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Spreading Poultry Litter Without Lab Analysis but With Soil Tests

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Editor's note
The printed version of this publication includes illustrations.

A primary need and concern for most poultry producers is managing litter. You must protect ground and surface water and fulfill regulatory requirements. Usually, these goals are met by applying litter to the land in a way that uses potentially polluting nutrients, such as nitrogen, phosphorus, potash and organic matter.

Litter as a fertilizer

View litter as a fertilizer resource and manage it like commercial fertilizer in your fertility program. You can damage water quality by meeting fertility requirements with commercial fertilizer then applying litter in addition for good measure.

Missouri waste application regulations are based on the rate of nitrogen application. With this plan, the phosphate (P_2O_5) and potash (K_2O) applied may exceed crop needs greatly.

The best fertility plan may be to apply less nitrogen from waste than the crop needs and buy supplemental nitrogen to balance the fertility program. Applying phosphorus to fields with a Bray 1-P test level of more than 800 pounds per acre may aggravate surface water quality problems.

It is highly recommended that you analyze a representative sample of poultry litter for nutrient values immediately before spreading. This, in addition to soil tests, determines the land application rate.

The purpose of this publication is to provide guidance for application of waste without the benefit of a lab analysis but with data from a soil test. Other publications in this series address application of poultry litter with other plans.

Managing poultry litter as a fertilizer

Unlike commercial fertilizers, litter is a highly variable substance. Even within an animal species, waste can vary up to 50 percent. Management styles for poultry operations, such as building cleaning on a certain schedule, dictate a different management technique than commercial fertilizer that can just be ordered and spread.

If a lab analysis is not available, use the average values of litter nutrients in similar waste management systems. Table 1 lists values for poultry litter.

Table 1
Average nutrient levels in poultry litter.[1]

	Nutrients (pounds per ton)				
	Total N	**Organic N**	**NH_4-N**	**P_2O_5**	**K_2O**
Broiler litter	54	46	8	59	38
Turkey litter	54	47	7	55	34

[1]Actual values are highly dependent on dilution, bedding, etc.

Note
P_2O_5 = 2.27 x P. K_2O = 1.2 x K

In contrast to commercial fertilizer, litter has the potential for nutrients (primarily ammonia nitrogen) to be lost to the atmosphere after field spreading.

Table 2 shows the available ammonia nitrogen as a function of time until incorporated into the soil. Table 3 lists the percent of available organic nitrogen available by year. Table 4 gives the percent of other nutrients available in the growing season after application.

Table 2
Litter ammonia nitrogen available by days until incorporated. Unavailable portion is lost to the atmosphere

Days until incorporation	Percent of ammonia N available for crops
0 to 2	80
2 to 4	60
4 to 7	40
more than 7	20

Table 3
Litter organic nitrogen available by year

Manure applied	Percent of organic N available during current year
Current year	40 to 60
1 year ago	10
2 years ago	5
3 years ago	5

Table 4
Minerals and micronutrients available in litter

Nutrient	Percent available in growing season
P	80
K	100

S, Mn, Cu, Zn	80
Ca, Mg	100

This publication estimates the amount of litter to apply to meet the soil test recommendations for nitrogen, using a poultry litter of unknown nutrient analysis. The soil test may call for more than 100 pounds of nitrogen per acre to be added to satisfy crop needs. This exceeds the 100 pounds per acre allowed under the conservative management approach. However, you may wish to use this worksheet with the conservative approach of applying 100 pounds of nitrogen to see what happens with P and K. Blank worksheets are included for actual applications.

This approach cannot be used if the Department of Natural Resources has issued a letter of approval based on the conservative approach of applying not more than 100 pounds of N per year, regardless of the crop and the crop production level.

Example 1

A fescue hay field soil/plant filter is available to receive litter from a turkey operation. No laboratory analysis of the litter is available. The soil test contains fertilizer recommendations for a yield goal of 3 tons of fescue hay per year from the soil/plant filter area. From the soil test, the following nutrient applications are recommended:

- 120 pounds N per acre
- 75 pounds P_2O_5 per acre
- 140 pounds K_2O per acre

Given this information, how many tons per acre of turkey litter should be applied to meet the nitrogen needs of the fescue?

Because no laboratory analysis of the manure is available, use the average values from Table 1. The litter applied is not incorporated into the soil, losing 80 percent of the ammonia nitrogen.

Worksheet 1
Worksheet for turkey litter with no litter applied in past three years

1. Crop nutrient requirements (from soil test)
   "Fescue"
   Yield "3" tons per acre
   Nitrogen "120" pounds per acre
   P_2O_5 "75" pounds per acre
   K_2O "140" pounds per acre
2. Available ammonia nitrogen (NH_4-N)
   NH_4-N pound per ton x percent available = NH_4-N pound per ton (Percent from Table 2, NH_4-N from Table 1)
   "7" pounds per ton x "0.2" percent available = "1.4" pounds per ton
3. Nitrogen available from this year's organic fraction
   N pounds per ton x percent available = N pounds per ton (Percent from Table 3, organic N from Table 1)
   "47" pounds per ton x "0.5" percent available = "23.5" pounds per ton

4. Because no litter was applied in any of the past three years, no residual nitrogen is available.
5. Litter application rate to supply nitrogen

$$\frac{\text{(Crop N (line 1)) - (residual N (line 4))}}{\text{Available } NH_4\text{-N (line 2)) + (available organic nitrogen (line 3))}} = \text{application rate tons per acre}$$

$$\frac{120 - 0}{1.4 + 23.5} = 4.8 \text{ tons per acre}$$

6. Phosphate available at calculated application rate for nitrogen
   Tons per acre x P_2O_5 pounds per ton x percent available = P_2O_5 pounds per acre (P_2O_5 per ton from Table 1, percent from Table 4)
   "4.8" tons per acre x "55" pounds per ton x "0.8" percent available = "211*" pounds per acre

***Note**
211 pounds per acre P_2O_5 is applied vs. 75 pounds per acre recommended by soil test.

7. Potash available at calculated application rate for nitrogen
   Tons per acre x K_2O pounds per ton x percent available = K_2O pounds per acre (K_2O per ton from Table 1, percent from Table 4)
   "4.8" tons per acre x "34" pounds per ton x "1" percent available = "163*" pounds per acre

***Note**
163 pounds per acre K_2O is applied vs. 140 pounds per acre recommended by soil test.

Example 2

Use the information in Example 1 — assuming that litter was applied at 3 tons per acre the past two years.

Worksheet 2
Turkey litter with litter applied the past two years

1. Crop nutrient requirements (from soil test)
   "Fescue"
   Yield "3" tons per acre
   Nitrogen "120" pounds per acre
   P_2O_5 "75" pounds per acre
   K_2O "140" pounds per acre
2. Available ammonia nitrogen (NH_4-N)
   NH_4-N pounds per ton x percent available = NH_4-N pounds per ton (Percent from Table 2, NH_4-N from Table 1)
   "7" pounds per ton x "0.2" percent available = "1.4" pounds per ton
3. Nitrogen available from this year's organic fraction
   N pounds per ton x percent available = N pounds per ton (Percent from Table 3)
   "47" pounds per ton x "0.5" percent available = "23.5" pounds per ton
4. Residual nitrogen available from past years' organic fraction
   Tons per acre x N pounds per ton x percent available = N pounds per acre (Percent from Table 3, organic N from Table 1)

1 year	"3" tons per acre x "47" pounds per ton x "0.10" percent available	= "14.1" pounds per acre

2 years ago	"3" tons per acre x 47 pounds per ton x "0.05" percent available	= "7.1" pounds per acre
Total	= "21.2" pounds per acre	

5. Litter application rate to supply nitrogen

$$\frac{\text{(Crop N (line 1)) - (residual N (line 4))}}{\text{(Available } NH_4\text{-N (line 1)) + (available organic nitrogen (line 3))}} = \text{application rate tons per acre}$$

$$\frac{120 - 21.2}{1.4 + 23.5} = 4 \text{ tons per acre}$$

6. Phosphate available at calculated application rate for nitrogen
   Tons per acre x P_2O_5 pounds per ton x percent available = P_2O_5 pounds per acre (P_2O_5 per ton from Table 1, percent from Table 4)
   "4" tons per acre x "55" pounds per ton x "0.8" percent available = "176*" pounds per acre

***Note**
176 pounds per acre P_2O_5 is applied vs. 75 pounds per acre recommended by the soil test.

7. Potash available at calculated application rate for nitrogen
   Tons per acre x K_2O pounds per ton x percent available = K_2O pounds per acre (K_2O per ton from Table 1, percent from Table 4)
   "4" tons per acre x "34" pounds per ton x "1" percent available = "136*" pounds per acre

***Note**
136 pounds per acre K_2O is applied vs. 140 pounds per acre recommended by the soil test.

Example 3

Turkey litter is spread on corn ground according to the soil test in Figure 2, but no lab analysis of the litter is available. The litter is not incorporated into the soil within 7 days. Ammonia nitrogen loss is 80 percent. Litter has been spread on the area the past three years at 4 tons per acre. The corn yield goal is 160 bushels per acre. Nutrient requirements are as noted in the soil test for corn (Figure 2).

Note
Nitrogen requirements can be reduced by 30 pounds per acre since soybeans were the previous crop.

Worksheet 3
Turkey litter with litter applied past three years

1. Crop nutrient requirements (from soil test)
   "Corn"
   Yield "160" tons per acre
   Nitrogen "160*" pounds per acre
   P_2O_5 "95" pounds per acre
   K_2O "96" pounds per acre

***Note**
Since soybeans were the last crop, N = 190 - 30 = 160 pounds per acre

2. Available ammonia nitrogen (NH_4-N)
   NH_4-N pounds per ton x percent available = NH_4-N pounds per ton (Percent from Table 2, NH_4-N from Table 1)
   "7" pounds per ton x "0.2" percent available = "1.4" pounds per ton
3. Nitrogen available from this year's organic fraction
   N pounds per ton x percent available = N pounds per ton (Percent from Table 3, organic N from Table 1)
   "47" pounds per ton x "0.5" percent available = "23.5" pounds per ton
4. Residual nitrogen available from past years' organic fraction
   Tons per acre x N pounds per ton x percent available = N pounds per acre (Percent from Table 3, organic N from Table 1)

1 year	"4" tons per acre x "47" pounds per ton x "0.10" percent available	= "18.8" pounds per acre
2 years ago	"4" tons per acre x "47" pounds per ton x "0.05" percent available	= "9.4" pounds per acre
3 years ago	"4" tons per acre x "47" pounds per ton x "0.05" percent available	= "9.4" pounds per acre
Total		= "37.6" pounds per acre

5. Manure application rate to supply nitrogen

$$\frac{\text{(Crop N requirement (line 1))} - \text{(residual N (line 4))}}{\text{(Available } NH_4\text{-N (line 2))} + \text{(available organic nitrogen (line 3))}} = \text{application rate tons per acre}$$

$$\frac{160 - 37.6}{1.4 + 23.5} = 4.9 \text{ tons per acre}$$

6. Phosphate available at calculated application rate for nitrogen
   Tons per acre x P_2O_5 pounds per ton x percent available = P_2O_5 pounds per acre (P_2O_5 per ton from Table 1, percent from Table 4)
   "4.9" tons per acre x "55" pounds per ton x "0.8" percent available = "215.6*" pounds per acre

***Note**
215.6 pounds per acre of P_2O_5 is applied vs. 95 pounds per acre recommended by the soil test.

7. Potash available at calculated application rate for nitrogen
   Tons per acre x K_2O pounds per ton x percent available = K_2O pounds per acre (K_2O per ton from Table 1, percent from Table 4)
   "4.9" tons per acre x "34" pounds per ton x "1" percent available = "166.6*" pounds per acre

***Note**
166.6 pounds per acre of K_2O is applied vs. 95 pounds per acre recommended by the soil test.

Worksheet 4
Litter fertility worksheet

1. Crop nutrient requirements (from soil test)

   Nitrogen pounds per acre
   P_2O_5 pounds per acre
   K_2O pounds per acre
2. Available ammonia nitrogen (NH_4-N) NH_4-N pound per ton x percent available = NH_4-N pound per

ton (Percent from Table 2, NH_4-N from Table 1)
pounds per ton x percent available = pounds per ton

3. Nitrogen available from this year's organic fraction
   N pounds per ton x percent available = N pounds per ton (Percent from Table 3, organic N from Table 1)
   pounds per ton x percent available = pounds per ton
4. Residual nitrogen available from past year's organic fraction
   Tons per acre x N pounds per ton x percent available = N pounds per acre (Percent from Table 3, organic N from Table 1)

1 year	tons per acre x pounds per ton x percent available	= pounds per acre
2 years ago	tons per acre x pounds per ton x percent available	= pounds per acre
3 years ago	tons per acre x pounds per ton x percent available	= pounds per acre
Total		= pounds per acre

5. Litter application rate

   (Crop N requirement (line 1)) - (residual N (line 4)) = application rate tons per acre
   (Available NH_4-N (line 2)) + (available organic nitrogen (line 3))

   _____ - _____ = tons per acre
   _____
   _____ + _____"

6. Phosphate available at calculated application rate for nitrogen
   Tons per acre x P_2O_5 pound per ton x percent available = P_2O_5 pounds per acre (Percent from Table 4)
   tons per acre x pounds per ton x percent available = pounds per acre
7. Potash available at calculated application rate for nitrogen
   Tons per acre x K_2O pound per ton x percent available = K_2O pounds per acre (Percent from Table 4)
   tons per acre x pounds per ton x percent available = pounds per acre

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Related MU Extension publications

- MWPS18, Livestock Waste Facilities Handbook
  http://extension.missouri.edu/publications/DisplayPub.aspx?P=MWPS18
- WQ220, Spreading Poultry Litter Without Lab Analysis or Soil Tests
  http://extension.missouri.edu/publications/DisplayPub.aspx?P=WQ220
- WQ221, Spreading Poultry Litter With Lab Analysis but Without Soil Tests
  http://extension.missouri.edu/publications/DisplayPub.aspx?P=WQ221
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