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Calculating the Value of Manure as a Fertilizer Source

Manure has value on a field if it offsets the need to purchase other nutrients or soil amendments. The worksheet in this guide allows users to calculate the fertilizer value of the manure for a specific field. Assemble the information specified in the input form (Table 1) before completing the worksheet (Table 2). An example scenario is described and is followed by a completed worksheet (Table 3) based on its inputs.

Manure has characteristics that may reduce its value relative to that of commercial chemical fertilizers. Manure can be a less dependable nitrogen source and is perceived as a source of weed seeds. Because manure is an unbalanced fertilizer source, using it may meet crop needs for one nutrient but result in application of too much or too little of other crop nutrients. Low nutrient concentration in manure increases handling and application costs. Manure has positive attributes as well: It is a slow-release fertilizer, and the organic material can improve soil quality.

The worksheet in this guide determines the value of manure considering only its value as a nutrient source, similar to commercial chemical fertilizers. The actual economic value of manure sold to a farmer is a result of negotiation between the manure seller and the buyer considering the fertilizer value adjusted for recognized positive and negative qualities of using manure as a fertilizer.

Table 1. Input form.

Step 1. Total nutrients in manure (pounds per ton or pounds per 1,000 gallons)

1. Total nitrogen (TN) _____
2. Inorganic nitrogen (IN) _____
3. Organic nitrogen (ON) (ON = TN – IN) _____
4. Phosphorus (P_2O_5) ($P_2O_5 = P \times 2.29$) _____
5. Potassium (K_2O) ($K_2O = K \times 1.20$) _____

Users should get the quantities of TN, P and K from a laboratory analysis of manure from their farm. Without a lab test, a table of typical nutrient values for manure can be used. Realize that the nutrient value of the manure could easily be half or double the tabular value. See MU Extension publication EQ215, Laboratory Analysis of Manure, for more information on manure testing. See MU Extension publication EQ201, Reduce Environmental Problems With Proper Land Application of Animal Manure, for average nutrient values of several types of livestock manure.

Step 2. Crop nutrient need (pounds per acre)

1. Nitrogen (N) _____
2. Phosphorus (P_2O_5) ($P_2O_5 = P \times 2.29$) _____
3. Potassium (K_2O) ($K_2O = K \times 1.20$) _____

The need for phosphorus and potassium should be based on soil testing results, and nitrogen need depends on the crop grown and yield goal. For more information, see MU Extension publications G9217, Soil Sampling Hayfields and Row Crops, and G9112, Interpreting Missouri Soil Test Reports.

Step 3. Fertilizer costs (dollars per pound)

1. Fertilizer N _____
2. Fertilizer P_2O_5 _____
3. Fertilizer K_2O _____

Step 4. Other information

1. Spreader capacity (tons or 1,000 gallons) _____

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Table 2. Worksheet to calculate fertilizer value per load of manure.

	Nitrogen			P_2O_5	K_2O
	Inorganic N[1]	Organic N	Total N		
1. Total nutrients in manure (pounds per ton or per 1,000 gallons) from input form, Step 1					
2. Nutrient availability[2]				1.0	1.0
3. Available nutrients[3] in manure (pounds per ton or per 1,000 gallons) *Multiply Line 1 by Line 2 for IN and ON. Add IN and ON to obtain TN.*					
4. Crop need (pounds per acre) from input form, Step 2					
5. Quantity of manure needed (tons per acre or 1,000 gallons per acre) *Divide Line 4 by Line 3.*					
6. Quantity of manure to apply[4] (tons per acre or 1,000 gallons per acre) *Select one value from Line 5.*					
7. Available nutrients that will be applied (pounds per acre) *Multiply Line 6 by Line 3.*					
8. Nutrients with value (pounds per acre) *Select the lower value of Line 4 or Line 7 in each column .*					
9. Fertilizer cost (dollars per pound) from input form, Step 3			$	$	$
10. Manure value by nutrient (dollars per acre) *Multiply Line 8 by Line 9.*			$	$	$
11. Manure value per acre (dollars per acre) *Sum the values in Line 10.*	$				
12. Manure value per unit of manure (dollars per ton or per 1,000 gallons) *Divide Line 11 by Line 6.*	$				

1. Inorganic N is also called ammonia N.
2. Inorganic N availability can range from 0.20 for surface-applied manure to 1.0 for incorporated manure. Organic N availability ranges from 0.25 to 0.6 in the year of application, depending on manure type. Missouri Department of Natural Resources (MDNR) regulations may stipulate that certain availability coefficients be used for MDNR-permitted waste facilities.
3. Add available inorganic N and organic N in Line 3 to determine available total N in Line 3.
4. Select from Line 5 the quantity of manure to be applied per acre based on whether you want to meet the N, P or K needs of the crop. If you want to meet or exceed all crop nutrient needs, select the highest value in Line 5.

Example

This example is based on a surface application of poultry litter on dryland corn. See example worksheet (Table 3).

Example inputs

Step 1. Total nutrients in manure (pounds per ton or pounds per 1,000 gallons)

1. Total nitrogen (TN): 54 lb/ton
2. Inorganic nitrogen (IN): 10 lb/ton
3. Organic nitrogen (ON): 44 lb/ton
   (ON = TN − IN)
4. Phosphorous (P_2O_5): 50 lb/ton
   (P_2O_5 = P × 2.29)
5. Potassium (K_2O): 39 lb/ton
   (K_2O = K × 1.20)

Step 2. Crop nutrient need (pounds per acre)

1. Nitrogen (N): 165 lb/acre
2. Phosphorous (P_2O_5): 98 lb/acre
   (P_2O_5 = P × 2.29)
3. Potassium (K_2O): 107 lb/acre
   (K_2O = K × 1.20)

Step 3. Fertilizer costs (dollars per pound)

1. Fertilizer N: $0.50/lb
2. Fertilizer P_2O_5: $0.70/lb
3. Fertilizer K_2O: $0.40/lb

Step 4. Other information

1. Spreader capacity (tons or 1,000 gallons): 8 tons

Table 3. Example worksheet for dryland corn and soybean fertilizer needs.

	Nitrogen				
	Inorganic N[1]	Organic N	Total N	P_2O_5	K_2O
1. Total nutrients in manure (pounds per ton or per 1,000 gallons) from input form, Step 1	10	44	54	50	39
2. Nutrient availability[2]	0.6	0.6		1.0	1.0
3. Available nutrients[3] in manure (pounds per ton or per 1,000 gallons) *Multiply Line 1 by Line 2 for IN and ON. Add IN and ON to obtain TN.*	6	26.4	32.4	50	39
4. Crop need (pounds per acre) from input form, Step 2			165	98	107
5. Quantity of manure needed (tons per acre or 1,000 gallons per acre) *Divide Line 4 by Line 3.*			5.1	2.0	2.7
6. Quantity of manure to apply[4] (tons per acre or 1,000 gallons per acre) *Select one value from Line 5.*			2.7	2.7	2.7
7. Available nutrients that will be applied (pounds per acre) *Multiply Line 6 by Line 3.*			87	135	105
8. Nutrients with value (pounds per acre) *Select the lower value of Line 4 or Line 7 in each column .*			87	98	105
9. Fertilizer cost (dollars per pound) from input form, Step 3			$0.50	$0.70	$0.40
10. Manure value by nutrient (dollars per acre) *Multiply Line 8 by Line 9.*			$43.50	$68.60	$42.00
11. Manure value per acre (dollars per acre) *Sum the values in Line 10.*	$43.50 + $68.60 + $42.00 = $154.10				
12. Manure value per unit of manure (dollars per ton or per 1,000 gallons)	$154.10 ÷ 2.7 = $57.07				

1. Inorganic N is also called ammonia N.
2. Inorganic N availability can range from 0.20 for surface-applied manure to 1.0 for incorporated manure. Organic N availability ranges from 0.25 to 0.6 in the year of application, depending on manure type. Missouri Department of Natural Resources (MDNR) regulations may stipulate that certain availability coefficients be used for MDNR-permitted waste facilities.
3. Add available inorganic N and organic N in Line 3 to determine available total N in Line 3.
4. Select from Line 5 the quantity of manure to be applied per acre based on whether you want to meet the N, P or K needs of the crop. If you want to meet or exceed all crop nutrient needs, select the highest value in Line 5.

Comments

Poultry liter was surface applied to ground that is to be planted in corn. Enough poultry litter was applied to meet the K_2O requirements of the corn and subsequent soybean crop. This manure would have a value of $154.10 per acre if applied at 2.7 tons per acre. The value per ton would be $57.07 ($154.10 per acre ÷ 2.7 tons per acre).

In this example, manure is applied to meet K_2O requirements of the crop. Consequently, N is underapplied and additional fertilizer N will be needed. The crop requires 165 pounds of N per acre; we will apply 87 pounds N per acre. The crop will need 78 pounds of additional fertilizer N per acre (165 – 87 = 78).

In this example, applying manure to meet the K_2O requirements of the crop results in applying substantially more P_2O_5 than is needed as indicated by a soil test. Excess P_2O_5 in the manure does not contribute to the value of the manure because the nutrients are not required for crop growth.

Additional information

Farmers can estimate the value of their manure by using the Manure Value Estimator workbook (XLSX).

Web addresses

The web addresses for the MU Extension publications and Excel workbook mentioned in this guide are listed below in order of appearance.

- **EQ215, Laboratory Analysis of Manure**
  extension.missouri.edu/publications/eq215
- **EQ201, Reduce Environmental Problems With Proper Land Application of Animal Manure**
  extension.missouri.edu/publications/eq201
- **G9217, Soil Sampling Hayfields and Row Crops**
  extension.missouri.edu/publications/g9217
- **G9112, Interpreting Missouri Soil Test Reports**
  extension.missouri.edu/publications/g9112
- **Manure Value Estimator workbook**
  extension.missouri.edu/media/wysiwyg/Extensiondata/Pro/Swine/Docs/ManureValueEstimator.xlsx

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