



# Best Management Practices of Poultry Litter in Pecan Orchards

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The utilization of animal manure as a fertilizer is an integral part of sustainable agriculture, and animal manures have been used effectively as fertilizers for centuries. Poultry manure, in particular, has long been recognized as perhaps the most desirable of these natural fertilizers because of its high nitrogen content. Poultry manure also provides other essential plant nutrients.

The use of poultry litter as a source of fertilizer in commercial pecan production has increased dramatically in the past few years due to the rising cost of synthetic fertilizers. When managed properly, poultry litter can be a valuable source of plant nutrients.

Broiler litter is composed of un-retained feed nutrients and shavings. Based on average plant nutrient levels (NPK) at 2008 prices, one ton of poultry litter has an estimated value of approximately \$137 per acre. However, this value may vary depending on a number of factors, including moisture, temperature, feed rations, number of batches before clean-out, storage, handling and synthetic fertilizer price. Broiler litter analysis has an approximate analysis equivalent to a 3-3-2 (NPK). A typical analysis for one ton of broiler litter is:

Nitrogen (N)	60 lbs./A
Phosphorous (P)	60 lbs./A
Potassium (K)	40 lbs./A
Calcium (Ca)	30 lbs./A
Sulfur (S)	15 lbs./A
Magnesium (Mg)	9 lbs./A
Zinc (Zn)	0.6 lbs./A
Copper (Cu)	0.6 lbs./A

Bedding material normally comprises 5 to 15 percent of the litter. It is strongly recommended that growers have samples analyzed before applying litter to the orchard in order to determine the actual values of nutrients contained in the broiler litter.

The availability of N from poultry litter, because it is an organic material, is less predictable than for commercial fertilizers. The amount and timing of N released from litter depends on a number of factors, including pH, temperature and available moisture. Parts of the nutrients contained in the litter are organically bound, and thus are released slowly. Normally, where poultry litter is used, liming will be required less frequently because poultry litter has some liming capacity. Regular soil testing will indicate when lime is required.

The carbon to nitrogen ratio (C:N) of poultry litter may range from 10:1 to 25:1 depending upon the bedding material used and the degree of composting. The C:N ratio affects N availability, total organic matter and the rate of organic decay. Organic materials with low C:N ratios of 15:1 to 20:1 will release N more rapidly than those with higher C:N ratios. When C:N ratios are less than 12:1, the rate of decay of organic matter is increased.

If conditions are extremely dry or cold, little or no N may be released. As a general rule of thumb, 60 percent of the total N content of poultry litter (36 lbs. N/ton) is available for crop uptake during the first season. Most of the remaining N will be released very slowly during the decomposition of the organic residues. Since N availability is highly variable, leaf sampling is strongly recommended.

Long-term concerns of using poultry litter include the buildup of P and Zn in soils. Phosphorous is relatively immobile, and its availability is directly related to the rate at which the manure decomposes and its binding qualities within the soil. All forms of K in manure are readily available to plants in most cases but are subject to loss by leaching. Buildup of excessive levels of Zn in orchard soils may be of less concern than would be expected for other crops because of the relatively high Zn requirements of pecan.

Although N is considered to be the most important nutrient element for pecan production, poultry litter applications should be based primarily on P needs due to the risk for P contamination of surface water; excess P-laden soils can be transported to lakes, rivers, streams and ponds by erosion. Also, if P and K soil levels are high and their application is unwarranted, as is commonly observed in many Georgia orchards, synthetic N can be economically competitive with poultry manure as a fertilizer source. A nutrient management plan can be a valuable tool for managing nutrient and poultry litter applications on a farm. More information regarding nutrient management plans can be obtained from your local county extension agent.

Poultry litter should be managed to provide spring P and K and a portion of the total N requirement. The remainder of the N should be applied as commercial fertilizer after crop load has been assessed. For example, 1 ton per acre of poultry litter applied in March and 1 ton per acre applied in May, followed by 25 to 50 lbs. N per acre applied as synthetic fertilizer in late August — or split between early August and early September when crop load is heavy — should provide adequate N for pecan trees. Additional K should be based on the leaf N:K ratio in July. In the “off” year, 1 ton per acre of poultry litter applied in March should be sufficient.

## Minimizing the Risk of Nut Contamination

Recent concerns about agricultural production and food safety focus on proper management practices for animal waste materials to ensure minimum risks of microbial contamination of edible crops. A single food contamination event can have potentially devastating effects for the pecan industry as a whole; therefore, it is vitally important that growers make every attempt to minimize the risk of contamination in their orchards. Although we can never completely eliminate this potential due to the passage of wild animals through the orchard, we can minimize the risk of contamination that may result from our own actions. The following recommendations are provided to help minimize the risk of a pathogenic contamination issue of pecans where poultry litter is used as a fertilizer source.

### 1. Use only properly composted poultry litter.

Fresh poultry litter has historically been used as a source of plant nutrients and soil amendment. When based upon a sound waste management program, land application of

poultry litter can be an economical and sound agricultural decision. However, if not managed properly, waste application can be an environmental hazard. **Therefore, for orchard application, it is highly recommended that only mature litter compost be applied.**

Properly composted poultry litter is unlikely to harbor human pathogenic strains of potentially harmful bacteria such as *Escherichia coli* (*E. coli*) and *Salmonella* sp. This is because the heat generated during aerobic composting elevates temperatures high enough to kill these organisms.

Composting is the aerobic decomposition of the biodegradable organic matter in manure and is performed primarily by bacteria, yeasts and fungi. In the process of composting, microorganisms break down organic matter and produce carbon dioxide, water, heat and humus, the relatively stable organic end product. Under optimal conditions, composting proceeds through two phases as the litter is turned on a weekly basis: 1) the thermophilic (high-temperature) phase, which can last from a few days to several months, and 2) a several-month cooling and maturation phase. Different communities of microorganisms predominate during the various composting phases. Initial decomposition is carried out by mesophilic microorganisms, which rapidly break down the soluble, readily degradable compounds. As the piles are turned, oxygen is re-introduced into the system and the compost temperature rises.

As the temperature rises above about 99° F, the mesophilic microorganisms become less competitive and are replaced by others that are thermophilic, or heat-loving. At temperatures of 131° F and above, microorganisms that are human or plant pathogens are destroyed.

During the thermophilic phase, high temperatures accelerate the breakdown of proteins, fats and complex carbohydrates like cellulose. As the supply of these high-energy compounds becomes exhausted, the compost temperature gradually decreases and mesophilic microorganisms once again take over for the final phase of “curing,” or maturation, of the remaining organic matter.

If the litter piles are not turned, oxygen is not introduced into the system. This leads to the formation of methane, CO<sub>2</sub> and odors. Composting in undisturbed piles may take several months or years. By turning the piles, the process is reduced to as little as a few weeks to a few months.

## **2. Apply litter early in the spring.**

Applying poultry litter to pecan orchards within one to two months of harvest carries a greater potential for pathogenic contamination of nuts than do early season applications. Certified USDA organic farming regulations prohibit the application of fresh manure for use on edible crops. These regulations also state that the last application of manure should be applied and incorporated into soils no less than 120 days before harvest for crops whose edible portions come into contact with the soil.

Poultry litter applied to pecan orchards is rarely incorporated; therefore, applications should be made no fewer than 180 days before harvest. Applying composted litter prior to mid-May should be considered a viable method of reducing the risk of contamination, and also helps avoid unfavorable perceptions by the public of “unhealthy” conditions in pecan orchards.

Due to the slow availability of nutrients from poultry litter, early season applications will also be more effective from a crop management standpoint. When manure is composted, volume decreases and nutrient concentration and acceptability for land application increases. Applying composted litter in which most of the nutrients are organically bound is similar to split applications of commercial fertilizer because nutrients are released slowly throughout the season.

## **3. Timely harvest.**

As soon as pecans ripen and fall or are shaken from the tree, they begin to dry and cure. Initially, this process improves nut quality until an optimum appearance, aroma, flavor and texture are acquired. If nuts remain on the ground and the process continues, the seed coat darkens and the oil in the kernel increases in peroxide and fatty acid levels, which can cause the nut to become stale and rancid. Therefore, pecan growers often attempt to harvest their pecans as early as possible to obtain a premium market price. Aside from the financial benefits of an early harvest, the potential for contamination of nuts is reduced if the crop is removed quickly from the orchard floor. The less time the nuts spend exposed to the soil surface, the less potential exists for contamination.

## **4. Avoid wet harvest conditions.**

Rainfall during the harvest period can potentially lead to higher risks for contamination of pecan nuts because wet soil conditions promote bacteria survival. As rainfall droplets hit the ground, the resulting splattering could

spread harmful microbes that may further thrive in the wet conditions. Although naturally occurring environmental conditions are beyond our control, growers should avoid shaking nuts out of the tree when orchard soil conditions are wet or when rainfall is expected before the nuts can be harvested. In addition, poultry litter should not be applied to areas of the orchard that have a tendency to hold standing water.

## **5. Reduce overcrowding in the orchard.**

Orchard overcrowding leads to poor production due to inadequate sunlight, water and nutrient availability. As a result, pecan trees are normally removed from orchards as they begin to crowd. Proper sunlight management within the orchard can also lead to a reduction in the risk of crop contamination by harmful organisms. The sun’s ultraviolet rays can potentially reduce the survival time of organisms like *E. coli* and *Salmonella* at the soil surface.

## **6. Management of thin-shelled cultivars.**

Thin-shelled pecan cultivars such as “Schley” and “Sumner” can be easily cracked during the harvesting process. Cracks in the pecan shell can serve as an entry point for bacterial pathogens to contaminate the pecan nutmeat. Thus, extreme caution should be used when applying poultry litter in an orchard where thin-shelled cultivars are grown. Pecan nut packing tissue is known to be toxic to certain bacterial pathogens, affording some protection against high initial contamination and subsequent organism survival.

Whether or not poultry litter is used in pecan orchards, there is still the remote possibility that *E. coli* or *Salmonella* bacteria may be introduced into orchards, or contact nuts, by any one of a host of wild, warm-blooded animals (birds, rodents, canines, etc.) or reptiles (snakes, turtles, lizards) that live in, or traverse, orchards. The washing and chlorination process that routinely occurs in pecan shelling plants is a safety practice designed to kill pathogens of any form before pecan nutmeat enters the food distribution chain. From the standpoint of orchard management, the best way to protect consumers from exposure to a human pathogenic strain of these two bacteria is to avoid usage of non-composted manures late in the growing season.

When managed responsibly, poultry litter can be a safe and effective means of supplying fertilizer nutrients to pecan trees.

## References

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