Forage News

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Using Poultry Litter as Fertilizer Source in Forage Systems

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Poultry was the top agricultural commodity in Mississippi in 2015 with 730 M broilers produced. Poultry litter should serve as an excellent complement to commercial fertilizer fertilizers. Poultry litter contains more of the three components needed in a fertilizer (nitrogen, phosphorus, and potassium) than does manure from other animals. Phosphorus (P) content in poultry litter is usually high, and applications rates should be based on P levels to avoid potential surface water contamination. Besides the fertilization advantage, poultry little can also serve as a soil amendment by adding organic matter, which can help improve soil and nutrient retention. It is important to note that organic matter benefit will vary with soil type, rainfall, temperature, drainage and microbial activity. However, in areas with high poultry production, over-fertilization of hay and pastureland occurs with poultry litter.

Using poultry litter should be based on two main principles: (1) always collect a soil sample to determine nutrient deficiencies in your forage system and (2) get a nutrient analysis of the poultry litter to determine the nutrient composition and adjust application rates. Forage producers having soils testing low or medium in phosphorus can profitably use poultry litter as a soil amendment. For maximum efficiency of poultry litter, it is essential to know the nutrient contact of the manure. A laboratory analysis should be done to the poultry litter with at least four weeks prior to application to determine the actual nutrient rate being applied and nutrient availability to the crop. This is also important because depending on the type of poultry operation, the manure composition can vary in nutrient content. Using poultry litter at high application rates over a periods of years is an unsustainable practice due the opportunity for soils to accumulate excessive levels of phosphorous loss to the environment through leaching and runoff.

Table 1. Average nutrient composition of poultry manures.

Poultry Litter Type	Nutrient Content (lb/ton)						
	Total N	Ammonium (NH_4-H)	Phosphorous (P_2O_5)	Potassium (K_2O)	Calcium (Ca)	Magnesium (Mg)	Sulfur (S)
Broiler							
Fresh (no litter)[1]	26	10	17	11	--	--	--
Breeder house litter[1]	31	7	54	31	94	7	9
Broiler house litter[1]	72	11	78	46	41	8	15
Stockpiled litter	36	8	80	34	54	8	12
Layer							
Fresh (no litter)	26	6	22	11	--	--	--
Highrise stored[2]	38	18	56	30	86	6	9
Undercage scraped[3]	28	14	31	20	43	6	7

[1]Annual litter accumulation consisting of coarse sawdust, wood shavings or peanut hulls.
[2]Annual manure accumulation on unpaved surfaces
[3]Manure collected within two days.
Source: Zublena et al., 1997. North Carolina State Univ.

Poultry litter can vary in physical and chemical composition due to the type of birds being raised, the number of birds per unit area, type and amount of bedding material (wood shavings and sawdust), nutrient density of their diets, storage, and post-production handling methods. Most of the poultry litter across the state is stockpiled which allows the litter to go through some degree of composting. Because most of the piles are unprotected and might have moisture from rainfall events, the moisture will decompose the organic nitrogen and allow mineralization. Data from North Carolina State University have shown the average poultry fertilizer plant nutrient content (Table 1) and how the nutrient content can impact application rates and nutrient availability. Note that nitrogen (N) in the manure can be highly variable and some N is in the form of ammonium. Ammonia is volatile and it could be loss to the atmosphere, especially at high temperature and humidity. The availability of organic forms of N, P and K (potassium) may be affected as well by rainfall, wind and sunlight.

Depending on how the poultry litter is being applied, nitrogen availability can vary. Poultry litter being incorporated has a nutrient availability coefficient of 0.60 and litter being broadcast has a nutrient availability of 0.50. Phosphorus and K has an average nutrient availability coefficient of 0.85 during the first year of litter application. Determine the available nutrients by multiplying these values by the nutrient composition values listed in the manure analysis report. For example, let's take the stockpiled litter analysis presented in table 1 and apply litter the at a rate of 2 ton/ac. That means that the application contains 72 lb N, 160 lb P_2O_5 and 68 lb K_2O per acre. The first year only 36 lb N (72 x 0.5 = 36), 136 lb P_2O_5 (160 x 0.85 = 136), and 58 lb K_2O (68 x 0.85) per acre.

Table 2. Relative value of nutrient content in one ton of broiler and stockpiled litter.

Nutrient	Fertilizer Cost ($/lb)	Broiler house ($/ton)	Stockpiled ($/ton)
Nitrogen[1]	0.51	18.36	9.18
Phosphate[2]	0.41	27.18	27.88
Potash[2]	0.41	16.03	11.85
Calcium	0.02	0.92	1.22
Total		**62.49**	**50.13**

[1]Assumes a 0.50 efficiency factor for nitrogen relative to commercial fertilizer.
[2]Assumes a 0.85 efficiency factor for phosphate and potash relative to commercial fertilizer.

Litter application rates to hay production systems (bermudagrass, tall fescue, bahiagrass, forage sorghums, etc.) are generally determined by matching the available nitrogen or phosphorus content to the nutrient requirement of the crop. Most of the hay systems in MS will require 40 to 50 lb of nitrogen per ton of hay produced. In most forage systems, the nitrogen requirements may determine the application rate, unless those areas as designated as "nutrient sensitive (P levels in the high to very high levels)" where P can move offsite (leaching or runoff). It is also important to keep in mind that excessive poultry litter applications to forage crops can cause high nitrate concentrations and can impact livestock through nitrate poisoning or create nutrient imbalances such as grass tetany. If application rates are based on soil P levels indicated in the soil test, the litter might not supply the adequate amount of other nutrients [N, K, calcium (Ca), magnesium (Mg), and sulfur (S)] that are required by the forage crop. In this case, be sure to supplement those nutrients with the most adequate commercial fertilizer to fulfill the plant nutrient requirements. In addition, it is important monitoring your soil pH to help optimize forage yields, nutrient availability, and promote the decomposition of the organic matter. In a poultry litter nutrient management program for forage crops, it is recommended to take annual or biennial soil samples to monitor changes in pH and changes in soil nutrient content (especially P).

Figure 1. Avoid storing poultry litter in low areas with water accumulation and high potential for nutrient runoff.

One question often asked by producers is: ***when should applied my poultry litter?*** To minimize nitrogen loses, littler should be applied as near as possible to the growing season. That means that for most warm-season hay systems we are looking at spring. Applications in the fall or winter for crops grown in the summer can increase nutrient losses. For sandy soils like those present in south Mississippi, manure applications should be made more frequently and lower rates because those soils have a higher water infiltration and lower capability to hold nutrients. These conditions can increase

N and K leaching under high rainfall events. Pay attention to the cation exchange capacity (CEC) in your soil report. If CEC is less than 8 mg/kg of soil, it will be recommended to do an application close to the growing season of the forage crop.

Keep mind that the longer the poultry litter is held prior to its application to forage systems, the more available N is lost to the atmosphere. Stockpiling uncovered poultry litter can cause reduction in nitrogen content (Fig. 1). The least expensive method (but not the most effective) to temporary protect stockpiled litter consists of using plastic sheeting anchored with earth or old tires. When using this method, it is recommended to use an elevated area that is well-drained and away from drainage ditches. Improperly stockpiled litter can also generate sufficient heat to cause fire. Stockpiled litter should not exceed seven feet deep from the center of the pile and monitor temperature of the pile, since litter with temperatures that exceed 180 ºF can cause spontaneous combustion. It is also important to keep different age litter stored separately.

How poultry litter application compares to commercial fertilizer? When comparing these two sources, it is recommended to convert the total poultry litter available nutrients by using the nutrient availability coefficients (Table 2). Let's assume that a stockpiled litter will be broadcast shows that it contains 36 lbs of nitrogen, 136 lbs of phosphate and 58 lbs of potash per ton. If the fertilizer prices are as follows: $0.51 per pound of nitrogen (urea), $0.41 per pound of phosphate, and $0.41 per pound of potash. One ton of broiler litter will be worth the following: (36 x $0.51) + (136 x $0.41) + (58 x $0.41) = $97.88 per ton assuming that the soil test is recommending each nutrient. Nutrients not needed should not be considered when estimating the economic value of the poultry litter.

Now, let's assume a hay field that needs to be fertilized based on soil test recommendations. The recommendation was for a soil with a medium P and low K level. The recommendation is to use 100 lbs N, 30 lbs P (65 lbs of P_2O_5) and 60 lbs K/ac (100 lbs K_2O). In this case, the producer needs to apply 2.8 tons of poultry litter to meet the nitrogen requirements that means that the cost of application will go up. If we assume that commercial price of poultry litter is $50 per ton including delivery, that cost will be $140 per acre. If we take the same recommendations and calculate the cost of commercial fertilizer. The producer will need 294 lbs of ammonium nitrate, 65 lbs of triple phosphate and 100 lbs of potash. Base on the cost per pound of fertilizer the cost of commercial fertilizer will be (100 x $0.51) + (30 x $0.41) + (60 x $0.41) = $87.90. This indicates a much cost lower of application.

This indicates that poultry litter could be a good source on nutrients, only when there is a major deficiency and not needed in very large quantities. When using poultry litter forage producers should practice soil fertility management practices that will allow for plant uptake and reduce nutrient imbalances. Keep in mind that the value of poultry litter varies with demand, nutrient composition, accessibility, and forage crop requirements. A successful utilization of poultry litter will depend on four factors: (1) obtaining a soil test to determine soil nutrient levels, (2) calculating the nutrient requirement for the forage crop, (3) obtaining a poultry litter nutrient analysis, and (4) applying poultry litter rates that are environmentally sustainable.

Upcoming Events

April 1, 2016— Cool-season Forage Tour, Starkville, MS
May 12, 2016—Hinds Co. Forage Field Day, Utica, MS
May 19, 2016—Alfalfa Field Day, Newton, MS
June 10, 2016—Lawrence Co. Alfalfa Field Day, New Hebron, MS
June 17, 2016—Clay Co. Forage Field Day, West Point, MS
June 28, 2016—Warm-season Forage Field Day, Starkville, MS

For detailed information relater to upcoming forage events please visit:
http://forages.pss.msstate.edu/events.html

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