

Typical Manure Only

This example illustrates calculating the maximum rate of manure required to meet the nitrogen needs of a crop and the net recommendation for the field based on total analysis for N, P₂O₅, and K₂O and can only be used for typical, nontreated dairy, swine, other livestock, and poultry manures.

Situation

- Recommendations for 150 bu/A corn crop from the soil test report were 150-50-100 pounds of N, P₂O₅ and K₂O, respectively.
- The liquid dairy manure analysis is 20 pounds total N, 11 pounds P₂O₅, and 21 pounds K₂O per 1,000 gallons.
- Manure is to be applied in the spring for this corn crop and incorporated the day after application.
- Similar manure has been applied to this field frequently in the past (two or three out of the last five years).
- The starter fertilizer program is 150 pounds per acre of 10-20-10.
- Last year, the crop in this field was soybeans, which yielded 50 bu/A.

Net Crop Nutrient Requirement

First, all sources of nutrients must be accounted for before a manure rate is calculated by starting with the soil test recommendations and then deducting any other sources of nutrients applied or already available in the field.

Net nutrients required = soil test recommendation – residual N from past manure – residual N from a previous legume crop in the rotation – starter nutrients

Residual N from Past Applications (Table 1.2-14, Part B)

Residual N = 20 lb N/A for a history of frequent manure applications

Residual N from a Previous Legume Crop in the Rotation (Table 1.2-8)

Soybeans @ 50 bu/A x 1 lb residual N/bu = 50 lb N/A from the soybeans the previous year

Starter Fertilizer Nutrients That Will Be Applied Regardless of the Planned Manure Application

150 lb/A of a 10-20-10 starter fertilizer will be used on this field. The N, P₂O₅, and K₂O applied in this fertilizer is calculated as follows:

- 150 lbs fertilizer/A x 10% N = 15 lb N/A
- 150 lbs fertilizer/A x 20% P₂O₅ = 30 lb P₂O₅/A
- 150 lbs fertilizer/A x 10% K₂O = 15 lb K₂O/A

Net nutrients required	N (lb/A)	P ₂ O ₅	K ₂ O
Soil test recommendation	150	50	100
–Residual manure N	20	—	—
–Residual legume N	50	—	—
–Starter nutrients	15	30	15
Net requirement (lbs/A)	65	20	85

N Balance Manure Application Rate

The N balanced manure application rate is determined by dividing the available N in the manure into the net crop N requirement calculated above.

Available N in the manure = total manure N x N availability factor (Table 1.2-14, Part A)

N availability factor = 0.4 from Table 1.2-14 (based on the time until incorporation or 1 day in this example):

Available N = 20 lb N/1,000 gal x 0.4 = 8 lb N/1,000 gal

Maximum rate per acre to meet N need = net N requirement ÷ available manure N

Rate per acre to meet N need = 65 lbs N/A ÷ 8 lbs N/1,000 gal = 8,125 gal/A

(Note: Any rate less than or equal to this rate is acceptable.)

Nutrients Applied at the Planned Rate

Based on this calculation, the farmer decided to apply 8,000 gal/A. At this application rate the following amounts of nutrients would be applied:

Nitrogen: 8,000 gal/A x 8 lb available N/1,000 gal = 64 lb available N/A

Phosphorus: 8,000 gal/A x 11 lb P₂O₅/1,000 gal = 88 lb P₂O₅/A

Potassium: 8,000 gal/A x 21 lb K₂O/1,000 gal = 168 lb K₂O/A

Final Nutrient Balance on the Field after Manure Application

The nutrient balance is simply the difference between the net crop nutrient requirement and the nutrients applied at the planned rate.

	N	P ₂ O ₅ (lb/A)	K ₂ O
Net crop nutrient requirement	65	20	85
Nutrients applied at planned rate (8,000 gal/acre)	64	88	168
Balance after manure application	1 short	68 excess	83 excess

As discussed earlier, this excess P should be evaluated with the Phosphorus Index to see if it represents a potential risk to the environment. If the P Index indicates that the risk is high, manure management may have to be changed to address this concern. The excess K could result in high K levels in crops, which can, under certain circumstances, cause problems in animal feeding programs and animal health.

All Manure Including Atypical or Treated Manure

This example illustrates calculating the maximum rate of manure required to meet the nitrogen needs of a crop and the net recommendation for the field based on analysis for dry matter, total N, NH₄-N, total P₂O₅, and K₂O. This calculation can be used for all manure, but it is required for atypical and/or treated manures.

Situation

- Recommendations from the soil test report were 160-50-40 lbs of N, P₂O₅ and K₂O, respectively.
- This poultry manure was composted and has an analysis of 50 lbs total N; 10 lbs NH₄-N, 40 lbs P₂O₅, and 30 lbs K₂O/ton; and 40 percent moisture.
- Manure is to be incorporated three days after application.
- Manure with the same analysis has been applied to this field at the rate of 10 ton/A each of the last three years.
- The starter fertilizer program is 5 gal/A of 10-34-0 (Note: 10-34-0 weighs 11.86 lb/gal).

Net Crop Nutrient Requirement

First all sources of nutrients must be accounted for before a manure rate is calculated by starting with the soil test recommendations and then deducting any other sources of nutrients applied or already available in the field.

Net nutrients required = soil test recommendation – residual N from past manure – residual N from a previous legume crop in the rotation – starter nutrients

Residual N from Past Applications (Table 1.2-15)

Residual N from past manure applications is estimated as follows: For each year in the last five when manure was applied, multiply the rate applied x organic N analysis x the appropriate factor from the section of Table 1.2-15 labeled "Organic N decomposed from past applications." Note that if the organic N is not given on the manure analysis report it can be calculated by subtracting the ammonium N from the total N on the report.

In this example the manure is composted and has 50 lbs total N/ton and 10 lbs of NH₄-N/ton

Organic N = total N – ammonium N = 50 lbs/ton – 10 lbs/ton = 40 lbs/ton organic N

Residual N from last year: 10 tons/A x 40 lbs organic N/ton x 0.05 = 20 lbs N/A

Residual N from 2 years ago: 10 tons/A x 40 lbs organic N/ton x 0.02 = 8 lbs N/A

Residual N from 2 years ago: 10 tons/A x 40 lbs organic N/ton x 0.01 = 4 lbs N/A

Total residual N from past applications: 32 lbs N/A

Residual N from a Previous Legume Crop in the Rotation (Table 1.2-8)

None in this example.

Starter Fertilizer Nutrients That Will Be Applied Regardless of the Planned Manure Application

5 gal/A of a 10-34-0 starter fertilizer will be used on this field. First, since this is a liquid fertilizer the gal/A must be converted to lb/A. To do this multiply the number of gal/A x the weight/gal.

5 gal/A x 11.86 lbs/gal = 59.3 lbs/A

Then the N, P₂O₅, and K₂O applied in this fertilizer are calculated as follows:

59.3 lbs fertilizer/A x 10% N = 6 lbs N/A

59.3 lbs fertilizer/A x 20% P₂O₅ = 20 lbs P₂O₅/A

There is no K₂O in this fertilizer.

Net nutrients required	N	P ₂ O ₅ (lbs/A)	K ₂ O
Soil test recommendation	160	50	40
–Residual manure N	32	—	—
–Residual legume N	0	—	—
–Starter nutrients	6	20	0
Net requirement (lbs/A)	122	30	40

N Balance Manure Application Rate

The N balanced manure application rate is determined by dividing the available N in the manure into the net crop N requirement calculated above. For treated manures the available N is the sum of the N available from both the ammonium and organic N.

Available NH₄-N in the manure = NH₄-N N x NH₄-N availability factor (Table 1.2-15)

NH₄-N availability factor = 0.4 from Table 1.2-15 (based on the time until incorporation or 3 days in this example):

NH₄-N x NH₄-N availability factor = 10 x 0.40 = 4 lbs N/ton

Available organic in the manure = organic N x organic N availability factor (Table 1.2-15)

In this example, the manure is composted and has 50 lbs total N/ton and 10 lbs NH₄-N/ton

Organic N = total N – ammonium N = 50 lbs/ton – 10 lb/ton = 40 lbs/ton organic N

Organic N availability factor = 0.1 from Table 1.2-15 (composted manure in this example):

Organic N x Organic N availability factor = 40 x 0.10 = 4 lbs N/ton

Total available N in the manure = available NH₄-N + available organic N

Total Available N = 4 lbs NH₄-N/ton + 4 lbs organic N/ton = 8 lbs available N/ton

Maximum rate per acre to meet N need = net N requirement ÷ available manure N

Rate per acre to meet N need = 138 lbs N/A ÷ 8 lb N/ton = 15.25 ton/A

(Note: Any rate less than or equal to this rate is acceptable.)

(Note: This may seem to be a very high rate for poultry manure, but because it was composted, the N availability is very low compared to raw poultry manure; thus, a larger amount is required to supply adequate available N for this crop.)

Nutrients Applied at the Planned Rate

Based on this calculation, which determined that up to 15.25 tons/A could be applied, the farmer decided to apply 10 ton/A. At this application rate the following amounts of nutrients would be applied:

Nitrogen: 10 tons/A x 8 lbs available N/ton = 80 lbs available N/A

Phosphorus: 10 tons/A x 40 lbs P₂O₅/ton = 400 lbs P₂O₅/A

Potassium: 10 tons/A x 30 lbs K₂O/ton = 300 lbs K₂O/A

Final Nutrient Balance on the Field after Manure Application

The nutrient balance is simply the difference between the net crop nutrient requirement and the nutrients applied at the planned rate.

	N	P ₂ O ₅ (lbs/A)	K ₂ O
Net crop nutrient requirement	122	30	40
Nutrients applied at planned rate	80	400	300
Balance after manure application	42 short	370 excess	260 excess

Note that one of the consequences of applying a low N availability material like compost at a rate that comes close to matching the N needs of the crop will usually apply a large excess of P and K. This is very clear in this example even though the rate the farm chose was much lower than the rate required to supply the available N needs.

Supplemental Fertilizer Needs

In this example the N applied at the farmers planned rate will not be adequate to meet the needs of the crop. Therefore, a supplemental N fertilizer application will be needed to supply the 42 lbs N/A that he is short.