Utilizing Dairy Manure for Crop Production

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High costs of production make dairy manure look better every day compared to purchased, synthetic fertilizers, but timing and application method greatly impact the nitrogen value a producer can recycle to crop production.

Any decision to use manure as a substitute for commercial fertilizer should be based upon manure and soil tests. Manure nutrients are farm specific and are affected by type of animal, feed, how manure is handled and stored as well as climate conditions, just to name a few. The dairy manure sample used in this article is as an example—any individual farm will have different values and those specific manure samples should be utilized to compare how your costs may differ from those provided in this article.

Table 1 shows the expected nutrients available from "typical" dairy manure by time of year and method of application. Surface applied manure will result in maximum ammonia-nitrogen loss, especially under hot and dry conditions.

A successful manure recycling program maximizes the value of manure nutrients by appropriately crediting nitrogen (N) and replacing purchased phosphorus (P), and potassium (K) with manure nutrients and placing these nutrients where a crop response is expected. The value of manure nutrients are realized when they replace purchased nutrients. Typically, the most profitable strategy also will minimize environmental impacts because manure nutrients are recycled to meet the needs of a growing crop and are not lost to air or water in the environment.

Table 2 highlights the expected value of commercial fertilizer and manure nutrients based on timing and method of application. Each nutrient program is based upon out-of-pocket (direct) costs including application of the respective nutrient ($10 is used for each fertilizer application and a $17.10/1,000 gallons for manure application). There can be a wide range of costs associated with manure application depending primarily upon the type of application equipment and hauling distance. Producers are encouraged to calculate their cost of owning and operating nutrient application equipment to make this example more relevant to their operations or to work with neighboring crop producers who can utilize the manure.

Table 2 compares three manure application strategies. Each strategy assumes 140 bu/ac grain corn is produced requiring 160 pounds of N, 30 lbs. of P2O5 and 60 lbs. of K2O (producers should check their specific soil test recommendations). Commercial fertilizer is expected to have an out-of-pocket cost of $165 per acre plus $10 for application charges, or $175 per acre.

Spring injected dairy manure at the rate of 6,250 gallons per acre (Column 1, Table 2) is more closely aligned with the phosphorus needs of this crop, but will require an additional 60 lb/ac N at side-dress application which provides a consistent rate of N more uniformly applied reducing the risk of non-uniform manure application. This strategy will apply 13 lb/ac P2O5 and 53 lb/ac K2O in excess of what the corn crop requires which will be credited to the next growing crop and has an expected out-of-pocket cost of about $162/ac.

The next strategy, Column 2, spring injects 10,000 gallons of manure per acre. This will supply all the nitrogen needs of the corn crop and 54 lb/ac P2O5 and 109 lb/ac K2O, about two years of P2O5 and nearly three years of K2O. Nitrogen basing manure every year on the same fields will result in unwanted building of phosphorus soil test levels. Rotating of manure and crops will reduce this situation.

Column 3 demonstrates a strategy when manure is spring broadcast applied under typical cool temperatures and damp soil conditions. Under these circumstances, 10 lbs. of nitrogen per 1000 gallons (100 lb N/

Dairy manure nutrient analysis

Table 1	Nitrogen lb/1000 gallons	Phosphate (P_2O_5) lb/1000 gallons	Potash (K_2O) lb/1000 gallons	Nutrient Value $0.75/lb of N $0.60/lb of P_2O_5 $0.45/lb of K_2O
Manure Test	22	11	15	$29.85 / 1000 gallons
Expected manure nutrients (spring injection)	16	11	15	$25.35 / 1000 gallons
Expected manure nutrients (broadcast, hot/dry conditions)	5	11	15	$17.10 / 1000 gallons

ac) is assumed to be retained for the corn crop and 54 lb/ac P2O5 and 109 lb/ac K2O are applied. This strategy requires additional N fertilizer applied at side-dress. If this manure could have been injected or incorporated quickly, an additional 60 lbs. of nitrogen ($45) could have been retained.

The three strategies compare the out-of-pocket cost of commercial fertilizer with dairy manure, including hauling/application costs. When dairy manure is spring injected, more fully utilizing the nitrogen, the out-of-pocket costs are expected to be less than those for a commercial fertilizer program. It is also worth noting the replacement value of manure nutrients exceeds the cost of application when manure nitrogen is conserved through injection or incorporation. However, this assumes manure nutrients are being fully utilized and replace other purchased nutrient inputs. The value of manure nutrients should be further discounted when manure is applied on fields that do not need purchased nutrients. Current soil tests are an important tool which can identify fields where manure nutrients can best be utilized.

Negative aspects of manure application may include soil compaction, especially if manure is applied when soils are wet. There is also the risk of complaints from neighbors not accustomed to manure in their area. Fortunately, some of the same practices that help retain N (injection, rapid incorporation) also reduce complaints and can reduce the risk of manure leaving the field.

Take home points for an efficient manure nutrient recycling program

- Plan to utilize manure nutrients prior to high nitrogen-using crops.
- Minimize ammonia-nitrogen losses through application timing and method: (spring is better than fall; late fall, after soil temperatures are less than 50°F is better than earlier in the fall; injected or immediately incorporated is better than broadcast).
- Prioritize manure to fields where soil tests indicate P2O5 and K20 will produce an economic yield response.
- Current soil samples will determine which fields benefit from manure nutrients.
- Use realistic yield potentials and manure tests to determine manure application rates.
- The more nutrients in the manure, the more cost effective to haul manure; i.e. manure with storm water and wash water will be more dilute.
- Calibrate manure spreaders to achieve the desired rate; unknown or inaccurate rates can minimize the best nutrient management plan.
- *For surface applied manure:* be sure runoff does not occur. *For tile drained fields:* be sure rates of application are not creating flow to the drain system. Check tile outlets prior, during and after manure applications.
- Consider odor control measures to reduce community concerns and impacts.
- Attend Great Lakes Manure Handling Expo, July 09, 2008, London, Ohio (www.oema.osu.edu) or (www.aniamalagteam.msu.edu)

Out-of-pocket cost comparison of nutrient resources

Table 2	Phosphorus based plan, spring injected (6,250 gal/ac)	Nitrogen based plan, spring injected (10,000 gal/ac)	Nitrogen based plan, spring broadcast (10,000 gal/ac)
Fertilizer recommendations for 140 bushels/ac corn	160-30-60	160-30-60	160-30-60
Out-of-pocket cost for commercial fertilizer program	$175	$175	$175
Expected plant available nutrients (lb/ac)			
Nitrogen	100	160	100
P_2O_5	68	110	110
K_20	94	150	150
Value of manure nutrients ($/ac)	$158	$254	$209
Cost of manure application @ $17.10/ 1,000 gallon	$106	$171	$171
Additional nitrogen supplied at side-dress (60 lb/ac + $10 application)	$55	No additional nutrients recommended	$55
Out-of-pocket costs for manure nutrient utilization	$161	$171	$226