ARIZONA COOPERATIVE EXTENSION
College of Agriculture and Life Sciences

Pecan Production Guidelines For Small Orchards And Home Yards

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Pecans (*Carya illinoensis*) are one of the most desirable trees to plant in home yards. Their size and natural beauty as a shade tree and its capacity to produce a nutritious food make them valuable. Pecans are native to the lower Midwest and Southeastern United States. They grow naturally in bottom lands with good alluvial soils and moisture. Pecans have compound pinnate leaves, composed of nine to 17 leaflets, and are twelve to 20 inches long. Pecans are the largest trees in the hickory family and can obtain heights of 100 to 140 feet. The tree is adapted to the diverse environmental conditions in Arizona but needs special care to produce high quality, well filled nuts. The main ingredients needed by pecan trees in Arizona include adequate space, water, nitrogen, zinc and more water. A mature pecan tree requires nearly 34,000 gallons of water per year. With annual average yields of 40 to 50 pounds per tree, this amounts to nearly 680 to 850 gallons of water per pound of nuts, depending on soil type. Proper management of these practices will result in fast growing productive trees. Trees will begin producing a few nuts three to four years after planting. Significant production can be achieved in six to eight years. Good production will begin the ninth or tenth year. Trees can be productive for a 100 years or longer. Pecans, like other fruit and nut trees, exhibit a characteristic called alternate bearing. This is when trees produce an abundant crop one year and the following year relatively few fruits/nuts. The third year yields will be abundant once more. The fourth year will produce small yields. This cycle continues for the life of the pecan tree..

Site And Soil

Pecans grow best in alluvial (riverbed) soils that are deep and well drained. However, pecan trees can be grown on any soil that allows water penetration to a depth of four to five feet or more. Water should be able to move down through the soil (drainage) at a reasonable rate and the soil should not have any layers which would prevent water from draining downward. Poor drainage will result in poor root development which may result in tree death. The majority of pecan roots will be in the top three to four feet of soil. The root system width will be four or more times as wide as the tree canopy.

In many areas of Arizona soils are under-layed with a layer of white-rockish soil known as 'caliche.' Caliche contains large amounts of calcium but will not prevent pecan tree growth or survival. In fact, caliche holds water very well and is an excellent subsoil when used correctly. When planting trees in soil with a caliche base, make sure the caliche layer is cracked, ripped or loose so that roots will penetrate into and beneath the layer. If the caliche is solid or hard it has to be broken into pieces so that water will drain deep into the soil. When digging a hole to plant a tree make sure that the caliche layer has been broken through. Pecan trees planted in caliche based soils will be very susceptible to zinc deficiency. A well managed zinc fertilizer program is a must. When choosing sites for planting pecan trees, always select the best soil for maximizing tree growth. Trees should be planted away from a residence, patio or driveway as honeydew from insects (aphids) will drip onto these areas resulting in a black sticky substance that can cause damage to paint on houses and cars. Roots may also lift and damage pavement surfaces and/or concrete.

Varieties

There are many pecan varieties available for planting. Varieties are selected on characteristics such as nut size, percent kernel (nut meat percentage of total nut weight), tree shape and production capacity. Pollination is somewhat of a consideration in larger plantings. A single pecan tree may produce ample pecans for home use. Cross pollination (pollination between two or more varieties) will enhance production slightly but is not absolutely necessary in most cases. For pollination, pecan pollen is wind blown to receptive flowers. Pecan varieties are classified into two pollination types known as Type I and Type II. If male flowers (catkins) dehisce or shed pollen before pistillate flowers are receptive, the tree is protandrous (*protos* = first; *andro* = male) and is classified as Type I. If female flowers are receptive before pollen is shed from catkins, the tree is protogynous (*protos* = first; *gyne*= female) and is classified as Type II. This type of flowering encourages cross pollination. However, varieties of the same pollination type will not result in good cross pollination. The separation of male and female bloom periods may overlap with some trees. A precocious tree bears nuts earlier after planting than a non-precocious tree. Table 1 lists some varieties and their characteristics that should be considered when planting.

Buying, Handling & Planting Trees

For best results in establishing trees follow these rules:

1. Plant bare root trees from January through March, or 30 days before normal bud break, to give roots time to acclimate to the soil. Plant container grown trees during early fall- September through October.

2. Buy trees from reputable nurseries that are 5 to 7 feet tall or have a minimum trunk diameter of ¾" to 1", six-inches above the bud union.

3. When handling trees never let the root system dry out even for one minute. This is the major cause of tree death after planting.

Table 1. Pecan Variety Characteristics

Pecan Variety Charateristics

Variety	Size (nuts/lbs.)	Shell Out (%)	Pollination Type	Tree Production	Nut kernel
Apache	50	60	II	Lovely tree, bears consistently	Thin shell
Burkett	45	57	II	Hard shell, bears consistently	Good flavor
Cheyenne	50	59	I	Precocious, bears annually	Attractive meat
Mohawk	35	57	II	Moderately precocious	Good quality
Pawnee	56	54	I	Early, uneven ripening	High quality
Western Schley	65	58	I	Precocious, heavy bearer	Excellent meat
Wichita	50	61	II	Precocious, alternate bearer	Good quality

4. Dig a hole to accommodate the roots. Loosen soil around the hole two feet deep and three to five times as wide as the hole diameter. Refill the planting hole with the soil that was removed. **Do not add any soil amendments or fertilizers.**

5. Always remove or cut back dead or broken roots before planting.

6. Plant the tree at the same depth as it was growing in the nursery. The soil line is usually where the bark color changes between the trunk and roots. Leave the bud union exposed. If planted too shallow the tree will die.

7. When planting, fill the hole half full of water and add soil. This forces all air out of the hole and insures good soil/root contact. Air pockets around roots can result in tree death. The soil will settle after 24 hours. Add more soil and water a second time. **Remember to plant trees at the same depth as they were grown in the nursery.**

8. Prune the tree back one-third to one-half its height to balance the top with the roots.

Tree Training

Allow tree branches to grow without pruning for the first couple of years. The main branches, known as scaffold limbs, will grow and define the tree's shape. Leaving branches on the lower portions of the trunk will produce a "trashy trunk." A trashy trunk tree will produce a larger tree faster than a "limbed up" tree. Begin removing these limbs the winter after the third-year after planting. Leave some limbs for removal the fourth-year. The fifth-year remove all lower limbs up to the desired height. Remove all limbs that are dead, diseased, broken, crossing or rubbing at any time.

Fertilization

Two fertilizer elements are needed annually by pecan trees in Arizona. They are nitrogen (N) and zinc (Zn). All other nutrients are normally found in adequate amounts in the soil. Leaf tissue samples are the best way to determine nutrient status of pecan trees. The Cooperative Extension publications, Leaf Sampling Guide with Interpretation for Arizona Pecan Orchards (AZ1410) (http://cals.arizona.edu/pubs/diseases/az1410.pdf) and Laboratories Conducting Soil, Plant, Feed or Water Testing (AZ1111) (http://ag.arizona.edu/pubs/garden/az1111.pdf), can assist in making proper fertilizer applications. These publications are also available from Arizona Cooperative Extension Offices..

Nitrogen (N) – Nitrogen should be applied to the soil just before bud break in the spring. On fertilizer bags/containers the first number represents the percent of nitrogen contained in the fertilizer. Common sources of nitrogen are ammonium sulfate (21-0-0), ammonium phosphate (16-20-0), urea (46-0-0) and complete lawn and garden fertilizers like 5-10-5, 10-20-10 or 12-12-12. Apply complete fertilizers based on nitrogen content.

Zinc (Zn) – In the arid southwest zinc deficiency is common in pecans, especially when the soil pH is above 7.0. Small leaves that may have brown patches, leaf loss and short shoot growth causing "rosetting"are symptoms of zinc deficiency (See Figs. 1-3). Rosetting is caused when shoots do not elongate and leaves are bunched at the terminal of the shoot, analogous to rose petals. Zinc, in many

Figure 1. Zinc deficiency causes brown spots between leaf veins.

Figure 2. Severely zinc deficient tree.

Figure 3. Zinc deficiency causes small leaflets.

cases has to be sprayed on foliage as a supplement to soil application. Spraying may be difficult with large trees or prohibited by cost, necessitating soil applications. The zinc source for spraying is zinc sulfate (36% zinc), or liquid zinc nitrate (17% zinc). Some liquid zinc formulations are sold that also contain liquid iron. DO NOT use zinc chelates as a zinc source for foliar or soil applications. Chelates are low in zinc (about 7-10%), and expensive. Chelates are not recommended because they do not supply enough zinc to satisfy pecan tree requirements. In addition the chelated molecule is large and is not absorbed very well by leaves and/or roots.

Nitrogen Applications – To determine the amount of nitrogen fertilizer to apply to a tree, measure the trunk diameter two to three feet above the ground or below the lowest limb if below two feet. For each inch of trunk diameter apply one-third pound of nitrogen to the soil. For each inch of trunk diameter apply one pound of zinc sulfate. Examples of rate calculations are found in Table 2.

Therefore, a tree with a trunk diameter of 4 inches would require 1.3 pounds of nitrogen which is equivalent to 6.2 pounds of ammonium sulfate or 8.1 pounds of ammonium phosphate or 2.8 pounds of urea. Also, 4.0 pounds of zinc sulfate should be applied.

Zinc Applications – An economic treatment for zinc deficient trees is the application of 36% zinc sulfate ($ZnSO_4$). Foliar uptake is improved by adding ammonium sulfate (NH_4SO_4) (21-0-0) or liquid nitrogen like urea. To prepare a spray add two heaping tablespoons each of zinc sulfate and ammonium sulfate per gallon of water, dissolve and strain into a sprayer. For larger volumes mix three to five pounds each of $ZnSO_4$ and NH_4SO_4 to 100 gallons of water. Zinc sprays should be agitated to avoid settling. A commercial preparation is easiest for homeowners to use. It should be applied at the highest recommended rate on the container to be effective. Agricultural supply firms sell suitable zinc materials. Spray leaves until they are thoroughly wet. Mature trees should be sprayed at least four

Table 2. Examples of Nitrogen Fertilizer Amounts

Sources of Nitrogen

Trunk Diameter (in.)	Nitrogen Needed (lbs.)	Ammonium Sulfate (21%N) (lbs.)	Ammonium Phosphate (16%N) (lbs.)	Urea (46%N) (lbs.)
3	1	4.8	6.3	2.2
4	1.3	6.2*	8.1	2.8
5	1.6	7.6	10.0	3.5

*(Amount of N needed divided by percent N in the fertilizer. Example: 1.3 lbs. N needed ÷ 21% N (or 0.21)= 6.2 lbs.)

times in the spring, waiting three weeks between applications, for best results. Young trees that are growing vigorously should receive five to six sprays during the growing season. A typical zinc spray schedule would be:

1st Spray	—	when leaves are 2 inches long (usually April)
2nd Spray	—	7 days after 1st spray
3rd Spray	—	14 days after 2nd spray
4th Spray	—	14 days after 3rd spray
5th Spray	—	14 days after 4th spray
6th Spray	—	14 days after 5th spray

Method of Soil Application – Nitrogen can be applied to the soil surface or in soil reservoirs (see Fig. 4). Zinc can be applied in soil reservoirs or sprayed on tree foliage. If the ground is bare, apply nitrogen fertilizer to the soil surface at the tree dripline. (The dripline is the area beneath the ends of the longest branches.) Mix it into the top two inches of soil. A good fertilizer program is to split the total amount of nitrogen to be applied into three or four applications of equal amounts. Application dates should be at bud-break, May 15 and June 15. A fourth application should be applied during early fall. The best way of fertilizing trees growing in lawns is to make soil reservoirs and fill them with nitrogen and/or zinc fertilizer. If zinc is to be applied to the soil use the soil reservoir method or "knifing-in," rather than broadcasting it on top of the soil, to benefit pecan trees. Punch holes in the soil using a soil auger, crowbar, iron pipe and hammer or posthole digger. Make holes one to two inches wide and 12 to 18 inches deep. Space holes 18 to 24 inches apart around the dripline of the tree. Also, place soil holes beyond the drip line and a little way under the tree canopy, within one foot of the trunk (see Figure 4. below). Divide and fill holes with the recommended amount(s) of nitrogen and/or zinc fertilizer. Knifing-in requires a tractor and fertilizer shank. Place the

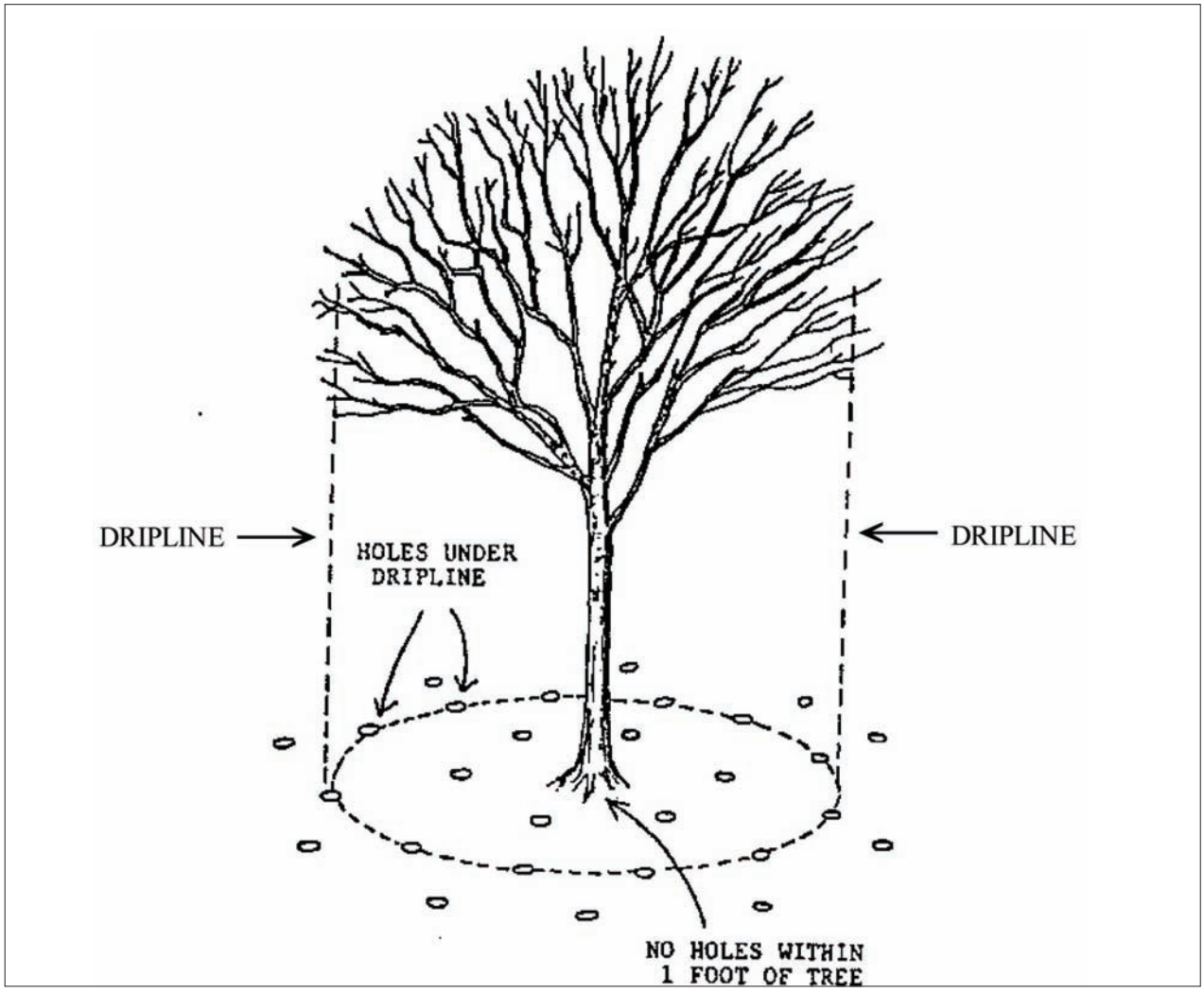

Figure 4. Soil Reservoir Method of Fertilizer Application

knifed-in fertilizer at the dripline several inches deep. A combination of soil and sprayed zinc applications is ideal.

Steps in Soil Reservoir Fertilizing:

1. Measure tree trunk diameter, six to twelve-inches above the soil line;
2. Calculate the amount of nitrogen and zinc needed to fertilize the tree using the Table 2;
3. Punch holes in the soil as described below;
4. Divide the amount of fertilizer up so that each hole will receive equal amounts of nitrogen and zinc; and
5. Cover holes with soil and then water.

Watering

Pecan trees need an ample supply of soil water for good growth and nut production. Flood and furrow irrigation are the preferred methods of water application. Sprinklers, drip irrigation and soaker hose systems can be used, but must run for considerable time to insure that water penetrates the soil three to four feet deep with mature trees. The soil should be full of water when trees start growing in the spring. To accomplish this apply the first amount of fertilizer and then water it in thoroughly when buds swell. This watering will last three or four weeks. Trees do not use as much water in the spring as during late summer when nuts begin to fill. Newly planted trees should be watered about once a week during the hottest part of the summer months.

When watering mature pecan trees make sure enough water is applied to soak the soil four feet deep in an area that is at least three feet wider than the drip line. This results in new root development and keeps trees healthy. For trees planted in lawns, do not rely on sprinklers to water both the grass and trees. The use of a lawn sprinkler system may supplement deep watering. To deep water run a soaker or water hose at the dripline on a prescribed schedule. Deep watering should be terminated the middle to last of October. Make sure the entire root zone, including three feet beyond the dripline, receives deep moisture regardless of the irrigation system used. Remember that fertilizer is placed in this zone also. Different soils should be watered at different intervals. A guide for deep watering mature pecan trees would be:

SOIL TYPE	IRRIGATION FREQUENCY
Sand	7-10 days
Loam	14-18 days
Clay	15-21 days

Nut Disorders

During the growing season pecan nuts suffer developmental problems for different reasons as shown in Figure 4. In May or June pecan trees may abort nutlets because there are too many for the tree to support. This is called June drop. Shuck (tissue that encases the nut and shell) disorders may affect nut development. Nuts are pollinated in the spring and begin to grow. The shell is formed as the shuck grows. During mid-August the nut fills with "water". This is called the **"water stage"**. In the months that follow the "water" solidifies into the nut meat or kernel, also known as endosperm. Insect feeding on or through the shuck may cause nuts to drop early or kernels to develop poorly. Insect feeding may cause dark spots on the kernel. Tree stress, usually caused by lack of irrigation, prior to shell hardening results in leaf loss as opposed to nut loss.

After shell hardening, stress results in poor nut filling and/or **"stick-tights"** (nuts which won't open). Typically, stick-tights show up in early August through September. There are characterized first by black markings on the shuck and later the entire shuck turns black. **Shuck dieback** affects pecans as they approach maturity. Shuck tips are black, curve backwards and remain attached to the pecan shell. This phenomenon occurs one to two weeks prior to normal shuck opening. Pecans that are damaged by pecan shuck dieback have a poorly filled kernel. The cause of this problem is not known. The abscission layers at the shuck sutures do not develop, the shuck does not open and sticks tightly to the nut. These pecans are hard to shake off the tree. The meat percentage is 10-30 percent. A certain number of pecans, although not significant, will always have shuck disorder problems regardless of the management program. These shucks will never open and have no kernel development. Stick-tights are best prevented by reducing late-season stress to the trees. This stress is most often related to lack of water or poor water management. Other stresses that lead to shuck problems include over cropping, crowded trees, lack of sunlight, poor soil and nutrition and poor weed control.

Another disorder in lower elevation areas is **pre-germination** (pre-germ. or vivipary) before harvest. Vivipary can occur when the kernel embryo forms and the nut germinates while it is still on the tree and may still contains liquid endosperm (See Figure 6). High temperatures and humidity of late summer and early fall cause the new nut to germinate and begin to grow even while it is still on the tree. Highly vigorous trees seem to have more germinating nuts than less vigorous trees. Pre-germination causes the nut to lose flavor and take on a bitter taste. Such nuts are usually discarded. To avoid pre-germination, select pecan varieties at planting that consistently produce nuts with a low incidence of

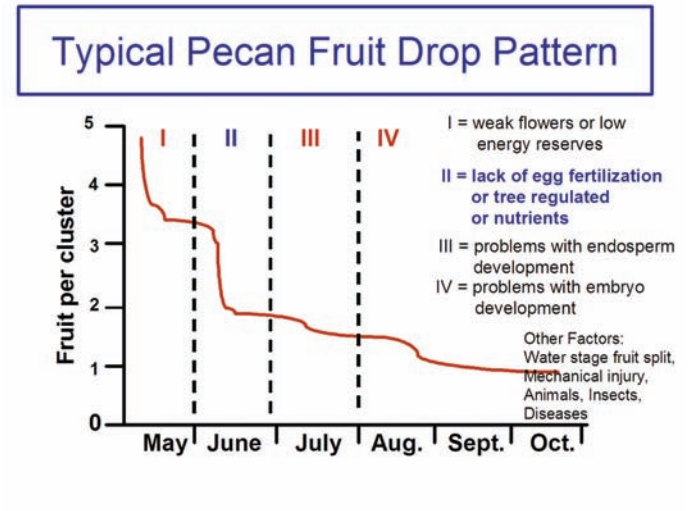

Figure 5. Reasons for Pecan Nut drop (Bruce Woods, ARS)

Figure 6. Vivipary or pre-germination

viviparity, such as 'Cheyenne' and 'Pawnee'. With varieties with potential vivipary problems in the low desert areas, like" Wichita" and "Western Schley", try harvesting the nuts just after the kernel matures but before germination begins. These nuts are harvested early before they have a chance to dry naturally on the tree and are called "green harvested" nuts. They will need to be removed from their husks and dried separately to prevent mold and mildew from forming on the nut shells.

Pruning

Pecans do not require annual dormant pruning like fruit trees. Winter or dormant pruning should be done from time to time to keep trees growing vigorously. This allows light into the center of the tree and to sustain nut quality. Of course broken, dead, diseased, crossing and rubbing limbs should be removed. Young trees, up to 20 feet tall, can be shaped in order to keep the tree symmetrical for beauty and shade.

When the tree is young a single trunk should be developed with scaffold (permanent) branches beginning at the height of five feet from the ground. As the tree grows let it develop naturally. Remove limbs which become too low, overcrowded, wind damaged, or growing downward or straight out . If ever in doubt remove offending limbs during the winter.

Old large trees may reach a point where they are not productive or produce nuts that are not filled. Many times a severe pruning will help these trees. In these cases remove one-third of the large limbs (three to six inches in diameter) while keeping the tree symmetrical. This will balance the top with the root system, resulting in rejuvenation of the tree, thus improving quality. The water and fertilization schedule should be continued.

Insects

Major insects of pecan trees in Arizona are aphids and true bugs. The former cause damage to the leaves and the later the nuts. Aphids also produce honeydew. Two species of yellow aphids and the black pecan aphid feed primarily on the underside of leaves. **Yellow pecan aphid** (*Monelliopsis pecanis* (Bissell)) (Figure 7) feed on the network of small veins located throughout the leaf. They damage pecan trees by extracting large amounts of photosynthate and water from leaves, which impairs the growth of leaves, shoots, roots and nuts. **Black pecan aphid** (*Melanocallis caryaefoliae* (Davis)) (Figure 8) cause more feeding damage than yellow pecan aphids. While feeding they inject a toxin into leaf tissue. The feeding sight turns bright yellow, causing a small angular area that develops between the leaflet veins. The area dies and turns brown. Just a few such spots cause a leaflet to shed.

Premature leaf drop results in poor nut quality and reduced bloom the following season. Treatment is justified when there are two or three black pecan aphids per compound leaf. Aphids also secrete large amounts of honeydew on to leaves. Sooty mold may grow on the honeydew substrate turning the leaves black and reducing photosynthetic efficiency because less light is absorbed by the leaves. **Ants** may "farm" aphids, protecting them from predators to feed on the honeydew. Insects from the Order Hemiptera or true bugs, like **stink bugs** (Figure 9) and **leaf-footed plant bugs** (Figure 10), may feed on the shuck or nut kernels before the shell hardens. This feeding will cause black or brown spots on kernels. Consult a Cooperative Extension Office, garden center or nursery for current recommendations to control these insect pests.

Figure 7. Yellow pecan aphid (*Monelliopsis pecanis* (Bissell))

Figure 8. Black pecan aphid (*Melanocallis caryaefoliae* (Davis))

Diseases

Immature leaves infected with **powdery mildew** (*Microspharea alni*) fungus may be slightly distorted and covered with a thin layer of white to grey fungus. Powdery mildew may also effect the shucks. In severe cases the fungus kills the epidermal cell, causing shucks to be brown and scarred. Any practice that will improve air circulation within the tree will aid in controlling powdery mildew, including pruning and removal of vegetation around the tree. On mature trees infection seldom requires protective measures. T**exas or cotton root rot**, (*Phymatrichum omnivorum*), is a soil borne fungus that infects roots of deciduous trees and shrubs. Infected plants die rapidly while retaining their dried leaves. The fungus kills the vascular system of the tree. Infected roots have tan fungal strands growing on the outside of the roots, many times visible with a hand lens. The fungus will grow along roots and may cross over to other trees if roots are touching. Losses can occur any time but are most severe during mid-to-late summer. There are no effect treatments for Texas root rot. Tree removal is recommended. **Sooty mold** (*Capnodium* or *Limacinia* species) lives on aphid or scale honeydew and turns leaves black, reducing the amount of light reaching the leaves for photosynthesis.

References Cited

1. 1997 Texas Pecan Handbook. Editors: George Ray McEachern and Larry A. Stein. Texas Agricultural Extension Service, TAEX Hort Handbook 105.
3. University of California Integrated Pest Management Program Website. Pecan Page. http://www.ipm.ucdavis.edu/PMG/selectnewpest.pecans.html
4. Leaf Sampling Guide with Interpretation for Arizona Pecan Orchards (AZ1410) http://cals.arizona.edu/pubs/diseases/az1410.pdf
5. Laboratories Conducting Soil, Plant, Feed or Water Testing (AZ1111) http://ag.arizona.edu/pubs/garden/az1111.pdf

Figure 9. Stink Bugs

Figure 10. Leaf-foot Plant Bug

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