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Keys to Managing Poultry Litter

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A long-term research project has found that farmers and ranchers who use poultry litter to fertilize fields can reduce the harm to local water supplies if they use appropriate management strategies.

The study found that producers can adopt several practices to use poultry litter safely, efficiently, and economically:

- First, test the soil to determine the nutrients that it already has.
- Have the poultry litter tested to determine the nutrients that it contains.
- Determine the crop's phosphorus and nitrogen needs, and apply enough litter to provide only the amount of phosphorus required. Add supplemental fertilizer to meet the crop's needs for nitrogen.
- Before applying the litter, calibrate the application equipment to ensure that you apply the correct rate.
- Immediately after applying the litter, incorporate it into the soil.

The research project was begun in 2000 to determine the long-term effects of applying poultry litter to fields. The study was conducted by the US Department of Agriculture–Agricultural Research Service (USDA–ARS) at its Grassland, Soil, and Water Research Laboratory near Waco, TX.

Figure 1. Land application of poultry litter.

In the study, researchers applied various combinations of poultry litter and commercially available (inorganic) nitrogen fertilizers to corn and wheat fields. They evaluated the effects of these applications on farm profitability as well as on soil and water quality

Benefits of using manure and animal by-products

When applied to the land, manure and animal by-products such as poultry litter offer many benefits to farms:

- They provide nutrients for crops (Fig. 1). In fact, poultry litters and layer manures may contain even more phosphorus and potassium than does beef manure (Table 1).

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- Applying manure to the land costs less than other waste-treatment alternatives.
- The litter is reused beneficially and not wasted.
- Litter and manures contain small amounts of other plant nutrients, including boron, calcium, chloride, copper, iron, magnesium, manganese, molybdenum, sulfur, and zinc.
- Manure and litter applications can reduce water runoff and erosion by improving the soil's structure, tilth, and workability, as well as its capacity to hold water and nutrients.
- These applications increase the activity of beneficial soil microorganisms.

Table 1. Average and range ( ) in nutrient value for manure per ton at the time of land application. Source: McFarland et al. 1998.

Source	% Dry matter	Nitrogen (N)	Phosphorus (P_2O_5)	Potassium (K_2O)
		---------- lb/ton ----------		
Cow (fresh)	25	15	8	10
Beef (feedlot)	65 (45–79)	27 (23–39)	24 (15–39)	36 (18–56)
Dairy (corrals)	65 (2–80)	28 (4–44)	11 (1–78)	26 (1–48)
Dairy (stockpile)	80	28	12	23
Broiler (litter)	65 (25–85)	58 (34–89)	51 (32–67)	40 (16–48)
Layer	35 (4–78)	30 (13–70)	40 (2–85)	20 (8–52)
Swine	18 (15–20)	10 (9–11)	9 (7–13)	7 (6–9)

Disadvantages of manure fertilization

If mismanaged, manure applications can lead to excessive runoff of nitrates and phosphorus, which can pollute water.

Research steps

In the study, litter was applied at 0, 2, 3, 4, 5, and 6 tons per acre on six fields. In the years that corn was planted, an inorganic fertilizer was also applied to ensure that the fields receiving the various litter rates met the prescribed nitrogen requirements for corn (Table 2) as outlined by soil tests. In wheat years,

Table 2. Corn yields and associated returns to applied poultry litter.

Field	Litter rate (t/ac)	Commercial nitrogen applied (lb/ac)	Average fertilizer cost ($/ac)	Average yield (bu/ac)	Average throughput ($/ac)
1	6	8	123	96	135
2	5	37	116	97	143
3	4	68	106	94	146
4	3	79	90	99	172
5	2	104	78	99	191
6	0	153	70	86	158

Figure 2. Poultry litter can be used to increase returns for corn crops.

commercial fertilizer was added only to the field that received no litter; for the other fields, the litter contained enough nitrogen to meet the requirements for wheat (Table 3).

The crops were harvested annually and the yields recorded. Tables 2 and 3 list the average throughput values (revenue minus nutrient costs) per acre for each crop.

For corn production, the application that brought the highest return—$191 per acre—was the combination of 2 tons of litter and 104 pounds of a commercially available fertilizer per acre. Second highest was $172 per acre, achieved by the combination of 3 tons of litter and 79 pounds of inorganic fertilizer per acre.

The field that received only the inorganic fertilizer produced returns of $158 per acre. The researchers calculated the application rate of 150 pounds of nitrogen per acre based on soil test results and published recommended rates for corn production by the Texas AgriLife Extension Service. However, historical yields and USDA–ARS research indicate that applying 75 to 100 pounds of nitrogen per acre may be more profitable in the Central Texas Blacklands.

Table 3. Wheat yields and associated returns to applied poultry litter.

Field	Litter rate (t/ac)	Commercial nitrogen applied (lb/ac)	Average fertilizer cost ($/ac)	Average yield (bu/ac)	Average throughput ($/ac)
1	6	0	124	39	40
2	5	0	103	37	55
3	4	0	83	43	99
4	3	0	62	41	111
5	2	0	41	40	128
6	0	72	39	34	111

Wheat followed the same trend: 2 tons of litter and 0 pounds of commercial fertilizer delivered the most revenue per acre, and 6 tons of litter and 0 pounds of commercial fertilizer per acre returned the least (Table 3).

Litter application not only improved yields and revenue for corn and wheat production, but it also increased soil phosphorus levels and runoff of phosphorus and nitrogen. After seven

Figure 3. Field equipment to collect surface runoff.

Table 4. Soil phosphorus levels based on the Mehlich 3 ICP test.

Field	Litter rate (t/ac)	Soil phosphorus (mg/kg)
Y8	6	0
W13	5	0
W12	4	0
Y10	3	0
Y13	2	0
Y6	0	72

annual litter applications, soil phosphorus levels increased on all the fields receiving poultry litter applications (Table 4), with higher increases for the higher application rates.

Litter application reduced the concentrations of nitrate in runoff (Table 5). This reduction resulted from the split application of compost and supplemental nitrogen fertilizer and because organic nitrogen is less likely to run off.

In contrast, applying litter increased the amount of phosphorus in the runoff, especially when the amount of litter applied provided more phosphorus than the crop needed.

Table 5. **Average nitrogen and phosphorus concentrations for runoff (2007–2008) on fields treated with poultry litter.**

Field	Litter rate (t/ac)	Nitrogen concentration (mg/l)	Phosphorus concentration (mg/l)
Y8	6	3.5	0.48
W13	5	5.0	0.55
W12	4	10.0	0.40
Y10	3	27.3	0.26
Y13	2	28.2	0.24
Y6	0	38.0	0.11

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