Establishing a Pecan Orchard

Lenny Wells, UGA Extension Horticulturist – Pecans

One of the most important decisions a pecan producer makes is about the establishment of a new orchard. A well-planned, organized orchard will be more efficient, require less input and offer larger potential returns. Select the orchard location based on its soil type, drainage, water table and land topography. Straight rows in planted orchards make maintenance, irrigation and harvest easier. Tree growth and spacing requirements can also be anticipated for the early planting and subsequent orchard thinnings.

UGA extension

Soil and Site Characteristics

The importance of good soil for pecan production cannot be overemphasized. An understanding of root growth in relation to soil conditions is helpful in selecting the orchard location. Pecan root growth increases sharply in the spring, peaks in late May/early June, and declines gradually until mid-September, when it decreases sharply. Root growth continues at low levels into the winter months. Due to soil temperature effects, root growth increases with soil depth as the season progresses. Root growth will generally not occur below soil temperatures of 65° F. Pecan root growth is most limited by poor subsoil drainage.

In a favorable soil environment, pecan root systems are distributed throughout a large soil volume. Root spread can be twice that of the branches and extend into areas beneath the canopy of adjacent trees. Most pecan roots are concentrated in the top 6 to 18 inches of soil and are most dense near branch tips.

While pecans can be produced over a wide range of soil types and conditions, reports indicate that for best rooting and good production, soils should be deep, fertile and well-drained, with good water holding capacity. Pecans tend to prefer soils with a sandy loam texture and a clay subsoil. A permeable clay subsoil aids in water holding capacity without water-logging the root zone. Light textured soils with low water holding capacity require adequate irrigation for consistent pecan production. The water table should remain 6 feet below the soil surface for good pecan growth. Shallow water tables limit rooting zones, which limits available water during a prolonged drought.

Upland soils, such as those found in Georgia, can support productive orchards; however, they are not high in natural fertility and nutrient amendments must be applied. These soils also tend to be highly acidic and require lime to adjust the soil pH to the 6.5-7.0 range. A suitable upland soil should have a well-drained topsoil at least 30 to 36 inches deep.

Orchard site topography should be level or gently sloping and free of areas that hold water. Nearly-level ground can aid in more efficient harvest and management. Gentle slopes help with air drainage. Disease problems can be more problematic when low-lying land restricts airflow, so plant pecan varieties that are susceptible to pecan scab on areas of high ground. Cold air settles in protected or low-lying areas, making trees planted in such locations more prone to cold injury. Steeply sloped land may lead to erosion problems and increased equipment hazards. Surface water should drain quickly from the land after heavy rains. Standing water in the orchard will cause waterlogging, which deprives pecan roots of oxygen. Trees growing in such areas are stressed and will normally decline in productivity and eventually die.

Land Preparation

Preparing the orchard site for planting involves clearing, leveling, improving drainage, fertilizing, liming and subsoiling.

Clear the site of all brush and trees. Debris piles can be burned at the edges of the orchard, preferably away from where trees are to be planted. Wood ash is a concentrated source of potassium and may raise the soil pH to detrimental levels, which can lead to nutrient imbalances. Weeds should be eradicated in the tree row prior to planting since they can greatly reduce growth and survival of young trees.

Efficient harvesting and equipment movement requires a smooth surface, so land should be leveled reasonably well, with high spots cut down and low areas filled. This is normally accomplished via repeated harrowing, rolling and/or box blade work. Pecans generally should not be planted in areas that hold water, but where the problem is minimal, water may be diverted through drainage ditches and/or subsurface drain tile.

Soil samples should be taken for nutrient availability before planting. This will give an indication of the amendments required to make the soil as suitable as possible for pecan growth. Soil samples should be taken at a depth of 8 to 15 inches before subsoiling. Lime will normally be needed on most Georgia soils to adjust pH to 6.5-7.0 for optimal pecan growth. Soil sampling kits can be acquired from the local county extension office. The soil amendments

required will vary for each site, so follow soil test recommendations for specific amounts. Nitrogen will not be needed during the year of planting until trees put on adequate growth. Phosphorous and potassium move slowly in the soil profile, so pre-plant incorporation will provide greater accessibility by the trees.

If the site is underlain by a clay hardpan, subsoiling will be required. If needed, subsoiling should reach 24-30 inches deep directly in the tree row and at 90 degrees to the rows. Subsoiling is best accomplished when the soil is slightly dry.

Orchard Design

The design of the orchard is important because it should provide proper pollination, ease in operation, and aid in future tree thinning. Orchards can be arranged according to a variety of patterns, including square, rectangle, diagonal or quincunx, triangle, and contour.

The square pattern is most common and consists of plantings within rows at the same spacing as that between rows (Figure 1a). When thinned, the pattern may become a rectangle or diagonal as the orchard matures. The rectangle pattern allows a greater distance between rows than between trees within the row (Figure 1b).

The diagonal or quincux pattern provides twice as many trees per acre as the square pattern (Figure 1c). It is formed by placing a tree in the center of the planted square. The center tree should be a precocious, temporary tree to be removed as the orchard becomes crowded. The triangle pattern allows the maximum density of trees to be planted. An equal distance occurs between trees in each direction (Figure 1d).

When land is sloping and erosion may be an issue, the contour pattern can be used to reduce topsoil and moisture loss (Figure 1e). Terraces may also be constructed; however, they may create obstacles to mechanical operations such as sweeping and harvesting.

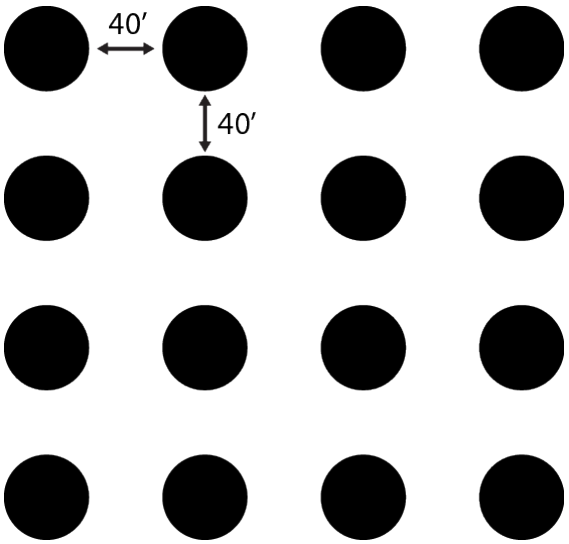

Figure 1a

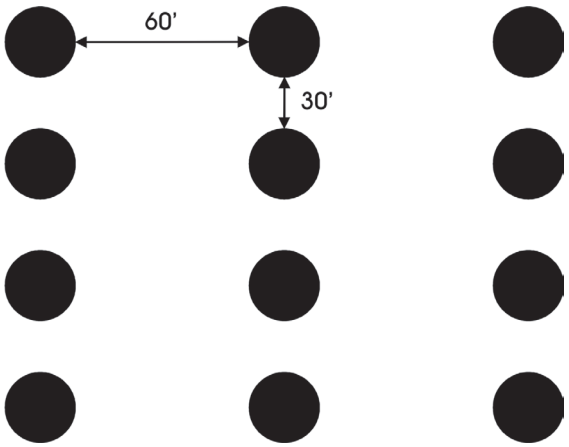

Figure 1b

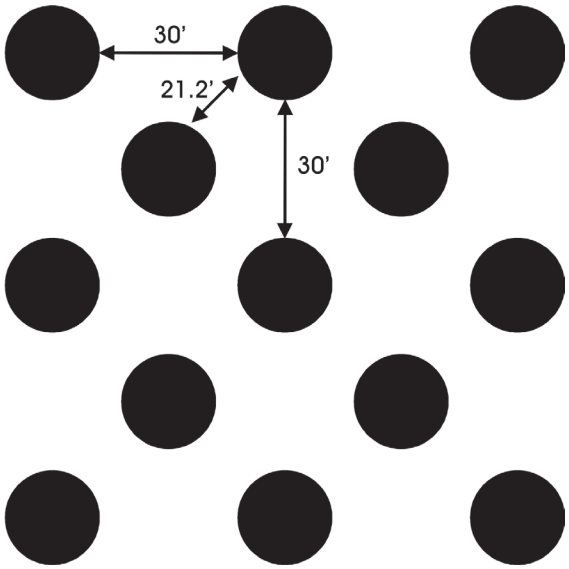

Figure 1c

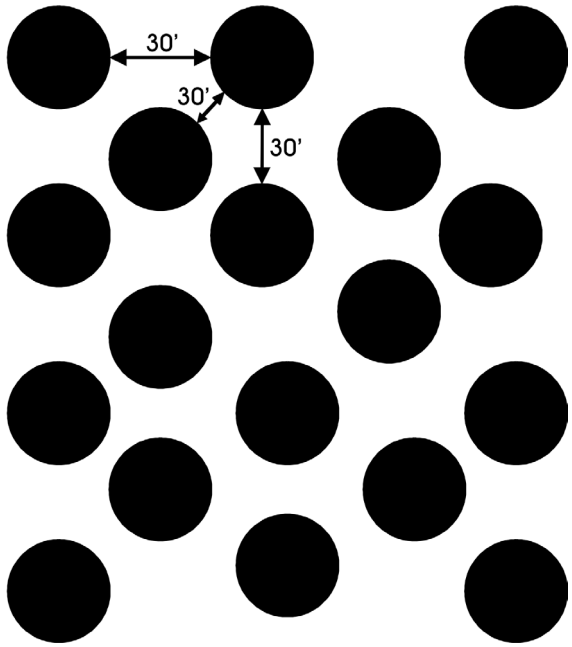

Figure 1d

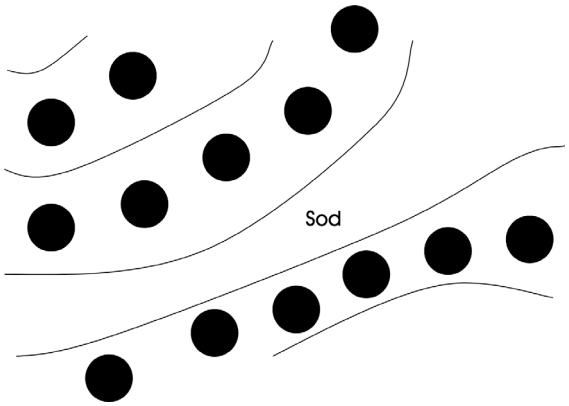

Figure 1e

High density orchards (35 trees per acre or more) require a large investment in labor and capital. Tree planting, pruning and training, pest management, tree shaking, and harvest become more intense as tree density increases. Additionally, the trees will need to be thinned at an earlier date due to crowding, but nut production will be greater until that time. A more conventional planting would be a 40 ft. x 40 ft. square planting. This spacing allows 27 trees per acre. In order to further delay crowding, a spacing of 30 ft. x 60 ft. is recommended. This allows 24 trees per acre, but shading is limited between rows as the trees mature. At full maturity, tree spacing may require densities of 7 trees per acre after thinning. Trees per acre at a given spacing can be calculated from the following equation:

$$\text{Trees per acre} = \frac{43{,}560}{\text{Ft. between trees in row X Ft. between rows}}$$

Table 1 shows tree density at various orchard spacings.

The inintial thinning should take place between 16 and 22 years after planting or when 50 percent of the orchard floor is shaded at mid-day. The first thinning should be done on the diagonal, removing alternate trees in each row and column. This removes half the trees and will increase the distance between trees by about 40 percent, allowing more available sunlight, air circulation, water, and nutrients for the remaining trees.

Growers may choose to plant precocious (early bearing) varieties as temporary trees in combination with less precocious varieties as permanent trees. Precocious varieties allow the grower to begin harvesting a marketable yield earlier in the life of the orchard, which provides a faster return on the investment. At maturity, some precocious varieties overbear and produce poor quality nuts in the on year and have low yields in the off year; this can be tempered by fruit thinning. If a grower chooses not to fruit thin the orchard, then most precocious varieties are best suited as temporary trees to be removed as the orchard becomes crowded. Permanent trees should be consistent bearers of good quality nuts.

Consider effective pollination when planning the orchard. Use at least two to three pollinator varieties in the orchard to ensure annual pollination. If varieties are planted in blocks, then the blocks should be no wider than six to eight rows apart depending on spacing, so that a pollinator is available within 150 feet after tree thinning. Alternatively, a pollinator variety should be planted so that, after the final thinning, a pollinator is positioned at every fifth tree on every fifth row. This allows adequate pollination, but prevents a reduction in price received for pecans due to undesirable blends.

Squaring the orchard helps to ensure

Table 1. Trees per acre at various tree spacings

Tree Spacing Within Rows (ft.)	Tree Spacing Between Rows (ft.)									
	20	30	35	40	45	50	60	70	80	100
20	109	73	62	54	48	44	36	31	27	22
30	73	48	41	36	32	29	24	21	18	15
35	62	41	36	31	28	25	21	18	16	12
40	54	36	31	27	24	22	18	16	14	11
45	48	32	28	24	22	19	16	14	12	10
50	44	29	25	22	19	17	15	12	11	9
60	36	24	21	18	16	15	12	10	9	7
70	31	21	18	16	14	12	10	9	8	6
80	27	18	16	14	12	11	9	8	7	5
100	22	15	12	11	10	9	7	6	5	4

straight, symmetrical rows, which is an aid to orchard operations. The triangle method is often used to accomplish squaring. A base line should be established on one side of the field by placing stakes at each end (A & B) and joining them with a straight line 60 feet apart. The intersection of an arc 100 feet from the second stake (B) is a point on a line perpendicular to the base line. A third stake (C) should be placed at this intersection. Stake C should be located 80 feet from stake A. After both corners are squared, the fourth side (D) can be determined by squaring on one of the cross lines. After squaring, tree locations, can be measured and marked on these four base lines (Figure 2).

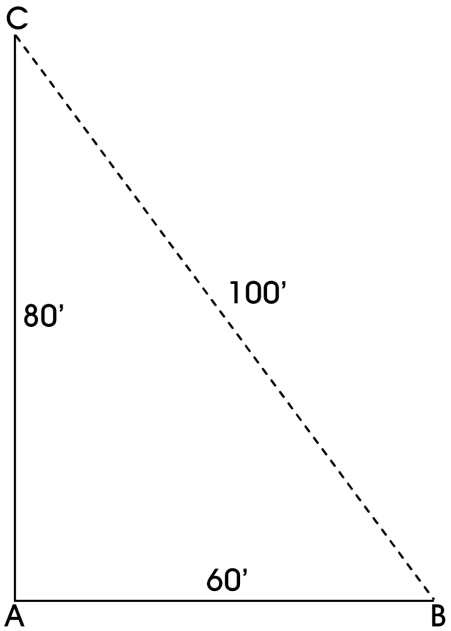

Figure 2

Planting Trees

Orchards can be started by planting seeds in place, planting seedling trees and grafting them in 2 years, or planting grafted trees. Planting seeds in place is not recommended due to weed competition, excessive mortality, and delayed production. One advantage of planting seedling trees and then grafting them after establishment is the low tree cost. Grafting is time consuming, however, and requires considerable expertise in order to establish an orchard by this method. The most common and effective way to establish an orchard is by planting grafted trees. The cost of planting grafted trees is more than planting seedling trees but labor and grafting costs may be avoided.

Pecan trees are most commonly planted as bare root transplants; however, container grown transplants may also be used. Bare root trees provide a lower initial cost and are more readily available. Transplant bare root trees while dormant, from December through March. The earlier they can be planted, the better, in order to get good root establishment by spring. Container grown trees normally suffer less transplant shock and can be transplanted from October-May. Although containerized trees may be planted while in foliage and non-dormant, tree stress is reduced and survival is better when planted in the dormant season. In any case, adequate soil moisture is a necessity.

Bare Root Planting

Plant bare root trees (Figure 3) as soon as possible after they arrive from the nursery. Circumstances often make immediate planting impossible. When in transit from the nursery, trees should be loaded onto a trailer or truck. Protect roots by packing them in wet hay or sawdust and wrapping the tree roots tightly with a tarp, which is then secured. Once the trees arrive, they may be stored for short periods of time (4-5 days) on a trailer with roots protected as described previously. Water should be continuously applied to the roots during this time.

Figure 3

If trees will not be planted for an extended period of time, heel them in. Dig a trench wide and deep enough to bury the roots to the depth they grew in the nursery. Lay trees in the trench in a slanted position so they will not be blown over by wind. Cover the roots with soil and watered thoroughly. Mound the soil and firm it in around the roots to provide good surface drainage. Trees may then be removed and planted as needed.

Dig holes for bare root trees with an 18" auger. Holes are normally 3 to 4 feet deep (depending on root size) and should be deep enough to accommodate the root system without bending the taproot. Keep the roots of bare root trees moist at all times before planting. Take care to prevent exposure of the roots to wind or sunlight to prevent drying.

When centered in the hole, trees should be set at the same depth they stood in the nursery. This can normally be observed as a color change on the bark of the tree. It is critical that the tree not be planted too deep. When this occurs, the roots may die from lack of oxygen, leading to tree stress or death. Additionally, trees set too deep are often easily blown over in a storm when they reach 15-20 years of age.

Recent research has shown that pecan trees develop better growth if all lateral roots are pruned off and the tap root is cut back to a length of 18-24 inches. Most of the new shoot growth is fed by newly developing lateral roots rather than those that are already present at planting.

After the tree is set at the appropriate depth, begin filling the hole with water. After the hole is ¼ full of water, begin pushing dirt into the hole while the water continues to run. When the water level approaches the top of the hole, turn off the water and fill the hole with dirt (Figure 4). This will prevent the development of air pockets around the roots. Level the soil around the tree but do not pack the soil down around the tree (Figure 5). Very little soil settling should occur, but additional soil can be added after settling to bring the soil level with the surface again. It is not necessary to create a berm or basin to hold water around the tree.

Figure 4

Figure 5

Figure 6

Figure 7

After the tree is planted, prune ⅓ to ½ of the top of the tree and remove any branches to compensate for the large percentage of roots lost when the trees are dug. When heading back the tree, cut at an angle just above a bud facing to the southeast (Figure 6). This will be the terminal bud that should develop into the central leader and will be somewhat protected from the prevailing northwest winds. Rub off all buds on the tree except the top two. By saving two buds, one of the two should survive and be available to form the central leader. If the uppermost bud exhibits good growth, remove the shoot formed by the lower bud.

Protect the trunk from cold damage, herbicide, and wildlife for the first three years of growth. This can be done by painting the trunk with white latex paint or placing a 3½ foot growing tube or sleeve over the tree. Often, 4 inch corrugated drain pipe is used for this purpose (Figure 7). If a tube or sleeve is used, split it down the length of one side so it can be removed after 2 years.

Containerized Tree Planting

Containerized trees are planted much the same way as bare-root trees. After trees are removed from containers, check for potbound roots. If this is a problem, roots should be pulled away from the soil and pruned. If the taproot has become twisted at the base of the container, it should be straightened or cut to encourage the growth of new taproot.

Place the root ball in the hole and add water and soil as mentioned above for bare root trees. The container soil mix can act as a wick and pull moisture away from the roots, so it is considered a good practice to cover container soil with an additional inch of soil to prevent roots from drying out.

Irrigating Young Trees

Drought stress is one of the leading causes of mortality of young pecan trees. It is essential that young trees have access to adequate soil moisture. This can be accomplished through sprinkler, drip, or micro-irrigation. Drip and micro-irrigation sprinklers are probably the most efficient means of supplying moisture to the young pecan roots, which occupy a smaller

Figure 8

volume of soil relative to those of a mature tree. With these two methods of irrigation, water can be applied more directly to the root zone of young trees. Micro-irrigation is particularly suited to young trees because it wets a larger area of soil than does the drip system, encouraging better root growth (Figure 8).

The following irrigation rates should be used for loamy sand or sandy loam soil: Microsprinklers should apply 100 gallons of water per tree per week (gpw) from budbreak through September until year 5. During extended dry periods increase to 170 gpw per tree. If drip irrigation is used, water should be applied at 48 gpw per tree for the same time period as described for microsprinklers. Where drip emitters are used one emitter should be located approximately 1 foot away from the trunk and another placed about 4 to 6 feet away from the trunk. Trees planted on heavy clay soil would still benefit from irrigation; however, irrigation rates should be significantly less than that described for sandy loam soils. Regardless of where or how pecan trees are irrigated, growth response is best when irrigated on a regular basis (every other day for example) to keep consistent soil moisture levels. Extreme fluctuations in soil moisture can generate stress on young trees leading to a reduction in tree growth.

Fertilizing Young Pecan Trees

A soil test is recommended for accurate determination of fertilizer needs before planting. After the first year of growth, soil and leaf analysis should be performed on an annual basis to determine fertilizer needs. A local county extension agent can assist with these samples.

Nitrogen is necessary for rapid tree growth, but too much nitrogen can burn the roots of young trees. Young trees are best fertilized by frequent application of small quantities of fertilizer.

Do not add any fertilizer to the hole when transplanting trees. In the absence of a soil test, no fertilizer should be added to trees the first year following transplanting until adequate growth is attained. Annual terminal growth for young pecan trees should be from 2 to 4 feet. If trees exhibit this kind of growth, they can be fertilized in June of the first year by application of 1 lb of 5-10-15 or 10-10-10 distributed in a 25 square foot area around the tree. If good growth is not observed, do not fertilize the first year. The following year, 1 lb. of 10-10-10 should be applied in March, May, and June. In the third year following transplanting, apply 4 lbs of 10-10-10 per inch of trunk diameter measured 1 foot above the soil surface. Applications may be split between March and June. Do not place fertilizer within 12 inches of the trunk.

In addition to 10-10-10, zinc sulfate should be soil applied at 1 lb. per tree for the first 3 years following transplanting if soil tests indicate Zinc levels below 15 lbs/A. Zinc moves very little in the soil. Therefore, foliar applications help move zinc into the tree more quickly. Young trees should receive two to three foliar zinc applications at a rate of 1-2 lbs of zinc sulfate per 100 gallons of water when rosette symptoms are apparent or when leaf zinc levels are less than 50 ppm.

Young pecan trees can be safely fertilized with N via fertigation through the irrigation system. Be sure the system is operating correctly and that there are no leaks or clogs. In year 1, fertigate at a rate of 5 lbs N per acre in June. In years 2-4, apply 5 lbs N per acre in April, May , and June for a total annual rate of

15 lbs N per acre. Apply a granular blend of phosphorus (P), potassium (K) and zinc sulfate over the tree row at rates of 40 lbs per acre, 40 lbs per acre, and 25 lbs per acre respectively in March or April of years 1 and 2.

Weed Control

Aside from soil moisture, weed competition is the most limiting factor to the growth of young pecan trees. Weeds can rob young trees of soil moisture and nutrients, reducing growth by as much as 50 percent in the first 3 years. Yield may also be reduced by 75 percent during the first 4 years of harvest if weeds are not controlled early in the life of the tree. Research indicates that a 7 x 7 foot area around the tree should be kept free of weeds during the first year of establishment and at least a 10 x 10 foot area is required in subsequent years for optimal growth and yield.

Protect the bark of newly planted pecan trees from herbicide by growing tubes, sleeves or white latex paint covering the bottom 3.5 feet of the trunk. This provides more herbicidal weed control options, so post-emergence materials such as paraquat and glyphosate can be used when directed at the ground. Care must still be taken to eliminate herbicidal drift onto exposed leaf tissue and bark. Growing tubes can be ordered from a nursery supplier or made from 4” plastic drain pipe.

Published by the University of Georgia in cooperation with Fort Valley State University, the U.S. Department of Agriculture, and counties of the state. For more information, contact your local UGA Cooperative Extension office.