Growth and Development of Pecan Nuts

Guide H-618

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In general, nuts of a nutbearing tree can be called storage organs. They store minerals and such elaborate food materials as carbohydrates (sugars and starch), oils, amino acids, and proteins that have been produced by the leaves of the tree. These materials are stored for future use by the nut embryo to sustain respiration, to permit germination, and to maintain the seedling until it has produced enough leaf area to become self-sufficient.

Nut production by a pecan tree starts with the onset of flowering. Pollen shed from catkins (male flowers) is generally abundant every year.

Female flowers may be present in adequate amounts or they may be scarce if the crop was good the previous year and alternate bearing is taking place in the orchard.

Some flowers may be prematurely shed early in the season. This will include (a) rudimentary flowers located near the shoot tip; (b) normal flowers that were not pollinated, and (c) pollinated flowers in which nutlets did not develop because food reserves were depleted during early growth or because of unfavorable moisture conditions. This shedding, which may occur around May, is worse with some varieties than others and often is not noticed by the pecan grower.

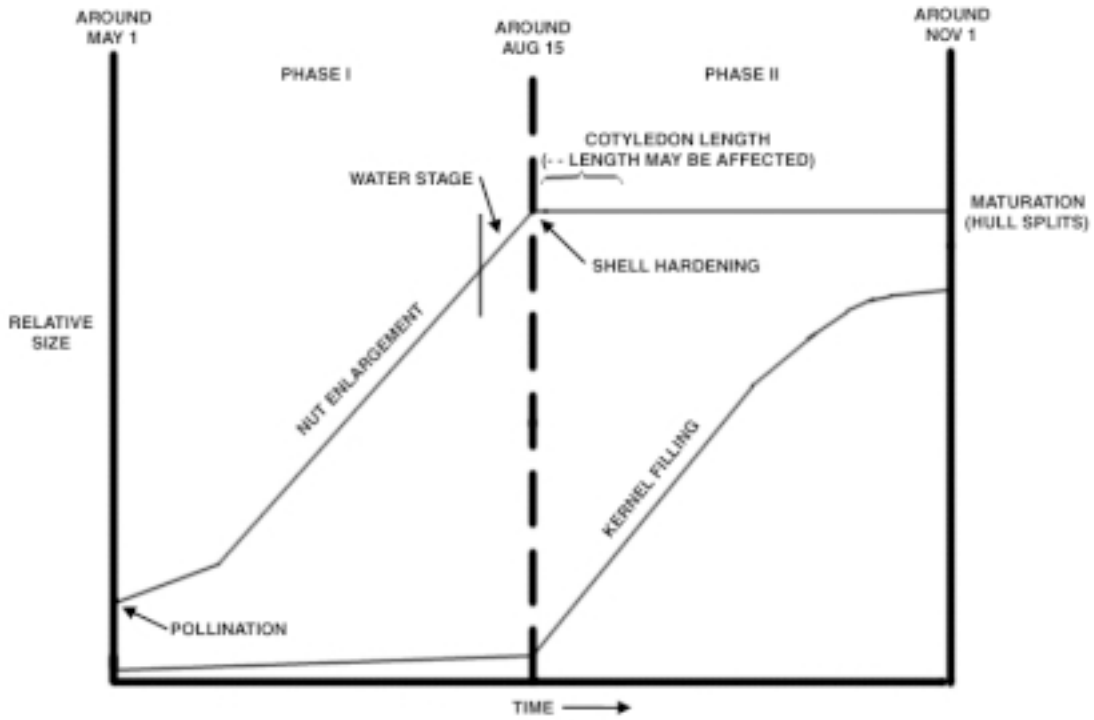
What has been referred to as June drop usually takes place around late June. It is caused by incomplete fertilization (fruit set). The pecan nut is characterized by double fertilization. When the pollen tube forms, the nucleus found within divides to form two nuclei. Coincidentally, growth processes in the pistil produce an endosperm nucleus to form the endosperm, which will nourish the embryo. This process offers two possibilities for premature nut shedding, which may occur at different times. First, premature shedding will result from lack of nutritional support of the embryo. On the other hand, if the egg cell is not fertilized, premature shedding will also occur. Research workers do not agree on how soon fertilization occurs after pollination. There is general agreement, however, that pistillate flowers that are not fertilized fall off within 5–6 weeks after they were receptive. June drop may be more conspicuous than the previous drop because nutlets will be larger.

About 25% of the total nut crop is shed during the first and second drops. Environmental stresses can increase the nut drop. Researchers have shown that less dropping occurs with cross-pollination than when self-pollination takes place. Good pollination is a must in pecan orchards.

Actual nut development starts with pollination and it can be divided into two distinct phases throughout the growing season. It is difficult to put an exact date on the beginning and ending of these two phases. Because of variation in weather conditions, growing degree hours may give a better estimate.

Phase I occurs from pollination (early to mid-May) to shell hardening (or until the end of the water stage). The pecan completes the sizing of the nut during this phase. The end of the water stage may occur between the middle and end of August in the Mesilla Valley.

Phase II occurs from the shell hardening (or end of water stage) until shuck splits. The kernel develops and fills out during this phase, ending when the hull splits along the sutures.



Pecan Development Stages

PHASE I: GROWTH IN NUT SIZE

It takes about 90 days after pollination for the fruit to grow to its full size, slowly at first and then more rapidiy. Toward the end of August the fruit has reached maximum size, so factors influencing fruit size will operate only during the first half of the growing season. The endosperm is entirely noncellular until the beginning of August or toward the end of phase I, which is why it is called water stage.

A remarkable feature of Phase I is the slow growth of the actual embryo, which later becomes the edible kernel of the nut.

Although the ultimate size of pecans is genetically predetermined, there are some factors that can influence nut size such as soil moisture availability, nutrition status and environmental conditions. The actual size of the nuts produced by a pecan tree is determined by a number of factors, one or all of which may operate during the course of the season.

- **Vigor of tree.** In general, it seems young trees are more vigorous and bear bigger nuts than do older trees.
- **Position of the nuts on the tree.** Nuts in the top of a tree are usually larger than those closer to the ground.
- **Fertility of the soil and moisture supply.** Nuts borne on trees growing on fertile soils adequately supplied with moisture are usually larger than those borne on trees on infertile soil or poorly supplied with soil moisture
- **Size of the crop.** Commonly, the larger the crop, the smaller the nut.

Close to the date when the first phase of nut development is complete, the third nut drop, called August drop, takes place. It usually occurs during the month of August and sometimes stretches into early September. It causes greater concern to pecan growers because of the large size of the nuts at this time, although the percentage shed is generally low, 8–10%. Embryo abortion is considered to be the reason for this late drop.

By the time August drop takes place, the embryo has attained full size, the ovary has about completed its enlargement, and the pecans will soon begin to harden. Premature shedding will occur when

something affects the embryo. If the embryo aborts after the shell hardens, the nut usually matures, but will be hollow. Although the causal factors for embryo abortion are not known, the following situations are considered, by some researchers, to cause embryo abortion:

- **A severe drought or water stress.** This is more likely to occur in poor soils and it frequently takes place during the water stage.
- **A prolonged period of excess moisture.** Lack of air in the soil impairs the root system's capacity to absorb water and nutrients required by the pecan tree.
- **Hot, dry winds** can increase water loss by increasing the pecan tree moisture requirements due to high transpiration rates.
- **Insects** (shuckworm, southern green stinkbug, pecan weevil). Puncturing of the ovary wall, the future nut shell, will cause nuts to fall in 3 or 4 days.
- **Physical damages** that can disturb the ovary wall (shell) of pecans.

PHASE 2: NUT FILLING

Although the shuck increases in thickness, no significant increase in fruit size occurs during Phase II because shell hardening prevents such growth. The embryo (kernel tissue) reaches full size about the third week in September, absorbing the endosperm as it grows. Filling of the kernel continues as long as conditions permit assuming the shuck is green and, ideally, until the nut is mature.

Most of the storage materials are translocated into the nuts from nearby leaves and shoots during the last 6 weeks of filling. This results in a severe, and sometimes exhaustive, drain on foodstuff in the tree. A high quality kernel contains 73–75% oil, 12–15% protein, 3–4%, water and 1.5% minerals.

The degree to which nuts are filled, or how well the kernels are developed at harvest, is determined by a rather large number of interrelated factors.

- **The size of crop** in relation to amount of foliage, or ratio of number of leaves per nut when too many nuts are set and carried through to the filling period compared to the number of leaves or the leaf area of the tree. It is difficult for the leaves to synthesize the large amounts of food materials required to fill the nuts when the crop is very large.
- **The average size of nuts**, because it takes more food materials to fill a large nut properly than a small one. Nuts may be poorly filled in seasons with favorable conditions to attain a good nut size.
- **The condition of leaves,** because to produce well-filled nuts, the trees must bear a large leaf area and the leaves must be in good health and vigor.
- **The size of preceding crop and how well the nuts produced were filled**. It seems that under conditions of heavy crop production, food material reserves left in the tree at the time of harvest are likely to be low. Excellent nutritional status of the tree (soil fertility) is needed to restore these materials and to produce a good quantity of vigorous female flowers.
- **Free of insect and disease injuries.** Healthy foliage is needed to ensure photosynthesis is conducted to full capacity in the trees. Insects affecting foliage or shuck will impair their ability to produce and conduct food materials, respectively.
- **Weather conditions** will likely have a big impact on nut development. Under conditions of prolonged drought, the kernels do not fill properly. Hot weather can also cause some sunscald or burning of the shucks and also affect filling of the kernel. This occurs mainly on the south and southwest sides of the tree when trees do not have a thick, dense foliage.
- Last but not least, **heterosis, or cross-pollination**, has been often reported to have an impact on nut filling. When the pistillate flowers of a certain variety are cross-pollinated with pollen from another variety, the kernel is larger and better filled.

A nut is mature when the hull splits along four sutures, exposing the nut. Bursting open of the shuck helps both the shuck and nut dry out, and moisture content of the nut drops from about 30% to 12% at harvest. This usually occurs after the first hard freeze (low 20's). In the Mesilla Valley, growers usually start harvesting after freezes have taken place. Release of the nut from the dried shuck depends on climatic factors (degree of dryness) and on the nut shape (less in round nuts).

GENERAL RECOMMENDATIONS

The specific effect of unfavorable growing conditions on nut development is determined by the time at which the unfavorable condition occurred. Poor growing conditions early in the season, when the nuts are developing size, result in pecans of below normal size. If they occur late in the season when filling normally occurs, the nuts are likely to be poorly filled.

Producers need to practice cultural management that will provide maximum leaf surface in spring and early summer. Nitrogen fertilization and irrigation just before bud break in the spring followed by the recommended zinc sprays may help to prolong shoot growth.

Sufficient soil moisture, nutrients, and other factors should be available so carbohydrates will be manufactured and stored from healthy leaves in late summer and autumn.

Early maturing varieties have a longer period after nut maturity in which they can replenish some of the food reserves used to produce the current pecan crop.

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