



# Pinal County Cooperative Extension Garden & Landscape Newsletter June 2009



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## SUMMER HEAT BRINGS STRESS TO PLANTS

From now until September, the summer heat can be quite stressful for many Pinal County garden and landscape plants, especially if the monsoon rains come late.

Summer heat stress in plants is caused by a lengthy, on-going exposure to the high temperatures and low relative humidity that are typical desert conditions during the early summer months of June and July. Extended temperatures over 110°F. and humidity readings consistently below 20% can seriously weaken or fatally injure even the hardiest of garden and landscape plants.

High temperatures heat the plant quickly. If the plant tissue heats up close to or beyond its tolerable limits, the tissues of the leaves and branches can be stressed or damaged. Even just a few degrees of temperature can make a huge difference in the amount of stress that a plant must endure.

Low humidity conditions, such as are commonly experienced during the month of June, can be stressful to plants because of the huge difference in water concentration between the inside and outside of the leaf. The process of diffusion, the same process that evaporates perfume from an opened bottle and spreads the smell throughout the entire room, pulls the water from inside the leaf to the outside. The lower the humidity reading, the greater the potential for water loss.

Heat stress and rapid loss of water from the leaf tissues together can cause the plant to become water deficient in a relatively short period of time. This is why we must water more frequently in the summer than we do during the cooler months.

Trees have remarkable powers to survive water stress. When there is insufficient water inside the plant to continue transpiration, the plant tries to compensate by drawing water out of plant tissues in other parts of the plant. Left too dry for too long, however, the drying or desiccation will seriously weaken the plant. When desiccation passes the point of no return, death occurs.

Plants cool themselves by evaporating water through the many stomates, tiny holes, that exist on the undersides of leaves to allow air into the leaf and water vapor out. This process, the process of transpiration, acts like a mini swamp cooler and helps keep the tissues of the plant from overheating. Water must remain in continuous flow from the lowest roots to the highest leaves in order for this to occur, however. Any interruption in the flow of water could spell disaster for the tissues on the far ends of the pipeline. We have to water on time, generally every five to seven days with a flood irrigation system, in order to prevent damage to plants.

Once the late summer monsoon storms begin, the amount of evaporated water in the atmosphere

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## PROTECT PLANT ROOTS

There is one sure thing about Arizona summers. Eventually it is going to get hot.

We all know that summer temperatures in Pinal County reach well over 100°F. The record high for our area is 121°F and those of us who remember that day know just how important shade, and air conditioning are.

Our plants, unfortunately, cannot escape the heat. They live outside. They cannot be moved to a cooler, more damp environment for the hot season, and then back again when it cools off. Instead, we select plants that are adapted to desert conditions; those that can live outside through all seasons and thrive. Even still, those same plants must be properly cared for if we hope to see them survive through our difficult summers. I can be even more specific. If we want to keep our landscape trees and shrubs healthy, we must take care of the roots that support those plants.

Leaves, branches and trunks are the parts of plants that we see every day, and because they are so familiar, we often get lulled into thinking that these are most important to the health of plants. However, it is the underground workhorses, the roots, that for the most part keep the aboveground parts healthy and doing their jobs. When caring for plants, it is important that we not just manage the parts that we see, but also those parts which we cannot see. Roots, while out of sight, should never be out of mind.

Unfortunately, this is too often not the case. Many of the landscape, garden and indoor plant problems seen throughout the county can be directly traced to problems in the plant's root system. Yes, insects, weather events, competition for sunlight and other aboveground factors can cause serious damage to plants; but, more often than not, injury symptoms seen in the leaves and branches actually are a result of injury to the roots. No plant, whether it is growing in a container or living in native soil outdoors, is safe from the risk of root injury.

So, why am I stressing this so much? Roots perform a number of essential functions critical

to the success of the plant. Roots absorb water and nutrients from the soil, give strong anchorage in the soil and provide a place to store food for future needs. If plants are to thrive, their roots must adequately perform these essential tasks.

In order to mine nutrients from the soil, roots must be in close contact with those nutrients. As roots deplete the soil in their immediate vicinity, they must continue to push into new soil to find additional nutrients. Roots that are not growing will not come in contact with new nutrients. Stunted plants are a common result. An important rule for growing healthy plants, then, is "Keep the roots growing!"

Proper application and timing of irrigations are key for good root growth. Correct irrigation is also important in the development a strong root system that will brace the plant during strong winds and give enough room to store sufficient food for future needs.

Next, help the plant develop and maintain a proper root system. A basic rule of botany states that there must be a balance of energy between the top portions of a plant and the roots. In rough terms this means that the bigger the plant, the bigger the root system necessary to keep the plant healthy. An average rye plant, for example, will have enough roots to extend three hundred and eighty seven miles, if the roots were all placed end to end. It takes many healthy roots to keep up with the work that the top part of the plant does during its lifetime. Correct irrigation, once again, is key to ensuring that there are sufficient roots to keep up with plant needs.

Root strength is another key to maintaining healthy plants. Scientific studies have shown that young trees that have been staked early on so that they could not sway in the wind have not properly developed enough tensile strength to support the plant during strong winds. Trees which have been allowed to free-sway, or at least to sway moderately, have developed larger trunks and sturdier roots than the tethered ones. Freshly planted trees should be

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## WHITEFLIES IN THE FALL

If the arrival of hot weather is not enough to convince us that summer has truly arrived, the increasing populations of the sweet potato whitefly ought to be a sure sign that we can put away the coats and gloves of winter.

The sweet potato whitefly, sometimes called the silverleaf whitefly, is a daunting insect pest of Pinal County gardens and landscapes. They should not be confused with their less prevalent and less harmful cousins, the greenhouse whitefly and the ash whitefly. Sweet potato whiteflies can be commonly found on many vegetable garden plants including tomatoes, lettuce, melons and squash. They also feed on many ornamental plants, such as lantana and hibiscus.

Temperature is important to these animals. Cool weather slows their reproductive rate while warm temperatures speed it up. That is why they are so plentiful in the summer, but hard to find in the winter. This spring, as the temperatures have crept up, the sweet potato whitefly populations have been slowly building. Late this summer, in August and September, they will hit their maximum numbers and the potential for plant damage will be at its highest.

The sweet potato whitefly was first identified as a serious plant pest about fifteen years ago. A tropical, heat-loving insect, it thrives under desert conditions. It damages plants by removing fluids and nutrients from the plants faster than the plant can replace them. Whiteflies eat by sucking plant juices through a tube-like mouthpart. Feeding by large



Whiteflies

populations can seriously damage, stunt or destroy their host plants. In some plants it also induces a feeding disorder.

The sweet potato whitefly has a yellow body with two pairs of white wings covered with a waxy powder. It is a small insect, about the size of a pinhead, and while it does not fly as gracefully as other insects, it is adept at moving from place to place. The style of flight is a simple flutter that serves to suspend the insect in the air until it bumps up against a new host plant.

The bodies of these insects are relatively high in fats. These fatty materials give them the energy needed to complete their life cycles. Evidence of this are the familiar, white, greasy stains left on the car or truck windshield as we drive about during warm weather. These stains are often one of the first signs that the whitefly season has arrived, and their absence is sure fire evidence that cool weather has returned. Airplane pilots have reported the impact of whitefly insects on windshields as high as 1000 feet above the ground, sometimes in relatively large numbers.

When the adult female whitefly finds a suitable host, she lays her eggs on the underside of the leaves, particularly along the veins of the leaves. The eggs hatch into "crawlers" that move around until they find a good place to feed. Once they have settled down, they molt and become what look like tiny transparent scales. The immature nymphs continue to feed by sucking juices from the plant. Eventually the insects pupate into winged adults, which fly off to mate, lay eggs and complete the life cycle. The immature nymphs are the most damaging forms because of the amount of nourishment they need to mature, but all stages, including the egg, pull fluids from the plant tissue upon which they rest.

Not all plants are damaged by the sweet potato whitefly. Citrus and palm trees, for example, are usually not hosts while tomatoes, squash and melons can be severely injured. Injury occurs in part because of simple nutrient and

## IRON CHLOROSIS CAN CREATE A PROBLEM IN LANDSCAPE PLANTS

Overwatering and high pH soils can lead to a condition of nutritional deficiency known as iron chlorosis.

Chlorosis is a term used to describe the yellowing of plant parts, particularly the leaves. There are many factors that can cause yellowing in plants. Nitrogen and other nutrient deficiencies, insect feeding, herbicide damage, and viral infections can all cause yellowing symptoms. However, in this area, one of the most common yellowing conditions is the nutritional disorder called iron chlorosis.

Iron is one of the sixteen essential nutrients required by all plants for proper growth and development. In the plant, iron is used within individual plant cells to form chlorophyll, the molecule that captures energy from the sun and transforms it into energy-rich sugars during the process of photosynthesis. Without photosynthesis, plants can not grow.

Iron also serves as an activator for biochemical processes such as respiration and symbiotic nitrogen fixation. In short, iron is critical to the normal health and development of all plants.

While iron deficiency symptoms in plants are seen mainly in plant leaves, the real reason for its appearance can almost always be traced to the soil. All soils, especially the granite-rich soils of Pinal County, contain iron. The problem comes when local soil conditions make it difficult for the plant to pull the iron molecules from the soil.

Our high pH, alkaline soils can chemically tie up iron and other nutrients in the soil and make it difficult for plants to absorb them through the roots. The higher the pH, the more difficult it is for plants to extract the nutrients. Some plants have a more difficult time than others extracting iron from the soil, even under the best of conditions. For these plants especially, high pH conditions cause severe problems.

In addition to high pH, iron chlorosis can be also be caused by poor aeration of the soil. Aeration refers to the amount of air which is found in the spaces between the individual soil particles and is essential for good plant health. The problem comes when soil compaction reduces the volume of space between the soil particles or when over watering keeps the spaces filled to the exclusion of air. Failure to reduce soil compaction and continued over watering will lead to iron deficiencies.

Symptoms of iron deficiency are fairly easy to recognize, even by the beginning gardener or landscape manager. Begin by carefully inspecting the younger leaves near the tips of the branches.

Look for pale to light green leaves where the veins of the leaves remain a darker green than the surrounding leaf tissue. This usually is the first hint of an iron deficiency problem. As the condition of the plant worsens, look for more intense yellowing of tissue but the veins of the leaves will almost always remain green. Only in extremely severe cases will the veins themselves turn yellow leaving the entire leaf a bright yellow color.

Leaf discoloration, called interveinal chlorosis, will be the first symptom seen. In severe, prolonged cases, twig dieback will also be seen and this can progress to death of entire limbs or plants.

Plants most often affected by iron chlorosis are grasses such as St. Augustine and sweet corn and some fruit trees and ornamentals like bottle brush, eucalyptus, pyracantha, peach, apricot and citrus. There are other plants that can suffer from iron chlorosis, but these seem to be among those most commonly affected.

The solution to iron chlorosis is usually straight forward. Iron is taken up by plants from the soil as ferrous ( Fe ++ ) ions. Ions are simply elements that have lost or gained one or more electrons and have a positive or negative charge, much like the poles of a magnet. It is these ionic charges that allow the plant to move the nutrient ions across cell membranes into the plant tissue.

Symptoms of iron chlorosis can often be resolved by adding iron-containing fertilizers into the plant environment, either through the soil, or by spraying the leaves. Which one is best? Well, that is the question.

Several years ago, we did an experiment on highly chlorotic pyracantha bushes. Both foliar (leaf applied) and soil applied iron fertilizer formulations were included in the experiment and the treatments were repeated several times on different shrubs. The study indicated that both types of iron fertilizers worked well. All of the treatments either reduced or eliminated the yellow symptoms. However, the foliar applied formulations seemed to green the plant up

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water loss due to the feeding. The greater the pest population, the greater the feeding damage.

Squash and pumpkins are especially susceptible to whiteflies because the saliva of the insect causes a distinctive feeding disorder called silverleaf where the entire leaf turns a dull silver color. Affected plants usually do not produce quality fruit.

Can we grow high quality pumpkins for Halloween here in Pinal County? No, we cannot, at least not in the warmer parts of the county where the whitefly flourishes. However, by planting pumpkins in the early spring, as soon as we can squeak them past the late frosts, we can harvest a crop before the whiteflies become a problem.

Another problem caused by whiteflies is plant disease. The insects have been shown to carry a number of virus diseases of annual plants, but they do not seem to infect trees and shrubs. If an annual plant becomes infected with a virus, little can be done except remove and destroy the plant.

So, how do you know if your plants are being affected by sweet potato whitefly? Look at the underside of the leaves for immature nymphs or other signs of these insects. Although the eggs and nymphs are difficult to see without the aid of a microscope or hand lens, the underside of the leaf will have the texture of sandpaper, and probably will have tiny droplets of sticky plant sap. Plants heavily infested with immature whiteflies may turn yellow and wilt. Sooty molds may grow in the excrement, called honeydew, causing the plant to turn an unsightly gray or black color. If you are not sure, bring in a sample to our office and we will take a look under the microscope for a final diagnosis.

The control method that has been shown to be most effective to date for homeowners is a spray of detergent, cooking oil and water. It does not give complete control, but it is the best that we currently have. Because this mix has the potential to burn plant leaves, it is best to start with a light rate and test it on one leaf that

is not critical to the overall appearance of the plant. If no damage occurs after 12 hours, spray the entire plant.

Make a stock solution of cooking oil and detergent by mixing 1 cup of vegetable-based cooking oil such as corn, cottonseed, safflower, soybean or sunflower oil, plus 1 tablespoon of dishwashing detergent or insecticidal soap available from most nurseries. The final spray solution will then consist of 1 cup of water plus 1 to 2 teaspoons of the stock solution. Make sure to completely spray the underside of all leaves where the immature nymphs are hidden. Repeat every three to four days as needed.

Isn't there anything better, or easier, you ask? There are no easy solutions in the garden or landscape for sweet potato whiteflies. There are no chemical controls or magic bullets that will do a good job in preventing plant injury from the feeding of these animals.

Perhaps the best way to avoid whitefly damage is to simply not grow those species of plants that are most sensitive to whiteflies at the time when populations are greatest. Remember, pumpkins, squash and melons can be planted in the early spring for harvest in early summer instead of planting them in July and having them destroyed by the insects in August. Similarly, delaying planting fall vegetable gardens and annual flower beds until the second week in October, or until the whitefly numbers have dropped off can also help avoid heavy population pressures.

While the appearance of sweet potato whiteflies can tell us that summer has arrived, we can also hope that cooler weather in the fall will also mean that we will get some relief from their feeding

faster than the soil applied materials, but they did not keep the plants green as long as the soil applied materials did.

When making an iron fertilizer selection, one aspect to consider is how quickly one wants the plant to respond and another is how often one wants to repeat the application. Foliar sprays may need to be repeated twice a year in some situations, where soil applied formulations may need to be applied annually, perhaps even less. A good plan would be to alter foliar applied and soil applied formulations from application to application to get the benefits of both.

More important than the temporary greening up of plant tissues, is the resolution of the underlying problems that have caused the yellowing in the first place. The first, and most obvious factor to check is the watering frequency. Too frequent irrigation may keep the soil profile filled with water and not allow air to move into the soil. Cutting back on irrigation frequency is the first place to start.

Another challenge may be soil compaction. Sometimes desert soils physically compact from foot or wheel traffic around the plants. Sometimes clay or silt soils will lose their structure and collapse in on themselves forming compaction layers. Caliche, a desert form of naturally occurring concrete, will consolidate and leave a hard layer with which roots have to deal.

Compaction layers, if not too severe, can often be reduced by drilling holes through the soil profile with a soil auger or with water pressure from a root feeder attached to a hose. These holes can be backfilled with sand which will speed the movement of water down through and into the soil. The holes also reduce the internal pressure within the soil profile and cause the soil to loosen in the vicinity of the holes. For these reasons, the more holes that can be dug in the area from the trunk of the tree to the outside edge of the plant, the better.

While compaction layers often can easily be reduced, there are some situations where nothing seems to work. One of these situations is when there is present a high concentration of caliche in the soil, and it is especially bad when that caliche seals together into hard concrete-like layers. In these situations, it is easier to select desert-adapted trees that will tolerate if not flourish under these conditions.

For example, consider the results of another experiment conducted under local conditions. Large, mature eucalyptus trees growing in heavy, caliche-saturated soil and suffering from severe leaf chlorosis and twig and limb dieback, were treated with several foliar, soil and vascular- injected iron fertilizer products. Because of the massive size of the trees and the difficult soil conditions, no reduction of symptoms could be achieved with any treatment, even at double and triple rates. Sometimes it is easier and less expensive to go with a different type of tree that can be more tolerant of the local conditions.

Finally, reduce the pH of the soil. All Arizona soils are alkaline, but some soils contain more salt and caliche than others. When present, accumulated salt and caliche can both quickly drive up the soil pH.

Over time, a good organic mulching program can go a long way in helping reduce pH problems in soil. Applications of compost or leaf mulch lightly spaded into flower or garden beds or spread on top of the soil under trees and shrubs and gently raked into the soil will help improve the structure of soils and release organic acids into the soil profile. Remember that the microorganisms that break down organic matter do their best work when temperatures top 100 degrees Fahrenheit and organic materials tend to disappear quickly under summer time conditions. Frequent applications may be needed through the growing season.

Another way to help reduce the soil pH is to apply horticultural grade sulfur to the soil. Soil sulfur can be found in most nurseries. It should be applied at label rates and gently raked into the soil just before the next irrigation. The water will turn the sulfur into sulfuric acid which will then work to help bring the soil pH from its alkaline condition to a neutral level preferred by most plants.

Iron chlorosis is just one of many conditions that cause problems for garden and landscape plants in the desert. By understanding why it occurs and how to reduce its impact, plant health and productivity can be improved.

climbs significantly and the temperature of the air often hovers between 100 and 107° F. These lowered temperatures and higher humidity levels greatly reduce the stress on plants and they often quickly recover if they have not been seriously damaged during the dry months. If the monsoon is delayed, however, the plant labors under extended potentially harmful conditions and the continued stress over long periods of time can spell big trouble.

Fortunately, proper variety selection before planting and good management year round can help prevent unnecessary damage to landscape and garden plants. Summer heat stress can be minimized by carefully watching for water stress symptoms and then quickly and promptly giving the plants a proper irrigation.

Wilting of leaves is the most common symptom and is usually the first symptom to be seen. Temporary wilting of plants during the hottest part of the day, especially in plants with large leaves like squash and cantaloupes, is usually not a serious problem. However, when plants start the day off wilted, or wilt quickly in the morning hours, these are problems that should be quickly addressed. Slow, deep irrigations are best to soak water down into the lower root zones of plants. Be sure to cover the entire area underneath shrubs and trees to ensure that a majority of the roots are receiving water.

Now, let's talk about some of the specific water-related problems that are often seen during the summer months. The first is severe dessication, or drying of plant parts. Desiccation is usually seen as wilting and drying of leaves. Sometimes the leaves will turn yellow and fall off the tree before they can turn brown. The yellowing leaves are usually scattered throughout the plant canopy hither and yon without any pattern.

Sunburn symptoms can also be quite prevalent during the summer. We have already seen numerous cases this year from samples that have been brought into the plant clinic at the Extension office. Sunburning of leaves causes a bronzing or yellowing of sun-exposed leaves and shrinking and drying of smooth bark surfaces. Sunburn is most often seen on the south and west sides of the tree. Another water related problem is iron chlorosis, or yellowing of leaves due to a lack of iron. It is often linked to trees that have been over watered.

Iron, an essential nutrient, becomes lacking when plants cannot absorb enough of the mineral to meet its needs. Soils that remain consistently wet aggravate the inability of the plant to pick up the nutrient. The solution is to irrigate when the soil at a depth of six inches is partially dry but still somewhat moist. Take a handful of soil from the bottom of the hole and squeeze it into a ball. For medium textured soils, irrigate when the lump of soil becomes crumbly around the edges when you release your hand. Sandy soils will require more frequent irrigations.

Applications of a chelated iron fertilizer applied either to the leaves or to the soil may help in greening up iron deficient tissues. To tell if a plant is iron deficient, check the leaves. Leaves that start to turn a pale yellow over the entire leaf but have the veins in the leaf remaining green usually have iron chlorosis.

Another problem caused by too much water are the root rot diseases. Phytophthora, Rhizoctonia, Pythium and Phymatotrichum are big names for big-time problems in many plants. Roots usually rot when one of these organisms invades and starts feeding on roots in constantly wet soil. As feeding occurs, the outer part of the roots become mushy and slough off. Wilt symptoms are usually the first hints that something is happening below ground. Avoid the temptation to water until you check the roots for signs of disease. Adding water to disease roots only makes the situation worse. Check the soil at six inches before irrigating to see if the soil seems to be overly wet. Dry soils tend to decrease fungal activity.

Finally, a common symptom of water stress is the splitting of citrus and pomegranate fruit after an irrigation. The cause is usually mechanical. Hot, dry weather slows the growth of both the juicy, inner fruit and the outer rind. Later when conditions ease and growth resumes, the inner part of the fruit expands faster than the rind resulting in ruptured fruit. Other than making sure that the trees are well fertilized and watered throughout the entire growing season, there is not much that a grower can do to prevent this damage.

If we understand the basics of summer heat stress, we can take the proper steps to minimize the stress or avoid it all together.

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correctly staked to avoid serious injury from heavy winds, but they should also be allowed some room to sway for proper development.

The primary root of a plant is strongly geotrophic; that is, it tends to grow down towards the source of gravity. This tropism, however, diminishes with distance and root branching becomes prevalent. This allows lateral roots to grow in any direction. Few trees maintain tap roots below forty inches because lateral roots expand to pinch off the tap root. Soil conditions usually are unfavorable for proper growth at that depth, and sinker roots, e.g. vertical roots extending downward from horizontal roots, begin to act as tap roots. Because of this, it is a good idea to irrigate underneath the entire canopy of the plant, not just close to the trunk, in order to properly develop the root system.

It is also important to irrigate to the full depth of the root system in order to keep the deeper roots moist and growing. If not, the root system will continue to develop only at a relatively shallow depth. Trees with insufficient root systems are susceptible to being blown down because they do not have the roots to provide proper anchorage.

Occasionally, a root system will be attacked by soil borne diseases, nematodes, insects or other problems. The best prevention of long term problems is to make sure that the roots are actively growing and vigorous so that damaged or diseased roots are readily replaced by new roots. Unless the infection or infestation is so large that it overwhelms the defenses of the plant, healthy roots can usually outgrow most problems and compensate for the loss of individual roots. It is usually only when the root system is stagnant and stunted that pest damage becomes catastrophic.

It is also important to know the signs of root stress as it is expressed in the leaves. Signs of insufficient water begin to show at the tops of the trees where leaves begin to wilt, turn yellow and fall off. Later, entire twigs may die.

Nutrient deficiencies caused by soil or root problems are also expressed in the leaves. Iron deficiency, for example is usually seen as a pale green or yellow leaf where the veins of the leaf remain green. Nitrogen deficiency is usually seen in yellowing of older leaves while younger leaves remain green.

So, what is the take-home message? Know what inputs plant roots need and make sure that they receive them in a timely manner. The best care that one can provide for a plant and its roots is to give it timely, deep irrigations with the water placed in the right places; regular nitrogen-based fertilizations in the spring, summer and early fall; and plenty of room to grow.

If we properly care for our landscape plants, we can expect them to make it through the summer just fine.

If you have questions, you can reach one of the Master Gardeners Volunteers at the Cooperative Extension office, 820 E. Cottonwood Lane, Building C, in Casa Grande. The telephone is (520) 836-5221 x204. Rick Gibson is the author and his email is [gibsonrd@ag.arizona.edu](mailto:gibsonrd@ag.arizona.edu)

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