THE UNIVERSITY OF GEORGIA
COOPERATIVE EXTENSION
College of Agricultural and Environmental Sciences
College of Family and Consumer Sciences

Poultry Litter Application on Pastures and Hayfields

Poultry Litter as Fertilizer

Poultry litter is commonly used as a fertilizer on pastures and hayfields in North Georgia. As the poultry industry expands to South Georgia, more litter will be available and its use in this region is expected to increase. Poultry litter is a good source of many nutrients. In fact, it is much like a complete fertilizer containing not only primary nutrients but secondary and micronutrients (Table 1). The fertilizer equivalent is typically about 3-2-2 (N-P_2O_5-K_2O); however, the actual nutrient content depends on the type of bird, what the birds are fed, the number of growouts before the house is cleaned out, the feed efficiency, and how the litter is stored and handled. More information on nutrient variability in poultry litter can be found in *"Maximizing Poultry Manure Use through Nutrient Management Planning"* listed in the Further Information section.

Nitrogen

Not all of the nutrients in poultry litter are immediately available for plants to use. Most of the nitrogen in poultry litter is in an organic form (about 89%), but poultry litter also contains ammonium (about 9%) and a small amount of nitrate (about 2%). The inorganic nitrogen (ammonium and nitrate) can be immediately used by plants. Organic nitrogen is not available to plants until it is converted to ammonium or nitrate by microorganisms in the soil. Because this is a biological process, the rate of conversion depends on soil moisture and temperature. The conversion takes place over time with the largest release of nitrogen shortly after application if the soil conditions are favorable, i.e. moist and warm (above 50°F). If conditions are extremely dry or cold, little or no nitrogen may be released. One advantage of poultry litter for pastures is that the slow conversion of organic to inorganic nitrogen distributes available nitrogen more evenly over the growing season.

Because there is ammonium in poultry litter, some of the nitrogen can be lost to the

Table 1. Average nutrient content of various types of poultry litter.

Constituent	Broiler Litter	Broiler Stockpiled	Broiler Cake
		lbs/ton	
Nitrogen	63	55	47
P_2O_5	55	57	59
K_2O	47	47	46
Calcium	43	36	54
Magnesium	9	10	81
Sulfur	15	12	91
		ppm	
Manganese	334	362	340
Copper	319	313	366
Zinc	265	286	272

Data from the Agricultural and Environmental Services Laboratory, University of Georgia.

atmosphere after the poultry litter is applied. This process is called *volatilization.* Hot, dry and windy conditions favor the loss of ammonium through volatilization. If poultry litter is applied during extended hot, dry and windy conditions, almost all the ammonium form of nitrogen in the litter can be lost. Application of poultry litter before rain can help incorporate ammonium into the soil as the water infiltrates. However, litter application before large storms can cause a substantial loss of nutrients in surface runoff.

Nitrogen can also be lost through leaching. The nitrate form of nitrogen is mobile in the soil and can move below the root zone, particularly during the winter months when some forages are dormant and rainfall is high.

Due to these processes, only about 50 percent of the nitrogen in a ton of poultry litter is available for plants to use during the growing season when it is applied. Most of the nitrogen not taken up by forages in the first season is either lost to the environment or stabilized as soil organic matter. Very little "carryover" of nitrogen from poultry litter can be expected the second year after application.

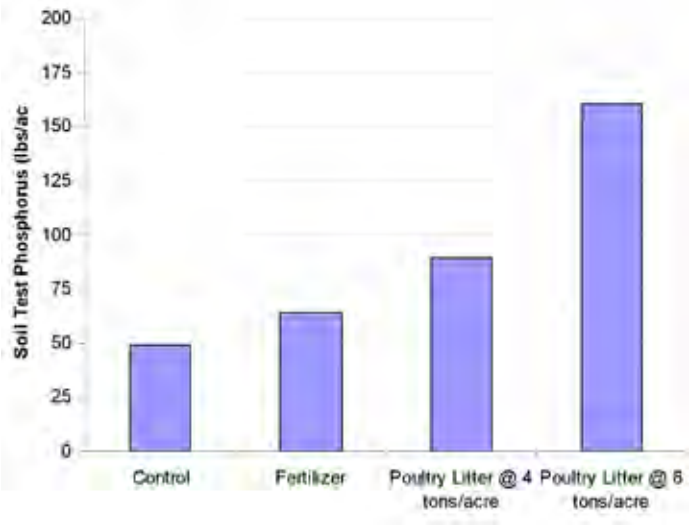

Figure 1. Soil test phosphorus under bermudagrass test plots in northwest Georgia after four years of poultry litter application.

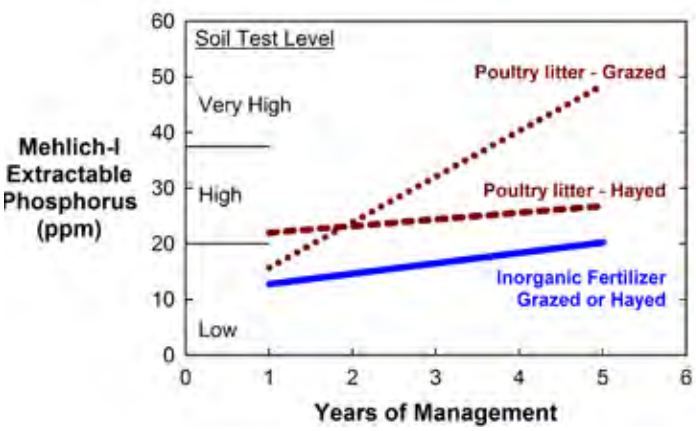

Figure 2. Fertilizer source and management effects on soil test phosphorus in NE Georgia bermudagrass fields.

Phosphorus

Poultry litter is a good source of phosphorus, which is beneficial when soils are low in phosphorus, but can present environmental problems if the soil is already high in phosphorus. Most of the phosphorus will be available during the growing season when it is applied.

Since grasses normally require three or four times more nitrogen than phosphorus, and poultry litter contains almost equal amounts of both, using poultry litter to meet the nitrogen needs of the forage will cause an over-application of phosphorus. Phosphorus can quickly accumulate to high levels with overapplication (Figure 1). Phosphorus build-up is slower on hayfields, where hay is being removed, than in pastures, where it is returned to the soil in manure and urine (Figure 2). Research has shown 80 percent of phosphorus consumed by cattle in grass is returned to the pasture. High rates of poultry litter application and greater stocking rates can quickly increase the amount of phosphorus in the soil.

High phosphorus levels in the soil have been directly linked to water quality problems; consequently, use poultry litter carefully to supply the nutrient needs of the forage without creating environmental problems. Many

farmers are using nutrient management plans to help them achieve these goals. Extensive information about nutrient management plans is available at the AWARE website (see Further Information section).

Soil testing should be conducted annually to monitor for phosphorus buildup in the soil. If soil test phosphorus from your soil test report is in the high to very high category, your local county agent should help determine the P Risk Index for your fields. The P Risk Index will indicate if the phosphorus levels in the soil and your management practices create a significant risk to nearby surface waters.

There are two common management alternatives to reduce risk. One option is to alternate the use of poultry litter with a commercial fertilizer source of nitrogen. Another option is to apply poultry litter to meet the phosphorus needs of forage and to use commercial fertilizer to meet the nitrogen requirement. These practices can help reduce the water quality impacts of excess phosphorus in the soil. (See AWARE website in Further Information section.)

Potassium

Poultry litter is also a valuable source of potassium. Nearly 100 percent of the potassium in poultry litter will be available during the growing season when it is applied. Whether the amount of potassium available in poultry litter is adequate for your forage crop will depend upon the potassium level in the soil, the particular forage, whether the field is grazed or hayed, and, if grazed, the stocking rate.

Secondary and Micronutrients

Poultry litter is also a source of secondary nutrients such as calcium, magnesium and sulfur as well as micronutrients such as copper and zinc. Studies have shown increased levels of copper, manganese and zinc in the soils where poultry litter has been used for four

Poultry litter being spread on a mixed fescue pasture.

to five years. Similar to phosphorus, copper and zinc can have detrimental effects if over-applied. Studies on metal uptake on various crops and forages generally show low levels of metals in the forages even at high poultry litter application rates. Data from northwest Georgia indicated copper and zinc levels in bermudagrass hay after four years of poultry litter application (4 tons/acre) were within the recommended range for cattle nutrition.

Poultry litter can also contain other elements such as arsenic. In some parts of the country, arsenic is used in the poultry feed to help control internal parasites. Arsenic is usually toxic to plants before it reaches levels in the plant that would create a health problem for animals. Discussions of arsenic in poultry litter can be found in the references (see Further Information section).

Poultry Litter and Soil pH

Soil pH is considered a master variable because it is so important in controlling the availability of nutrients in the soil for plants to use. Most grasses have optimum yield and quality at a soil pH of 6.0. Since calcium carbonate (lime) is used in the feed rations of poultry, the litter can serve as a dilute liming material (about 1/10 strength of most

agricultural limestones). Consequently, the use of poultry litter can help maintain soil pH and reduce the frequency of lime applications.

In the soils of northwest Georgia, poultry litter at the recommended application rate (4 tons/ac) for bermudagrass hay maintained soil pH at 5.76 after five years compared to 5.42 in the unfertilized plots and 5.18 in the plots receiving ammonium nitrate fertilizer. In northeast Georgia, the soil pH in hayfields receiving poultry litter for five years was 6.6 compared to 6.0 in a hayfield fertilized with inorganic fertilizer and limestone. Similar effects are likely in the sandy soils of south Georgia.

Although poultry litter can help reduce soil acidity, lime will likely still be needed. Because magnesium is generally lower in poultry litter than calcium, a dolomitic lime may be needed to supply this nutrient. Use your soil test results to determine the lime needed and whether dolomitic lime should be used.

Forage Yields

In general, forage yields with poultry litter are comparable to those with commercial fertilizer, assuming the poultry litter is applied at an equivalent nitrogen rate. In a grazing situation, you may be able to use a lower equivalent nitrogen application rate when using poultry litter as compared to inorganic fertilizer. In northeast Georgia, grazed bermudagrass pastures fertilized with poultry litter had the same productivity as those receiving inorganic fertilizer, although the poultry litter supplied about 30 percent less nitrogen (138 lbs/ac) than the inorganic fertilizer (200 lbs/ac). In a hayfield situation, the lower nitrogen application rate with poultry litter led to a 22 percent reduction in yield.

The use of poultry litter can affect forage growth patterns and mix of plant species that occur in the pasture. Tall fescue fertilized with poultry litter tends to have slightly higher growth in the summer and slightly lower growth in the spring and fall than fescue fertilized with spring and fall inorganic fertilizer applications. This is probably due to the slow release of nutrients over the growing season.

Several studies report that poultry litter use reduces the amount of clovers in mixed clover/fescue associations. This may be an important consideration for producers managing fescue toxicosis by dilution with clovers. The plant composition of bermudagrass pastures can also be altered by the use of poultry litter. After five years of poultry litter application, bermudagrass hayfields fertilized with poultry litter had a higher proportion of annual grasses and broadleaf weeds. This weed increase was not seen in the grazed bermudagrass pastures (Figure 3). Many producers report increases in weeds when using poultry litter. Studies indicate this is not due to weed seeds in the poultry litter but is due to the availability of nutrients over a longer period of time during the growing season. Many weed species germinate more readily when soil nutrient

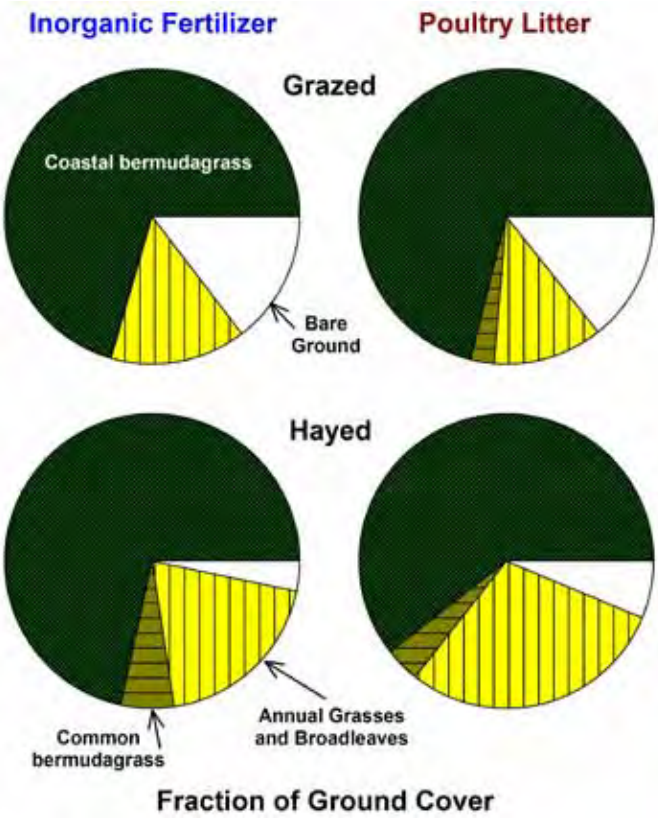

Figure 3. Fraction of ground cover in Coastal bermudagrass, common bermudagrass, annual grasses/broadleaf weeds, and bare ground after five years fertilization with ammonium-nitrate fertilizer (200 lbs N/ac/yr) or poultry litter (173 total N/ac/yr in two applications).

levels improve and compete well with forage species under these conditions.

Forage Quality and Animal Performance

Forage quality with poultry litter fertilization is generally similar to or better than that of commercial fertilizers though results will vary with the type of forage, management and soils. A four-year study in northwest Georgia indicated that crude protein and total digestible nutrient content of bermudagrass hay fertilized with 4 tons/acre of poultry litter was similar to that fertilized with commercial fertilizer at a similar nitrogen fertilizer rate. The calcium, phosphorus and potassium content of the poultry litter fertilized hay tended to be higher than the commercially fertilized hay. A West Virginia study in a mixed grass/clover pasture fertilized with poultry litter found increased crude protein and higher digestible nutrients as well as higher phosphorus and potassium contents compared to the pasture fertilized with commercial fertilizer.

There are studies indicating some forage grown with poultry litter may have higher sulfur content than comparable forage grown with commercial fertilizer. Because high sulfur content in forage can induce copper deficiency in cattle, producers should be aware of potentially higher sulfur content in forages fertilized with poultry litter. In Georgia, sulfur content of forage is assumed to be low because, in our high rainfall climate, sulfur tends to move rapidly through the soil profile. With the reports of high sulfur forages in the state, feeding a high copper mineral supplement (25,000 ppm) may be warranted in some cases to ensure cattle health.

Some studies also report lower magnesium contents in forage fertilized with poultry litter. Low magnesium concentrations relative to potassium can induce grass tetany. This is particularly common in nursing cows. There is anecdotal evidence of a higher occurrence of grass tetany with poultry litter use. Producers should feed magnesium supplements and monitor cattle intake regardless of whether or not poultry litter is applied to pastures to prevent this disease.

Cattle performance on pastures using poultry litter is typically good. In northeast Georgia, stocker cattle on tall fescue pastures fertilized with poultry litter had equivalent weight gain to those on fescue fertilized with inorganic fertilizer. However, seasonal weight gain was different. The cattle on pastures fertilized with inorganic fertilizer tended to have a greater weight gain in the autumn and winter. Cattle on poultry litter fertilized

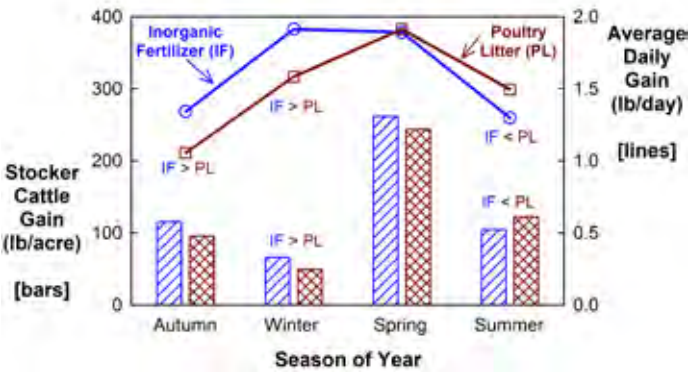

Figure 4. Stocker cattle gain and average daily gain on 'Jesup' tall fescue fertilized by poultry litter and ammonium-nitrate. Results were similar with wild, free and friendly endophyte fescue.

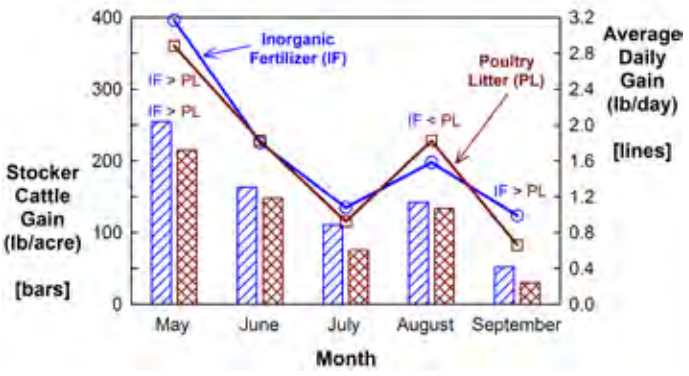

Figure 5. Stocker cattle gain and average daily gain on Coastal bermudagrass fertilized by poultry litter and ammonium-nitrate.

pastures tended to have higher weight gain in the summer (Figure 4). These seasonal differences in weight gain reflect the pattern of nutrient availability, weather conditions and forage production. Fewer nutrients are released from poultry litter under cool conditions.

In a similar study, weight gain by stocker cattle on bermudagrass pastures fertilized with poultry litter was lower than on pastures with inorganic fertilizer. Again, the slow nutrient release of poultry litter and weather conditions were important factors in the animal's performance. Nutrients released from poultry litter in late summer when conditions were hot and moist allowed better bermudagrass growth in the late summer (Figure 5). More information can be found at the Agricultural Research Service website (see Further Information section).

Using Poultry Litter Wisely

Producers using poultry litter from their own houses are required to have nutrient management plans, which specify how much litter can be applied based on soil testing, forage needs and the nutrient content of the litter. More information about nutrient management planning can be found on the AWARE website. Producers who obtain litter from brokers or other farmers should also use nutrient management planning to efficiently utilize the nutrients and prevent potential environmental impacts. Ask the farmer or broker for the results of a nutrient analysis of the litter. Brokers are required to provide a litter test report. Then use soil test information to determine the amount of litter that can be applied in a specific situation. If site specific information is not available, general application rates for different forage crops have been developed based on the nitrogen need of the forage and the typical nitrogen content of litter (Table 2).

Special Considerations

Forage Establishment

Poultry litter can be an effective soil amendment when forage crops are being established. Organic material in the litter can improve soil conditions for seeding and early seedling establishment if applied at moderate rates. Slow release of nitrogen is also useful because seedlings do not require high levels of nitrogen following emergence or during early development. Moderately high soil test

Table 2. Common poultry litter application rates for various forages to meet nitrogen fertilizer requirements.

Forage	Management	Target Nitrogen	Recommended Rates [1]	Comments
Hybrid Bermudagrass	Pasture	150-250 lbs	3 to 5 tons/ac	Application should be split with half applied in early spring and other half in mid-summer. Higher application rates will cause excess phosphorus accumulation in the soil.
	Hay	200-400 lbs	3 to 6 tons/ac	
Common Bermudagrass, Bahia Grass, or Dallis Grass	Pasture	75-175 lbs	1 to 3 tons/ac	Depending on grazing pressure, application may be split between early spring and summer.
Fescue/ Orchardgrass	Pasture	50-100 lbs	1 to 3 tons/ac	The higher rate may be split between early fall and early spring.
	Hay	100 lbs	3 tons/ac	
Fescue/Clover Mix (<20-25% clover)	Pasture	50 lbs	1 ton/ac	
Small Grains Winter Grazing	Pasture	100 lbs	1 to 2 tons/ac	The higher rate should be split between fall and late winter.

[1] Based on average nitrogen content of fresh broiler litter of 62 lbs/ton.

concentrations of phosphorus and potassium are useful when legumes will be added to forage stands in later years.

Legume Establishment

Poultry litter should be used sparingly when interseeding legumes such as clovers into existing grass stands. Nitrogen in the poultry litter can increase grass competition with small clover seedlings, which can lead to legume failure due to shading. If grass competition is carefully managed with flash grazing, low rates of poultry litter can be helpful, particularly where phosphorus levels are low.

Forage Nitrates

Applying poultry litter above the recommended rate can result in increased nitrate concentration in forages. Nitrate accumulation is not specific to poultry litter. It occurs when an excess of nitrogen is available and conditions such as drought, cloudy days or

cool weather retard forage growth. Producers should be aware of these conditions and use recommended rates.

Weeds

Studies have shown properly stored poultry litter does not contain viable weed seeds. If poultry litter is stored outside uncovered, then weed seeds can be introduced from birds or other sources. Many times weed species germinate or grow rapidly when additional nutrients are applied to pastures. These weeds are noticeable in pastures after poultry litter applications. Good pasture management techniques such as using the proper stocking rate, leaving enough forage height to maintain a dense and healthy forage cover, and judicious application of herbicides will help control weeds.

Summary

Poultry litter is widely used on pastures and hayfields in Georgia. There are many benefits when it is used wisely. Producers should use nutrient management planning and recommended rates to ensure poultry litter is used in ways that maximize its benefits without harming the environment.

Further Information

AWARE website. Animal Waste Awareness in Research and Extension. www.agp2.org. Click on Animal Waste Management.

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