per acre provided a substantial yield response when applied annually to bearing Chinese chestnut trees. This study also revealed that leaf tissue from trees receiving 125 pounds per acre averaged 2.4% nitrogen when foliar sampling was conducted.

For chestnut orchards at varying sites, the best way to evaluate the nutritional status of the trees is by foliar sampling. Between July 15 and 31, obtain a sample of twenty fully-expanded mid-shoot leaves from bur-bearing shoots from an orchard and submit it with the accompanying form at http://soilplantlab.missouri.edu/soil/plantsamples.aspx to the MU Soil and Plant Testing Laboratory. Recommendations are provided based on the nitrogen content of the submitted sample.