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Broiler Litter Production in Kentucky and Potential Use as a Nutrient Source

by Monroe Rasnake

The poultry industry in Kentucky is expanding rapidly—especially the broiler industry. Poultry numbers have increased from almost none in 1988 to more than 60 million per year in 1994. In 1995, two new broiler companies began construction of processing plants, which should bring total production to about 200 million per year by 1998. The numbers are expected to increase as more companies move to Kentucky.

Litter Production

As poultry numbers increase, so does the amount of litter (manure). Tests conducted in Carlisle County broiler houses yielded an estimate of litter produced per year. For houses in which two to five flocks had been produced since the house was last cleaned out, amounts of litter present ranged from 45 to 90 tons. Usually at least six flocks are produced yearly, which results in an estimated total of 100 tons of litter per house per year. An additional eight to 10 tons are removed between flocks during the cake removal process, bringing total litter production to 140 to 150 tons per house per year. Extrapolating these numbers to the 1,200 houses planned for Kentucky by 1998, total litter production will be about 180,000 tons per year. While this sounds like a lot of litter, if two tons per acre were used on corn, it would take only 90,000 acres (about 7.5 percent of the corn acres in Kentucky) to use all the litter produced. Because broiler operations will be located in areas where much of Kentucky's corn is grown, there should be few problems in efficiently using all the litter expected to be produced.

Nutrient Content

Broiler litter is one of the highest value manures in terms of nutrient content. The amounts of nitrogen (N), phosphate (P_2O_5), and potash (K_2O) in litter sampled from Carlisle County broiler houses are shown in Table 1. Nutrient levels increased with the number of flocks. After five flocks, N was 56 pounds; P_2O_5, 65 pounds; and K_2O, 63 pounds per ton of litter at about 20 percent moisture. These amounts are subject to change when the litter is removed from the house and stacked. They also vary from one house to another. Therefore, when sampling to measure nutrient content, take samples of the litter as close to the time of use as possible. That is the best way to know the amounts of nutrients being applied with the litter and whether additional fertilizer is needed. Use Extension publication AGR-146A to calculate how much litter to use.

Table 1. Average nutrient content of broiler litter in houses.

Flock no.	Nitrogen (lbs N/T)	Phosphate (lbs P_2O_5/T)	Potash (lbs K_2O/T)
2	46	54	54
3	48	58	59
4	54	61	61
5	56	65	63

Broiler litter contains many secondary nutrients and micro-nutrients in addition to N, P_2O_5, and K_2O. Averages of some litter samples taken in North Carolina and Arkansas showed 35 pounds of calcium (Ca), 15 pounds of sulfur (S), 0.5 pounds of zinc (Zn), 0.07 pounds of Boron, and 10 pounds of sodium (Na) per ton. Some Kentucky samples averaged 33 pounds of Ca, 7.2 pounds of S, 0.6 pounds of Zn, 0.07 pounds of B, 13 pounds of Na, and 12 pounds of chloride (Cl) per ton. Most of these nutrients are not needed for good crop production in Kentucky, but they also are not present in high enough levels to injure a crop. Some could build

up to excessive levels over years of heavy litter application on the same field.

Broiler litter has been shown to reduce soil acidity (or increase pH levels). This may or may not be of benefit, depending on the initial soil pH level. The organic matter contained in broiler litter could be very beneficial, especially where topsoil has been lost due to erosion or machinery operations. Where these situations occur could be the best places to use broiler litter since they are likely to be low in nutrients as well.

Broiler Litter on Corn

Corn is a good crop for utilizing broiler litter. It has a high requirement for nutrients and a long growing season that allows litter to decompose and release nutrients. Field trials in Kentucky have shown that corn responds well to applications of broiler litter. In most cases, four to six tons of well-preserved broiler litter resulted in maximum yields.

Results of two tests comparing broiler litter with fertilizer N are shown in Table 2. These were conventional tilled plots, but treatments were applied after corn was planted and were not incorporated. In these tests, four tons per acre of broiler litter resulted in the highest yields of corn. In both cases, fresh litter was used and there was good moisture during the growing season.

Table 2. Corn response to fertilizer N and broiler litter (bu/a).

Carlisle County		McCracken County	
150 lb N/A	138	125 lb N/A	177
4 T litter/A	160	2 T litter/A	153
8 T litter/A	163	4 T litter/A	174
		6 T litter/A	154

Where litter was surface-applied on no-till corn, higher rates of broiler litter were needed to produce maximum yields. This is due in part to the fact that more N is lost as ammonia escapes into the air. Also, less organic N is released from surface-applied litter than incorporated litter, especially during dry years. Good moisture is needed to decompose the litter and move nutrients into the root zone.

A more efficient way to utilize litter, especially on no-till corn, is to use litter to supply half the N needed by the crop and fertilizer to supply the rest. This reduced amount of litter would in most cases supply all the P_2O_5 and K_2O needed and double the number of acres fertilized.

Broiler Litter on Pastures and Hay Fields

Pastures and hay fields in Kentucky could benefit greatly from applications of broiler litter. Many of these fields are low in P_2O_5 and K_2O. Broiler litter normally contains 50 to 60 pounds of each P_2O_5 and K_2O per ton. Broiler litter also supplies N, which can increase yields—especially on grasses.

Tests with tall fescue (Table 3) at Princeton showed that a broiler litter application of two tons per acre in early May was about equal to a split application of 100 lbs N/A. The four-tons-per-acre litter treatment had the highest yields in each of the four years of the study.

Table 3. Yields[1] of tall fescue following applications of fertilizer and broiler litter.

Treatment	1991	1992	1993	1994
Check	1.65	2.34	2.14	2.52
100 lbs N/A[2]	2.37	4.17	3.11	2.98
100 lbs N + P[3]	2.38	4.34	3.14	3.40
2 T litter/A	2.48	4.97	3.05	3.16
4 T litter/A	3.18	7.22	4.17	3.89

[1]Tons/A hay equivalent

[2]50 lb/A in May + 50 lb/A in August

[3]Same as above except 50 lb/A P_2O_5 applied in 1991 and 1993

In a one-year study, 10 tons per acre of broiler litter produced up to nine tons per acre of hay equivalent yield from bermudagrass. The litter was applied in May, and the grass was cut three times during the summer.

Effect of Broiler Litter on Soil

Soil samples were taken in April each year from the long-term fescue study to follow the changes in soil nutrient status. Soil pH increased from 6.7 in 1991 to 7.1 in 1995 (Figure 1) on the plots where four tons per acre of broiler litter had been applied each year. The litter-treated plots were about 0.5 pH units higher than the untreated plots. The plots treated with 100 pounds of fertilizer N per year as ammonium nitrate were 0.2 to 0.3 pH units lower than the check plots. These results show that broiler litter does not acidify soil like nitrogen fertilizer can. This may be due to the high levels of calcium and magnesium (Table 4) present in broiler litter.

Figure 1. Effect of Broiler Litter and Nitrogen Fertilizer Applied to a Fescue Sod on Soil pH

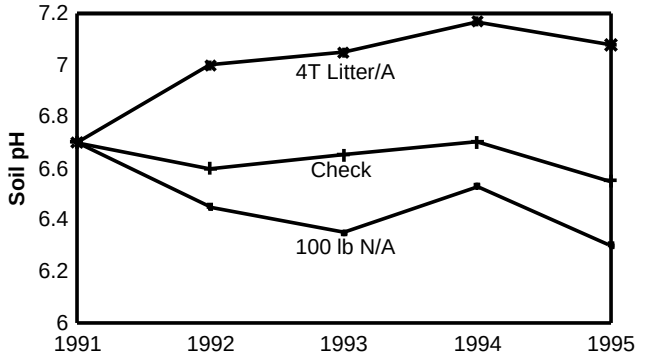


Figure 2. Effect of Broiler Litter and Nitrogen Fertilizer on Soil Test Phosphorus

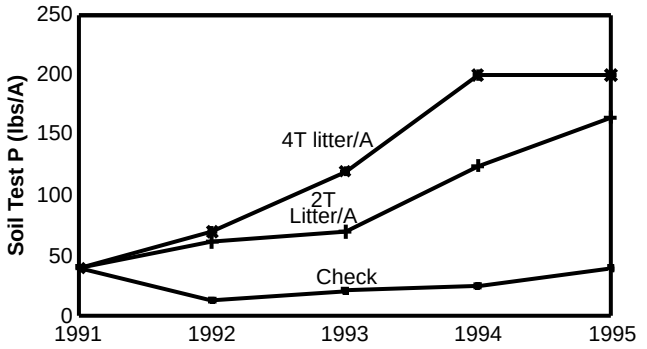
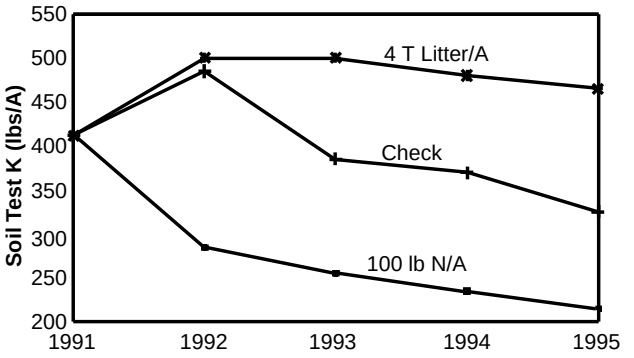


Figure 3. Effect of Poultry Litter and Nitrogen Fertilizer on Soil Potassium



Broiler litter treatments also increased soil test phosphorus (P) levels (Figure 2). After four years of applying four tons of litter per acre per year, soil test P had increased from about 40 to more than 200 pounds per acre. The two-ton litter rate increased soil test P to about 170 pounds per acre. Phosphorus levels increased rapidly when broiler litter was applied every year.

To avoid rapid soil test P increases, it may be best to alternate using broiler litter with N fertilizer or reducing litter application rates and supplementing with N when needed. The litter provides enough P_2O_5 and K_2O even at the reduced rates in most cases.

Soil potassium (K) levels increased the first year after broiler litter was applied (Figure 3), but then declined slightly over the next three years. When only N fertilizer was applied, soil K levels decreased dramatically the first year and continued to decrease over the next three years. This was due to large amounts of K being removed with the harvested forage. This trend probably would not be seen in pasture situations where most of the K in the harvested forage would be returned to the soil in the form of manure.

These results show that fescue hay readily utilizes the K available from broiler litter. Since grasses also use large amounts of N, grass hay fields are excellent places to use broiler litter.

Soil samples taken after four years of treatment with N and broiler litter were also tested for calcium (Ca), magnesium (Mg), and zinc (Zn) (Table 4) and showed significant amounts of these nutrients contained in the broiler litter. However, it is unlikely that fescue yields were increased by their addition since these nutrients were present at this site in sufficient levels for good crop production. Broiler litter could be of value in adding Ca, Mg, and Zn to soils deficient in these nutrients.

Table 4. Soil test levels of calcium, magnesium, and zinc after four years of nitrogen fertilizer and broiler litter applications to a tall fescue sod.

Treatments	Calcium	Magnesium	Zinc
		---------- lbs/A ----------	
Check	3637	273	6
100 lb N/A	2717	206	4
100 lb N/A + P	4057	242	5
2 T Litter/A	5447	305	13
4 T Litter/A	5223	370	21

Weed Seed in Broiler Litter?

Is there a danger of contaminating fields with weed seed when broiler litter is applied? Tests conducted in Alabama and Kentucky showed this should not be a problem. Researchers at Auburn University tested litter from 18 broiler houses and found no viable weed seeds present. The litter was from either peanut hulls or wood shavings.

Samples from broiler houses in Kentucky using rice hulls for litter also contained no viable weed seed. Therefore, unless litter is contaminated with weed seed *during storage and handling*, weed seed in litter should not be a problem.

Conclusions

Large amounts of broiler litter are expected to be available to Kentucky farmers for use as a nutrient source as the poultry industry expands. Broiler litter is an excellent source of N, P_2O_5, and K_2O and contains most secondary and minor nutrients. It also adds organic matter, which could benefit many soils.

Broiler litter is best used with crops such as corn and grass pastures or hay fields that can utilize N efficiently. Legume crops such as soybeans can be used in a rotation to help utilize carryover P_2O_5 and K_2O.

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