

## **Broiler Litter as an Alternative to Commercial Fertilizer**

Gerald W. Evers  
Regents Fellow and Professor  
Texas AgriLife - Research  
Texas AgriLife Research and Extension Center  
Overton, Texas

### **Introduction**

After World War II, anhydrous plants used to manufacture explosives were modified to make commercial nitrogen fertilizer. This low cost input was an economical way to increase food, grain, and forage production. Natural gas is required to manufacture nitrogen fertilizer. As natural gas costs have increased over the years, a pound of nitrogen fertilizer has increased from about 8¢/lb in the early 1970's to about 70¢/lb in 2008. World demand has increased the price of phosphorus from 30¢ to \$1.14 and potash from 16¢ to 70¢.

Animal manure has been successfully used as a soil amendment since the dawn of civilization. Some of the earliest Greek and Roman agriculturists (Theophrastus, Varro, Columella) recognized not only that animal manures varied naturally in fertilizer value (ranking them as poultry > swine > goat > cow > horse) but that management practices (e.g., the use of bedding, type of animal feed) could alter manure quality. For almost 2,000 years until the advent of chemical fertilizers in the 1940's, animal wastes were one of the primary sources of plant nutrients for agriculture. As commercial fertilizer prices continue to escalate, animal manure is again becoming an economic alternative to commercial fertilizer. The remainder of the paper will focus on broiler litter since it is the most available animal manure in the eastern half of Texas.

### **Broiler Litter**

Broiler litter is a mixture of poultry manure, bedding, feathers, and spilled feed. An estimated 450,000 tons of broiler litter are generated by the broiler industry in Texas each year. The average nitrogen (N), phosphorus (P), and potassium (K) content of broiler litter samples in Alabama was 62, 59, and 40 lb/ton, respectively (Table 1). When broiler litter is applied to a pasture, from 60 to 65% of the nitrogen is available the first year, about 25 to 30% is lost through ammonia volatilization, and about 10% is not available until after the first year. Essentially all the phosphorus and potassium are available.

### **Advantages as Fertilizer**

Contains nutrients other than N, P, and K. Most commercial fertilizer grades only contain N, P, and K because they are needed in the largest quantities by plants. Since manure is grain and plant tissue that is not absorbed by animals during digestion it contains all necessary nutrients for plant growth. Calcium (Ca), magnesium (Mg), and sulfur (S) are minor elements and chlorine (Cl), boron (B), iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), and molybdenum (Mo) are micronutrients necessary for plant growth. Hence, animal manure is a more complete fertilizer for plant growth than commercial fertilizer.

Contains organic matter. Organic matter is a critical part of soil fertility and is an indication of soil quality. It improves soil structure, increases nutrient and waterholding capacity of the soil, and provides energy for soil microorganisms such as earthworms. Sandy soils in East Texas typically have less than 1% organic matter.

Slow release of soluble nutrients. As organic matter decays, nutrients are released into the soil over a period of time. In contrast, nutrients in commercial fertilizer are immediately available which allows soluble nutrients like nitrogen, sulfur, and boron to be leached from the soil during heavy rainfall. It is a recommended practice to split the required commercial N fertilizer into 2 to 4 applications during the growing season to minimize N losses. Animal manure only needs to be applied once a year.

More economical than commercial fertilizer. What is a ton of broiler litter worth? It depends on the N, P, and K content of the broiler litter and what the current costs of these nutrients are. Using the average N, P, and K levels from Table 1 and the present value (April 2008) of 50¢, .30¢, and 90¢/lb of N, P, and K, respectively, a ton of broiler litter has a value of about \$73.70 (Table 2). This does not include the economic value of the other nutrients, liming benefits, and added organic matter. However forages can not utilize all the N, P, and K in the broiler litter (see N:P ratio below). Price of broiler litter is also influenced by transportation cost. The farther broiler litter must be moved from the poultry house, the more expensive it becomes.

### **Disadvantages as Fertilizer**

Variable nutrient content. Nutrient concentration of broiler litter is variable (Table 1) due to age of the bird, composition of the diet, how the manure is handled, and the number of batches of birds raised since the last clean out. It is important to get a sample of the broiler litter for analysis before it is spread so the producer knows how much is being applied. Broiler litter is usually purchased without any knowledge of the nutrient content.

Availability. One has to buy broiler litter whenever it is available which may not be the optimum time for fertilizing hay fields or pastures. Poultry integrators set general policy on how often broiler houses are cleaned out. The greatest demand for broiler litter is in early spring for hay production. Total clean out can occur throughout the year but a majority of the houses are cleaned out in the spring and early summer. Broiler litter available in the fall and winter can be applied to winter pasture.

High application rates. Because of low nutrient concentrations compared to commercial fertilizer, rates of broiler litter are applied in tons/acre compared to 200 and 500 lb/acre for commercial fertilizer. Transportation costs limit the distance broiler litter can be moved economically.

Odor. Odor problems are due to the release of ammonia, hydrogen sulfide, and other compounds when broiler litter is applied on the pasture surface. Odor problems occur during and after land application until after the first rain. Odors are reduced if the applied litter is incorporated into the soil by disking. Producers should avoid applying broiler litter near residential areas.

N:P ratio does not equal crop needs. With commercial fertilizer, the exact N, P, and K requirements of a crop can be applied. When applying broiler litter, the nutrient content is variable and unknown. The average N:P ratio of broiler litter is about 1:1. Annual ryegrass and warm-season perennial grasses such as bermudagrass take up N, P, and K in about a 4-1-3 ratio. All N will be utilized but only 1 lb P and 3 lb K will be used for every 4 lb of available N. Based on the nutrients actually removed by the grass, a ton of average poultry litter is now worth only \$50.00 (Table 2). If broiler litter is the only fertilizer used, P builds up in the soil which can lead to environmental problems if it moves into surface water from runoff or erosion. The best way to utilize the excess P and K is to add additional N as commercial fertilizer. Another source of N are forage legumes that can remove N from the air if their roots are infected by the correct strain of rhizobia bacteria. Combining additional N from commercial fertilizer or a legume with animal manure, will result in plants utilizing the excess P and K and increase the fertilizer value of a ton of poultry litter above \$50.00.

## **Recommendations**

When warm-season perennial grasses like bermudagrass and bahiagrass are used for grazing, apply 2 tons/acre of broiler litter every other year and apply about 75 lb/acre of N in years that broiler litter is not applied. An alternative to applying N is to overseed the warm-season grass with a cool-season annual legume each fall as a N source. If fertilizing for 2 hay cuttings, apply 2 tons/acre of broiler litter in the spring and apply about 75 lb/acre of N after the first hay harvest. If 3 to 4 hay cuttings are needed, apply from 3 to 4 tons/acre of broiler litter in the spring. After the second hay cutting, apply 75 lb N/acre for the third harvest. After the third harvest, apply 75 lb/acre of N and K for the fourth hay harvest. For winter pasture, apply 2 tons broiler litter/acre in the fall and 50 lb/acre of N in December.

Warm-season pastures that are fertilized with broiler litter should be overseeded each fall with annual ryegrass and/or legumes for spring weed control. One of the benefits of animal manure is the slow release over time. If cool-season forages are not overseeded, the nutrients released during winter will enhance weed growth. Samples of the broiler litter should be analyzed to know how much P is applied and soil samples taken at least every 2 years to monitor soil P levels.

## **Summary**

Broiler litter is a valuable fertilizer for the low fertility, acid sandy soils in East Texas. Broiler litter has all the nutrients needed for plant growth and the added organic matter improves the soil. However, it must be applied at proper rates and combined with N from commercial fertilizer or legumes to prevent environmental problems from excess P moving into surface water.

Table 1. Average and range of nutrients in 146 poultry litter samples (80% dry matter basis) collected in Alabama.

Nutrient	Average	Range
	-----lb/ton-----	
Nitrogen (N)	62	34 – 96
Phosphate (P <sub>2</sub> O <sub>5</sub> )	59	22 – 142
Potash (K <sub>2</sub> O)	40	13 – 99
Calcium (Ca)	35	13 – 98
Magnesium (Mg)	8	3 – 34
Sulfur (S)	6	0.2 – 13

Table 2. Estimated March 2009 fertilizer value of broiler litter based on average nutrient content, percent nutrient availability, and nutrient uptake by grass.

Nutrient	Amount	Available	Cost	Value
	lb/ton	lb/ton	¢/lb	\$/ton
Nitrogen (N)	62 (60-65%)	40	50	20.00
Phosphorus (P <sub>2</sub> O <sub>5</sub> )	59 (90-100%)	59	30	17.70
Potash (K <sub>2</sub> O)	40 (90-100%)	40	90	36.00
				73.70
4-1-3 Ratio for Bermuda, Bahia, etc.				
Nitrogen (N)		40	50	20.00
Phosphorus (P <sub>2</sub> O <sub>5</sub> )		10	30	3.00
Potash (K <sub>2</sub> O)		30	90	27.00
				50.00