Feedlot Manure Utilization as Influenced by Application Scheme and Diet

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Summary

The BFNMP$ program was utilized to study effects of dietary nitrogen (N) and phosphorus (P), and N volatilization on economics of manure utilization. Feeding high CP (18.7%) and P (0.5%) diets increased manure net value $6.92/head compared to manure with a traditional diet (13.3% CP and 0.3% P) being fed. Spreading this manure on a four-year P basis is economical and environmentally friendly.

Introduction

The Beef Feed Nutrient Management Planning Economics (BFNMP$) computer program (available at *http://water.unl.edu/web/manure/software*; described in the *2006 Nebraska Beef Cattle Report,* p. 98; *2008 Nebraska Beef Cattle Report,* p. 59; and *2009 Nebraska Beef Cattle Report,* p. 89 can assist producers in understanding the impacts manure handling changes could have on their operation. The BFNMP$ program calculates manure management economics based on animal nutrient intake, manure nutrient availability, land requirements for spreading, operating costs, and fertilizer value. These values can be altered to fit individual operations or to look at industry averages. The first objective of this study was to look at the impacts of changing dietary nitrogen (N) and phosphorus (P) from levels found in a traditional grain-based diet to higher levels more indicative of a diet with 40% inclusion of distillers grains. A second objective was to study the effect of different N volatilization rates. A final objective was to evaluate the impact of changing manure application rates from N to P based and from one- to four-year rates.

Procedure

Several scenarios comparing diets (Table 1), N volatilization rates, and application rates (Table 2) were developed. While comparing scenarios, all other factors in the model were constant. The feeding scenario fed out 5,000 head of cattle per year in 100 head pens from 750 to 1,300 lb with 144 days on feed. Equipment used to clean pens included a four-yard loader and 20- ton truck-mounted spreader with $3.00/gallon fuel and a labor rate of $12/hour. Fifty percent of the land around the feedlot was accessible to spread manure on, 50% of which would be in corn each year with a corn and soybean rotation. Corn yields were set at 157 bu/ac and soybean yields at 42 bu/ac, which represent average yields in the United States from 2008-2010 (USDA-NASS). Fertilizer was valued at $0.55/lb N, $0.67/lb P, and $0.53/lb K ($0.25/lb urea, $0.30/lb P_2O_5, $0.32/lb K_2O). These represent three-year average prices paid in 2008-2010 for urea, P_2O_5, and K_2O in the north central region of the United States (USDA-NASS).

Results

An extensive survey of 29 feedlot nutritionists (*Journal of Animal Science*, 85:2772) looked at nutrient concentrations in feedlot diets. They found that, on average, feedlot diets, on a DM basis, are 13.3% CP, 0.7% Ca, 0.3% P, and 0.7% K. Based on this, two scenarios were evaluated, one with 13.3% CP and 0.3% P, and a more nutrient dense diet that would

Table 1. Impact of diet, N volatilization, and application rate on manure value and costs for a 5,000-head feedlot.

Diet	N volatilization	Application rate	Nutrient value[1], $/hd	Total cost, $/hd	Net value[2], $/hd	Average miles	Maximum miles
13.3% CP, 0.3% P	70%	N 1 year	18.18	6.26	11.92	0.2	0.4
13.3% CP, 0.3% P	50%	N 1 year	21.53	7.39	14.14	0.4	0.7
13.3% CP, 0.3% P	20%	N 1 year	26.55	8.96	17.59	0.6	0.9
18.7% CP, 0.5% P	70%	N 1 year	24.76	7.06	17.70	0.3	0.6
18.7% CP, 0.5% P	50%	N 1 year	29.70	8.64	21.06	0.5	0.9
18.7% CP, 0.5% P	20%	N 1 year	37.11	10.96	26.15	0.8	1.2
18.7% CP, 0.5% P	50%	N 1 year	29.70	8.64	21.06	0.5	0.9
18.7% CP, 0.5% P	50%	P 1 year	29.70	19.68	10.02	1.4	2.1
18.7% CP, 0.5% P	50%	P 4 year	29.70	9.35	20.35	1.4	2.1

[1]Based on inorganic fertilizer values of $0.55/lb N, $0.67/lb P, and $0.53/lb K. This does not take into account that when spreading on a one-year N rate every year there will be a buildup of P, which would decrease the value of the manure in subsequent years because the P is no longer needed.
[2]Net value accounts for increased value of manure with less N volatilization, but does not account for increased costs in order to achieve this.

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Table 2. Impact of manure application rate on land requirements and crop N and P requirements.

Diet[1]	Application rate	Manure N, lb/year[3]	Manure P[2], lb/year[3]	Crop N required, lb/year	Crop P[2] required, lb/year	Land required, acres	Land required, acres/year
13.3% CP, 0.3% P	1 year N	76,163	78,534	76,163	25,387	672	672
13.3% CP, 0.3% P	4 year P	76,163	78,534	59,040	78,534	2,072	518
18.7% CP, 0.5% P	1 year N	112,336	148,425	112,336	37,490	995	995
18.7% CP, 0.5% P	4 year P	112,336	148,425	111,096	148,425	3,944	986

[1]Assume 50% N volatilization for all diets.
[2]P_2O_5.
[3]Crop available nutrients.

be typical of a 40% distillers grains diet with 18.7% CP and 0.5% P (*2006 Nebraska Beef Cattle Report,* p. 51).

Manure from cattle fed a traditional grain based feedlot diet, with 70% N volatilization, had a fertilizer value of $18.18/head (Table 1). This represents the value of all nutrients (N, P, and K) in the manure, but the actual value of the manure may be different if all nutrients are not utilized. Manure from cattle fed the same diet during the winter with 50% N volatilization was worth $21.53/head. When N volatilization was reduced to 20%, the manure value was $26.55/head. A more nutrient dense diet, i.e., 40% distillers grains, had a manure value of $24.76/head, $29.70/head, and $37.11/head for 70%, 50%, and 20% N volatilization, respectively. The best way of decreasing N volatilization is to clean pens more frequently; most likely this would increase costs as well as value of the manure. The increased cost of transporting and applying this manure is accounted for in the model.

Table 2 compares manure from the two different diets, with a constant 50% N volatilization, to show nutrient differences due to applying on a one-year N or four-year P rate. When manure is spread to meet N requirements of corn for one year, approximately four times the required amount of P is spread. If this is repeated every year there will be buildup of P in the soil and increased risk of P runoff into streams and lakes. Once P buildup occurs, future applications of manure are worth less because the P no longer has any value. If manure is spread to meet P requirements of corn for one year, then another source of N, such as anhydrous ammonia, will need to be added to the field. This requires going over the field twice each year to spread fertilizer, which is costly and unnecessary. In order to overcome both of these challenges, manure can be spread on a four-year P basis. The cost to spread on a one-year N rate is $8.64/head and requires the feedlot to travel an average of 0.5 miles around the feedlot to crop fields. Spreading on a one-year P rate increases this cost to $19.68/head and traveling to 1.4 miles. If the manure is spread on a four-year P rate, the cost is $9.35/head but the distance is still 1.4 miles because only one-fourth of the crop fields around the feedlot are being used each year. When applied on a four-year P rate, manure N closely matched crop N requirements for one year. For the four-year P application rate, total acres required to spread on are 2,072 or 3,944 for the low and high nutrient density diets, respectively. However, each year only 518 or 986 acres will be needed. By applying on a four-year P rate producers can avoid the environmental hazards of over applying P and get the most value out of the manure.

In conclusion, increasing dietary N and P increases excretion of these nutrients. Capturing these nutrients in the manure increases costs, but increases manure value at a greater rate. Spreading on a four-year P basis costs approximately the same as spreading on a N basis, but requires about three times the acres. However, spreading on a N basis results in buildup of P, which will lead to decreased value of the manure. Spreading on a one-year P basis is expensive and unnecessary. Fertilizer prices have increased dramatically in recent years which has renewed interest in manure fertilizer and enhanced the value of manure.

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