NM-1418

Manure Spreader Calibration

For Nutrient Management Planning

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Purpose for Calibration

Livestock manures contain many beneficial and valuable plant nutrients, mainly nitrogen (N), phosphorus (P), potassium (K) and micronutrients. However, if the application rate of manure is not properly calibrated, these valuable nutrients may be wasted in overapplication or underapplication and crop yield goals may not be met.

Misapplication of manure also leads to a higher risk of environmental pollution. Environmental issues with manure pollution pertain mainly to bacterial pathogens, P in runoff entering surface waters and N leaching through the soil to groundwater. These factors can cause health problems and decrease environmental quality (Freitas and Burr, 1996).

Nutrient Properties

Manure has many inorganic (mineralized) and many organic (immobilized) nutrients. The immobilized nutrients are not plant available until they have been mineralized by microbes. Roughly 60 percent of the N, 80 percent of the P and 90 percent of the K found in manure is plant available during the first growing season application. Most of the remaining immobilized nutrients will be utilized the following growing season.
The added organic matter from manure promotes sustained fertility due to a slow release of nutrients and an increased ability to hold onto positively charged ions (cation exchange).

Soil characteristics such as water-holding capacity, water infiltration, bulk density and soil buffering can be improved by using manure with a properly planned and practiced nutrient management plan. Economic benefits arise from increased soil health, crop production and money saved from reduced fertilizer costs.

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Testing Manure

Manure composition can vary greatly due to differences that include animal species, bedding, diet, climate and storage facilities. Book values (Figure 1) can help develop a nutrient management plan, but manure should be tested to better understand nutrient amount, ensure safe environmental practices and meet crop yield goals. Refer to NDSU Extension publication "Manure Sampling for Nutrient Management Planning" (NM-1259) for sampling methods and interpretation of test results.

Figure 1. Book values of various manures.

Animal	N	P_2O_5†	K_2O‡
	— Pounds Per Ton —		
Beef	25	18	22
Sheep	20	13	27
Poultry	55	63	40
Equine	12	6	12
	Pounds per 1,000 Gallons		
Dairy	22	14	20
Swine	27	19	15

† P fertilizer typically is expressed as P_2O_5
‡ K fertilizer typically is expressed as K_2O

(Midwest Plan Service, 1993, and Wiederholt, 2004)

Calibration Methods

Sheet Method

The Sheet Method works well for solid manure applications. For this manure spreader calibration procedure, all that is needed is a sheet of known area (width x length = feet^2), a 5-gallon bucket and a scale. The sheet can consist of almost any material. Landscaping cloth works well because applied manure will not slide off as easily as it will on a plastic sheet.

- Weigh the bucket and sheet to tare the weight of the manure.
- Lay out the sheet and anchor it down with a few rocks or stakes.
- Record your tractor gear, engine's revolutions per minute (RPM) and spreader settings.
- Apply the manure over the sheet.
- Weigh the manure-covered sheet in the bucket.

The weight per area now is known. If a sheet measuring 21.8 feet^2 (3 feet by 7 feet 4 inches or 4 feet by 5 feet 6 inches) is used, then the weight in pounds of manure on the sheet is equal to tons/acre (Figure 2, Example 1). Example 2 displays how to determine an application with a sheet that is not 21.8 feet^2. The equation to determine the application rate is tons/acre = (pounds of manure on sheet x 21.8) ÷ square feet of sheet.

Axle Weight Method

The axle weight method works for solid and liquid manure applications. This procedure requires a 100-foot tape measure or a measuring wheel and a scale capable of weighing the manure spreader. Truck scales or portable axle scales work well. The equation to determine the application rate is tons/acre = (weight in pounds of loaded spreader – weight in pounds of empty spreader) ÷ 2,000 pounds ÷ square feet of applied area ÷ 43,560 square feet.

- Weigh the manure spreader loaded. In the event the spreader is a tandem axle and the scale is unable to weigh both axles at the same time; each axle may be weighed individually and their weights can be added. (If using a tractor-pulled spreader and parking the tractor and spreader on the scale is not possible, be sure to lower the manure spreader jack onto the scale to take weight off of the tractor tongue.)
- Apply the manure to a desired area of known dimensions (equivalent to length multiplied by the width covered with one load).
- Record tractor gear, engine RPM and spreader settings.
- Weigh the spreader after application.
- Find the difference of weights from before and after manure application (Figure 3).

Figure 2. Sheet method worksheet.

	Manure on Sheet (lbs)	Multiply	Correction Factor (21.8)	Divide	Square Feet of Sheet (Length x Width)	Equals	Tons of Manure Per Acre
Example 1	*21.25*	x	*21.8*	÷	*21.8*	=	*21.25*
Example 2	*21.25*	x	*21.8*	÷	*24*	=	*19.3*
Sheet 1		x		÷		=	
Sheet 2		x		÷		=	
Sheet 3		x		÷		=	

This procedure also should be replicated three or more times and averaged to help account for variability (Jokela, 2008).

Figure 3. Axle weight method worksheet.

	Area Applied (Sq. Feet)	Divide	Square Feet Per Acre (43,560)	Equals	Acres Applied (Use Later)	Manure-loaded Spreader Weight (lbs)	Minus	Spreader Weight After Application (lbs)	Divide	2,000 lbs	Divide	Acres Applied (From Earlier)	Equals	Tons of Manure Per Acre
Example	*16,438*	÷	*43,560*	=	*0.377*	*37,188*	-	*19,321*	÷	*2,000*	÷	*0.377*	=	*23.7*
Application 1		÷	43,560	=			-		÷	2,000	÷		=	
Application 2		÷	43,560	=			-		÷	2,000	÷		=	
Application 3		÷	43,560	=			-		÷	2,000	÷		=	
Application 4		÷	43,560	=			-		÷	2,000	÷		=	

This procedure might be the most time consuming, but it is the most accurate because it can account for variability within the application procedure.

References

Freitas, R.J., and M.D. Burr. 1996. Animal Wastes. *In* Pollution Science. I.L. Pepper, C.P Gerba, and M.L. Brusseau (ed). Academic Press. San Diego, Calif.

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Midwest Plan Service. 1993. Livestock waste management. Vol I. CRC Press, Boca Raton, Fla.

Wiederholt, R. 2004. Manure Application Planning Workbook AE-1187 (Revised). North Dakota State University Extension Service, Fargo, ND.

Refer to NDSU Extension publication
"Manure Sampling for Nutrient Management Planning" (NM-1259)
for sampling methods and interpretation of test results.

For more information on this and other topics, see: www.ag.ndsu.edu

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