Mississippi State University Extension Service

Broiler Litter as a Feed or Fertilizer in Livestock Operations

Poultry and beef are competitors in the fresh-meat market. However, at the farm level, these two enterprises can be mutually beneficial, complementary, environmentally sound, and economically viable to individual producers.

Poultry industry sources estimate there are approximately 5,000 poultry houses in the state, with broiler houses accounting for about 93 percent of the total. An additional 2,000 broiler houses are expected to be built in the state over the next several years.

Each poultry house generates approximately 100 tons of poultry litter per year, for a total of 1 billion pounds annually for Mississippi. Most poultry houses use wood shavings or sawdust as bedding material. This material is usually replaced once a year. The mixture of manure, feed, feathers, and bedding material from these houses is commonly referred to as "poultry litter." Because of its physical properties, caged layer waste is used only as a fertilizer, but broiler litter can be used both as a fertilizer and as a feed for livestock. Since 93 percent of Mississippi's poultry litter comes from broiler houses, the designation "broiler litter" will be used in this publication.

Broiler Litter as Fertilizer

In many states, regulations require a poultry producer to have an approved plan for poultry litter disposal before building a poultry house. Assuming that 100 tons of broiler litter is generated per broiler house each year and that there is an application rate of 4 tons of broiler litter per acre of land, a producer needs at least 25 acres of pastureland for each broiler house he owns or operates.

Broiler litter contains the equivalent of approximately 58-48-37 pounds per ton of N-P_2O_5-K_2O on a dry basis. This nutrient analysis is the equivalent of a bagged, commercial fertilizer analyzing approximately 3-2.5-2 percent of N-P_2O_5-K_2O, respectively. Based upon current fertilizer prices, broiler litter would be worth about $30 to $40 per ton as a fertilizer, not including spreading and transportation charges. Broiler litter applications of 2 to 4 tons per acre have been effective in promoting grass growth in pastures. However, broiler litter application rates on pastures of 8 tons per acre and above in a single application have been shown actually to reduce grass growth. Broiler litter fertilizer applications on pastures will reduce or eliminate clover production. The reason for this decline in clover production is not clear. Broiler litter may reduce clover production in grass-clover mixtures either by stimulating the grass to grow faster because of additional nitrogen (N) in the litter, or the broiler litter may increase diseases in the clover, which

causes a stand reduction. Some producers have concerns that applying broiler litter to pastures increases weed production, incorrectly assuming that weed seeds are present in the litter. Alabama researchers found that broiler litter contained no weed seed and was actually detrimental to the germination of some types of weeds. Increases in weeds in a field receiving broiler litter would then result simply from the greater concentration of nutrients, which increases the growth rate of all plants and not just weeds in that soil.

Forage growth response to broiler litter is slow and may be disappointing to the producer after the initial application. Nitrogen in broiler litter is organically bound and is not as readily available as the N in a commercial fertilizer. This slow release of N in broiler litter can be both negative and positive. On the negative side, there is not a rapid growth spurt in forages following litter application, as seen with commercial fertilizer, because of the slow release of N from broiler litter. On the positive side, litter applications one time per grazing season work well because of the slow release of N, which can promote season-long forage growth. Broiler litter fertilization of pastures would be particularly positive in grazing systems where season-long growth at relatively constant forage levels is desired. Volatilization losses of N in broiler litter applied as a fertilizer are possible; Wolf et al. reported that 37 percent of the total N in broiler litter can be lost within 11 days of application because of volatilization. Therefore, application of broiler litter on pastures, like urea fertilizer, should be done in cooler times of the day or year (i.e., spring) under damp soil conditions to reduce N losses.

Broiler litter is frequently used as a fertilizer for winter pastures. For optimal results, broiler litter should be applied preplant and incorporated into the soil at a rate of about 4 tons per acre. To stimulate good ryegrass growth in the fall, an additional 50 pounds of N fertilizer (ammonium nitrate, N Sol, or urea) should be applied at or shortly after planting to stimulate early-season growth. The N in broiler litter is released slowly in the fall, and the cool and cold temperatures of fall and winter result in an even slower release of N in broiler litter that is organically bound.

Information is becoming available about the long-term impact of broiler litter as a fertilizer and its impact on soils and their nutrient status. Improper broiler litter application can create potential nutrient buildup problems in certain soils. Concerns include runoff of litter material into streams and ponds, nutrients in the litter moving through the soil profile and into ground water supplies, and buildup of certain minerals in the soils resulting from long-term broiler litter application. The mineral of most concern in broiler litter applications is usually phosphorus (P) because of reports of its buildup in soil and its ability to stimulate algae growth once it reaches ponds and streams.

A recent study in Alabama compared broiler litter application rates of either 4 or 8 tons per acre with a typical fertilization rate of 400 pounds per acre of ammonium nitrate and 100 pounds per acre of triple superphosphate. The litter application rate of 8 tons per acre increased runoff of both N and P compared to commercial fertilizers, whereas 4 tons of broiler litter per acre actually produced less nutrient runoff than did plots receiving commercial fertilizer. Using broiler litter as a fertilizer with rates not exceeding 4 tons per

acre appears to be as environmentally safe as using any routine commercial fertilizer application.

Soil sample results from Scott County in Mississippi have shown that continued applications of broiler litter over several years have led to soil test results that are low to very low in potassium (K). These same soil samples measured adequate to high in P, Ca, and Mg. These observations are considered to be specific to that particular soil, since reports from other areas have found that K and other nutrients build up in many soils where broiler litter has been applied to pastures over long periods. However, these conflicting results based on soil test results clearly demonstrate the effect that soil type has on nutrient buildup and the need for specific evaluations based on farms. An annual soil test should be taken to detect potential problems, and changes in fertilizer programs should be planned based on these soil test results.

In 1993 Kingery et al. compared soils in the Sand Mountain region of northern Alabama, where much of the state's poultry industry is located; some sites had received broiler litter applications over periods of 15 to 28 years. The Alabama study compared soil test analyses from pastures that had received broiler litter applications over a long period to similar soils that had not received litter. Pastures that had received broiler litter over the long-term period were higher in soil pH, organic matter, total N in the soil; they also had higher extractable levels of phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), copper (Cu), and zinc (Zn) than did soils not receiving litter.

Health problems including grass tetany, milk fever, abdominal fat necrosis, and toxic effects from high N levels applied to fungus-infected fescue have been associated with broiler litter applications. In 1994 Kingery et al. stated that long-term land applications of broiler litter can alter soil chemical conditions and can create the potential for adverse environmental impacts if not closely monitored. Georgia researchers found that the availability of Cu, Zn, and Manganese (Mn) from broiler litter was altered by soil pH and soil type. There is less of a problem with nutrient buildup in sandier type soils, where poultry houses are usually located, than in clay type soils.

Recommendations for Litter as Fertilizer

Broiler litter can be used as a fertilizer for grass pastures, but rates of application should probably not exceed 4 tons per acre annually. Broiler litter slowly releases nutrients, particularly N, so growth rates of grasses following litter applications are not as pronounced as observed with commercial N fertilizers. Annual applications of broiler litter are possible and practical because of the slow release of nutrients from the litter, and this slow release tends to work well in season-long livestock grazing systems. Because of potential N volatilization losses, broiler litter should be applied to pastures during cool, moist times of the year. Applications of broiler litter should be made on land areas where direct runoff of litter into a stream or pond is not probable. Grasses like bermudagrass, with a thick thatch should be capable of reducing possible runoff of broiler litter after

applications, particularly when a small buffer strip is left between the area of application and any body of water. Pastures receiving broiler litter applications should be soil-tested annually to determine the status of the soils. Deficiencies (such as K) can be corrected, and if any buildups of certain nutrients are detected (such as P), they can be corrected by eliminating broiler litter applications until the situation corrects itself.

Broiler Litter as Livestock Feed

Although broiler litter can be used efficiently and effectively as a fertilizer, its greatest potential economic impact is as a feed source for beef animals. Good-quality broiler litter is approximately equal to good-quality alfalfa hay, based on nutrient analysis. Broiler litter is not as palatable as other common feed sources, and cattle require a period of time to get adjusted to the broiler litter. To make broiler litter diets more palatable in order to increase consumption, corn or other feeds are added. Fontenot, in 1978, estimated that broiler litter as a feed is worth two to three times more than its value as a fertilizer for pastures. However, not all broiler litter currently produced is acceptable quality for use as animal feed; broiler litter unacceptable as feed should be used as fertilizer.

Broiler litter substituted in high-grain diets resulted in a reduction in daily gains and a lower feed conversion ratio. Using a lower-energy-based diet, Cross and Jenny found gains of feedlot steers were similar between cattle fed diets containing corn silage with either 0, 10, or 30 percent broiler litter substituted for corn silage. Several other recent studies have demonstrated the potential use of broiler litter in livestock diets. In 1994 McCaskey et al. reported that beef steer gains were 2.53 pounds per day on a concentrate diet as compared with 2.12 pounds per day on a diet of 50 percent broiler litter and 50 percent corn. Based on animal performance and current feed prices, a producer could afford to pay up to $123 per ton for the 50 percent broiler litter-50 percent corn diet.

Diets containing broiler litter can produce acceptable levels of performance by beef cattle. However, raw broiler litter needs to be processed to ensure its safety from potentially harmful pathogens. Processing can be achieved by moderate heat, either during the ensiling process or by deep stacking or pelleting the broiler litter.

Considering Public Perception

Following a thorough review of the available literature concerning the use of broiler litter in both beef and dairy cattle diets, there appears to be no more health risks to animals or indirectly to humans from properly processed broiler litter than from any other source of cattle feed. The rumen (stomach) of a beef animal does an excellent job of breaking down and converting broiler litter into nutrients, which can then be absorbed and used by the animal. However, public perception regarding food safety can be influential. Many changes in agriculture have resulted from public fear and public perception rather than from

scientific data and accurate information. Regulations and safety recommendations are detailed later in this publication to help ensure correct usage of broiler litter in livestock diets.

If you feed diets containing broiler litter to cattle, be aware of potential public relations problems. Broiler litter is as safe as any other livestock feed if processed and handled properly. Still, be aware of public concern in using poultry waste in your livestock operation.

Ensuring Microbial Safety

The easiest and most cost effective way of processing broiler litter to ensure microbial safety is by allowing the litter to go through a heat cycle created by deep stacking the litter. Deep stacking broiler litter requires that the material be pushed up into a pile or stack. In 1991 Ruffin and McCaskey reported that litter needs to be under a barn or shelter where it will not be rained on, and it is best also to cover it with 6-mil-thick plastic sheeting. An internal temperature in the stack of 130°F must be reached to ensure microbial safety of the litter by destroying all potentially harmful microorganisms. In 1993 Rankins et al. reported that covering the litter stack with plastic will help to control the temperature and prevent overheating. Temperatures above 160°F throughout the stack can cause a reduction in the feeding quality of the broiler litter; high temperatures reduce quality of the protein through denaturing.

Removing Foreign Objects

It is best either to produce your own broiler litter or to purchase it from a reputable dealer. Broiler litter can contain extraneous materials, such as rocks, pieces of mesh wire, nails, glass, wrenches, or even hammers. A method of removing these foreign materials must be in place if you plan to feed this material to livestock, because these objects are hazardous to both animals and equipment. For safety, pass the broiler litter through equipment with magnetic strips to pick out metal contaminants (such as nails and wire).

Assessing Moisture Content

For ease of processing and feeding, moisture in the broiler litter should be between 12 and 25 percent. Your Extension county agent can assist you in having your broiler litter analyzed for moisture content. If the broiler litter is too dry, it will not go through a proper heat cycle during deep stacking, and it will be dusty when fed. Dusty feeds are often poorly consumed by livestock. If the moisture content is more than 25 percent, the deep stack may

heat up too much (i.e., wet hay in a barn), and the excess heat may damage (denature) the protein in the litter. Also, wet litter will be gummy and hard to mix with other feeds.

Checking Ash Level

An ash content analysis is the chemical analysis that usually provides the most information about the quality of the broiler litter. Ash analysis measures the mineral content of the litter. Ash is relatively high in all broiler litter samples, comprising at least 15 percent; broiler litter is normally high in ash because of the wood shavings or sawdust. Ash samples between 15 and 25 percent are acceptable. If ash content is above 28 percent, the litter should not be fed to cattle, according to Ruffin and McCaskey. High ash levels indicate that large amounts of soil are contaminating the litter. Cattle do not find even good-quality broiler litter highly palatable, and litter with a high ash content (above 28 percent) will result in poor consumption and subsequent poor animal performance.

Using Vitamin and Mineral Supplements

Vitamin A. Broiler litter contains very low or no vitamin A, so the supplement fed to cattle consuming broiler litter diets should contain vitamin A. Fresh forages are very high in vitamin A, and cattle can store relatively large quantities of vitamin A in the liver. However, vitamin A is a relatively inexpensive feed additive, so you should routinely feed a supplement containing vitamin A with litter diets.

Magnesium and Calcium. Broiler litter is an excellent source of most minerals, but mineral imbalances can result. The most widespread mineral-deficiency problem in cattle fed broiler litter is milk fever. Grass tetany has occurred in beef cows grazing pastures where broiler litter was used as a fertilizer. These problems are caused by a blood deficiency of magnesium (Mg) for grass tetany and a blood defiency of calcium (Ca) for milk fever. The onset and symptoms for these mineral imbalances closely resemble each other, and there have probably been cases when one was mistaken for the other. Grass tetany generally occurs in early spring and with cows that have recently calved. Although forages may contain ample Mg, the onset of grass tetany results from low blood Mg. Similar to grass tetany, milk fever, caused by a deficiency of Ca in the blood, occurs almost always in cows shortly after calving. Because most beef cows calve in the spring, this is the time of year when the incidence of milk fever is highest in beef herds. The cure prescribed for both grass tetany and milk fever are intravenous injections of Mg and Ca, respectively, with rapid recovery after treatment. Because of their similarities, these two metabolic disorders can be mistaken for each other. Frequency of occurrence for these nutritional imbalances can be reduced by removing cows 30 days before calving from either broiler litter diets or lush spring pastures.

Beede in 1992 described a method to reduce the incidence of milk fever, involving feeding mineral supplements that are negatively charged. These negatively charged supplements are referred to as anionic salts. Most minerals we are concerned with in nutrition are positively charged cations, like Ca, Mg, Cu, and Zn. Incidence of milk fever in dairy cows was shown to be reduced when higher levels of anions were fed before calving, having the effect of lowering (making more acidic) the pH of the feed. Most broiler litter has a pH in the high 8.0's, indicating that maintaining a proper pH in the diet (around 7.0 or below) can be a potential problem.

This area of mineral nutrition is confusing because of the many interactions between minerals, the problem of varying levels of mineral digestibility, and the effects of pH on mineral availability. Incidents of grass tetany have been seen in beef steers, indicating a blood deficiency of Mg. However, Mg is very high in broiler litter. Milk fever has been observed in beef cows shortly after calving, even though broiler litter is high in Ca. The potential problems with grass tetany and milk fever must be considered in any well-managed livestock operation. If the theory dealing with feeding high levels of anionic salts is correct, then plain white salt should be a good supplement when feeding broiler litter. However, when and if either grass tetany or milk fever occurs, an injection of Cal-Mag-Dextrose intravenously in the neck usually provides an immediate cure if caught in time. Having a bottle or two of this solution on hand may be a life saver.

Copper. Copper (Cu) toxicity (indicating levels too high) has been a problem widely reported when broiler litter is fed to sheep. Cattle are not as sensitive to Cu as are sheep, and Cu toxicity is very rare in cattle. Copper sulfate was widely used in the poultry industry as a mold inhibitor, which led to high levels of Cu in broiler litter. Many broiler houses have now changed from using copper sulfate to using propionic acid, which means high levels of Cu should not be a problem in litter from those houses. When broiler litter is fed less than 180 days, Cu toxicity is extremely rare in cattle consuming litter with "normal" levels of Cu (250-500 ppm).

Crude Protein. Good-quality broiler litter should contain 20 to 30 percent crude protein. Litter can be low in crude protein because of either a very high ash content or because of excess volatilization of N in the poultry house. High temperatures and excess moisture in the poultry house leads to N volatilization. If crude protein values are below 18 percent, the litter should be used only as a fertilizer and not as a feed source. Hays reported in 1994 some pilot studies showing that certain experimental chemicals can be added to the bedding material in poultry houses that may prevent volatilization of N and solubilization of P; investigation in this area is ongoing.

Recommended Feed Mixtures

Broiler litter fed to cattle is usually mixed with a more palatable feed, such as corn. Any number of palatable feeds in addition to corn can be used to mix with broiler litter, such as wheat, milo, commercial grain mixes, and soybean hulls. In recent studies (Burdine, et al.,

1993; Bagley, et al., 1994), animal performance was the same with broiler litter diets mixed with either corn or soybean hulls. Alabama recommendations (Ruffin and McCaskey, 1991) are to feed beef cattle the following feed mixtures:

Dry beef cows:	**80% broiler litter, 20% grain**
Lactating beef cows:	**65% broiler litter, 35% grain**
Stocker cattle:	**50% broiler litter, 50% grain**

These diets are relatively inexpensive, yet performance will be adequate if good-quality broiler litter is used. Stockers on the 50-50 mix should gain approximately 2 pounds per head daily. All diets containing broiler litter should be supplemented with 2-5 pounds of hay per day to meet fiber needs of cattle.

Cattle need an adjustment period when fed broiler litter. Start feeding livestock a 50-50 mix of broiler litter and grain initially, and as cattle adapt to the broiler litter, gradually decrease grain and increase proportions of broiler litter in the diet until the desired mixture is reached.

Legal Considerations

Currently there are no Mississippi state laws that govern the use of broiler litter as fertilizer or feed as long as the broiler litter is generated and used on a producer's operation as part of an integrated livestock operation. Therefore, a producer who owns poultry houses and uses the litter generated out of those houses is exempt from any current regulations regarding using the litter as a fertilizer on his pastures or feeding his own beef cattle. Good management practices as outlined in this publication can result in efficient and proper use of broiler litter in forage-livestock operations.

Anyone who sells broiler litter in Mississippi with the specific intent for its use as a fertilizer, which requires describing the N-P-K content of the litter, is subject to the rules and regulations specified under "Mississippi Fertilizer Law of 1970 and Rules and Regulations." Regulation 12, which deals with the use of animal waste, states: "Manipulated animal and vegetable manures shall be registered by brand and grade with the Commissioner of Agriculture and Commerce and State Chemist and shall be subject to inspection, sampling, reporting, etc., as required for any other commercial fertilizer products (adopted 1991)." Similarly, broiler litter marketed as a feed ingredient falls under the "Mississippi Commercial Feed Law of 1972 and Rules and Regulations under the Mississippi Commercial Feed Law of 1972." The marketing of any animal waste as a feed falls under Regulation 13 for processed animal wastes for use as an animal feed ingredient. Following are the summarized guidelines:

- **Selling of broiler litter for feed must be permitted through the Commissioner of Agriculture and Commerce.**

- **The person wishing to sell broiler litter must describe the facilities and equipment used in the processing.**
- **Each process must follow certain prescribed standards.**
- **Natural quality standards shall include:**
    - **less than 12 percent moisture content**
    - **more than 10 percent crude protein**
    - **maximum of 40 percent crude fiber**
    - **minimum of 1.5 percent P**
    - **minimum of 2.0 percent Ca**

For a complete set of rules and regulations on the selling of broiler litter as fertilizer or feed, please contact the Office of the Commissioner of Agriculture and Commerce in Mississippi.

Environmental and Economic Precautions

Broiler litter is a poultry industry by-product that must be disposed of in an environmentally sound and economically efficient manner. The use of broiler litter as both a fertilizer source for permanent grass pastures or as preplant, soil-incorporated fertilizer for cool-season annual pastures and as a feed source for beef cattle is environmentally sound and economically efficient if proper precautions are taken. Broiler litter should be generated on the producer's own farm or purchased only from a licensed, reputable dealer to ensure that the quality of the broiler litter is suitable for its intended purpose. When broiler litter is used as a fertilizer, soils should be sampled and analyzed annually to prevent deficiencies or excesses of nutrients.

Checklist for Broiler Litter Use

Following is a checklist that summarizes the use of broiler litter for fertilizer and feed in livestock operations.

- **Upon receiving a load of litter, place the litter in a pile (deep stacking) under a barn or cover with 6 mil plastic sheeting, take a sample for nutrient analysis, and leave the stack undisturbed for at least 3 weeks before it is to be fed.**
- **Based on the nutrient analysis of broiler litter, use it as a feed if it is good quality or as a fertilizer if it is poor quality (ash greater than 28%).**
- **Broiler litter to be used as a fertilizer should be spread on permanent grass pastures (i.e., bermudagrass or bahiagrass) or soil-incorporated into annual pastures at a rate not to exceed 4 tons per acre per year when seasonal applications are made. Always leave a small grass buffer strip between the area receiving broiler litter and any body of water.**
- **Do not feed broiler litter to lactating dairy cows.**

- **If cattle will be sold and possibly go to slaughter, withdraw broiler litter from the diet of the animals at least 15 days before the sale.**
- **Feed broiler litter to sheep only under strictly controlled situations because of their sensitivity to copper.**
- **Before feeding litter, always process for removal of foreign objects.**
- **Feed hay to satisfy fiber requirements of cattle.**

With proper precautions, broiler litter can be a key ingredient in an economically successful livestock operation. Using broiler litter as both a fertilizer and a feed in a beef cow-calf operation is probably the most environmentally sound and economically efficient agricultural enterprise that is available to Mississippi producers on a broad basis.

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