Applying Manure to Corn at Agronomic Rates

Tim and Jeremy review plant available nutrients from manure test

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Project Summary

The nutrients found in manure are valuable as crop fertilizer. However, when not managed properly, they are a potential source of surface water and ground water pollution. Water pollution commonly occurs when the combination of manure and commercial fertilizer exceeds crop demand. Our goal for this project is to demonstrate proper manure nutrient planning, manure testing, manure nutrient crediting and spreader calibration. Two Dakota County farms (a dairy and a hog enterprise) have developed manure management plans and are comparing manure to commercial fertilizer for their ability to deliver plant nutrients to row crops. In 1998, corn fertilized with manure yielded the same as corn grown with commercial fertilizer. Wet conditions in 1999 reduced nutrient availability from dairy manure but not hog manure. This coming year, we will be fine tuning the starter fertilizer to account for this.

The farmers are demonstrating an overall economic savings, showing that it pays to test manure and follow a manure nutrient management plan.

Project Description

In an increasingly urban community, manure and feedlot issues are a growing concern. Ray and Ken Taylor (Taylor Farms) and Blake Otte and Doug Wille (Square Deal Dairy) are interested in demonstrating to their neighbors that profitable agriculture does not have to come at the expense of the environment. Both Taylor Farms and Square Deal Dairy are interested in following manure nutrient management plans. Proper utilization of the manure should achieve desired crop yields and reduce commercial fertilizer expenses. Both farms realize that sound nutrient management is essential if they wish to continue farming into the next century.

Tim Becket and Jeremy Geske have developed a manure nutrient management program to benefit Dakota County farmers and the environment. Together, we provide technical, educational and financial assistance to livestock producers who want to refine their handling of manure.

In our extensive experience working with farmers, we find that many are not properly accounting for the nutrients in the manure they apply. In order for manure to be a reliable source of plant nutrition, the farmer needs to know how much is being applied. This can only be achieved by knowing the quantity of nutrients contained in the manure and the rate at which the manure is applied to the land. Farmers regularly have their soil sampled for fertility but they do not test their manure for nutrient value. Manure spreaders are not commonly calibrated for the rate of manure being applied. Thus, manure is viewed by farmers as an undependable fertilizer source. Manure and/or commercial fertilizer is then over-applied, increasing the potential for ground water and surface water pollution. This is not only harmful to water quality, but is an economic loss to the farmer when commercial fertilizer is unnecessarily applied to land that has received adequate nutrients from manure.

Farm descriptions. Taylor Farms consists of 400 acres of corn and soybeans on fine sandy loam with 2-6% slopes. The Taylors custom background 1,600 gilts. Liquid manure is sweep

injected. Square Deal Dairy is owned by Blake Otte and Doug Wille. They milk 330 cows and raise 750 acres of corn and alfalfa on a loam soil with minimal slope. Manure with bedding is broadcast and incorporated within 12 hours.

Experimental design. At both farms we used randomized field sized plots (30' x 400'), replicated three times to compare the dependability of manure nutrients with commercial fertilizer. Treatments at both farms included:

1. Commercial fertilizer at U of M recommended rate.
2. Manure at U of M recommended rate.
3. Control (no fertilizer).

Manure application rates at both farms were based on projected nitrogen availability from a laboratory manure analysis (see sample manure analysis for Taylor Farms in Table 1) and nitrogen needs of the corn based on standard U of M criteria (see sample manure rate calculations for Taylor Farms in Table 2). In 1998, a fourth treatment included manure applied at twice the recommended rate to demonstrate the wastefulness of such a practice. This treatment was discontinued in 1999.

On July 2, 1998, corn leaf tissue was tested for nitrogen status using a chlorophyll meter. The meter actually measures leaf "greenness". A greener leaf means more chlorophyll and better nitrogen nutrition. This method of monitoring nitrogen status was not uniformly dependable in 1998. We would not have been able to use the technology to deliver a metered nitrogen sidedress so the activity was discontinued in 1999.

We wanted to show that following a sound nutrient management plan would be financially beneficial to the farm so we tracked the fertilizer replacement value of the manure.

Table 1. Sample Analysis: Taylor Farms Liquid Hog Manure

Nutrient	%	lb/gal
Nitrogen	0.17	0.014
Phosphorus	0.05	0.004
Potassium	0.13	0.010

Results

1998. At Taylor Farms, the corn fertilized with hog manure had the highest average yields (see Table 3 on next page). Statistically, yields with hog manure were similar to yields with commercial fertilizer. The control treatment (no fertilizer or manure) had the lowest yields. Over-application of manure did not produce higher yields.

Yield results at Square Deal Dairy were consistent with Taylor Farms. Again, well managed manure was competitive with commercial fertilizer. Overall yields were lower due to extremely wet conditions. We were surprised that the surface applied, unincorporated manure produced approximately the same yield as the incorporated manure.

1999. As expected, the plots fertilized with hog manure at Taylor Farms produced identical yields to those fertilized with commercial fertilizer. By following the nutrient management plan, the Taylors were able to achieve their 140 bushel yield goal and save money on fertilizer.

Yields at Square Deal Dairy were affected by wet weather. Overall yields were low and manured plots yielded significantly less than commercially fertilized plots but still much higher than the unfertilized control. This is likely due to the high amount of organic nitrogen in the dairy manure (compared to the Taylor's hog manure). Wet conditions on the heavier soil slowed the early season release of nitrogen from the organic form. For the 2000 growing season, we plan to increase the amount of starter fertilizer nitrogen in these plots to supplement the dairy manure.

Chlorophyll meter readings on July 2, 1998 were only able to predict the low yields in the control plots at Square Deal Dairy (data not shown). All other treatments showed no difference in nitrogen status as measured by leaf greenness.

We wanted to show that farmers could benefit economically by following a sound manure nutrient management plan. Taylor Farms has incorporated the information from the first year of this demonstration into their fertilizer program. As a direct result of manure testing and better planning, they are now able to fertilize 160 acres of corn exclusively with liquid hog manure. They achieved a savings of $31.90/A or $5,100 in reduced commercial fertilizer cost in 1999. Nitrogen savings alone were $16.25/A (125 lb x $0.13/lb) or $2,600 over the whole farm.

Table 2. Sample Calculation: Taylor Farms Manure Application Rate to Corn

	1998	1999
Crop	corn	corn
Yield goal	140 bu/A	140 bu/A
Previous crop	soybeans	corn
Soil organic matter	low	low
N requirement	110 lb/A	150 lb/A
2nd year N credit	0 lb/A	32 lb/A
3rd year N credit	8 lb/A	0 lb/A
N to apply in manure	102 lb/A	118 lb/A
Actual manure rate	11,400 gal/A	5,700 gal/A
N from manure	104 lb/A	87 lb/A
N from fertilizer	0 lb/A	27 lb/A

Table 3. Grain Yield: Manure vs. Commercial Fertilizer

Site	Fertilizer	1998 Yield (bu/A)	1999 Yield (bu/A)
Taylor Farms	Liquid hog manure, injected	168	154
	Commercial	167	152
	Control	131	117
	Double rate hog manure	153	--
Square Deal Dairy	Solid dairy manure, incorporated	135	131
	Commercial	143	150
	Control	77	67
	Double rate dairy manure	138	--
	Dairy manure left on surface	133	--

The cost of engaging in the nutrient planning process is simply the cost of manure nutrient sampling plus the time invested in working through the plan. Manure samples currently range from $12-$20. They should be taken for three consecutive years to build a dependable baseline for each farm. Farmers should expect to spend between one-half and one day to work through a nutrient management plan, depending on the complexity of the operation. Two hours will be invested in sampling manure and spreader calibration. With all those nutrient dollars waiting to be captured from the manure, we hope more farmers will engage in a similar planning process.

Our goal to show the dependability of manure as a primary nutrient source is supported by this demonstration. We have also shown that over-application of nutrients, whether from manure or commercial fertilizer, does not increase yields, wastes money and risks a potential pollution hazard.

Management Tips

1. Test your manure for nutrient content.

2. Calibrate your spreader for actual manure delivery rate.

3. Contact local professional staff to help build a nutrient management plan.

4. Monitor crop response to tailor your plan to your resources.

Cooperators

Ray and Ken Taylor, Northfield, MN
Blake Otte and Doug Wille, Randolph, MN

Project Location

To Taylor demonstration: go north on Hwy 3 from Northfield 1 mile to Hwy 47. Go northeast 1 mile to Cty Rd 94. Go east 1 1/2 miles to Cty Rd 59. Go south 1/4 mile to farm on 310th St. E.

To Square Deal Dairy demonstration: go southwest on Hwy 47 from Hampton 1 1/2 miles to Cty Rd 83. Go south 2 miles to farm on northwest corner of Cty Rd 83 and 270th St E.