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Farm Trial Results – Hay Fertilization Demonstration Project

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Objectives:

- To evaluate the use of broiler litter applied to hay land on a Vancouver Island farm.
- To demonstrate broiler litter value as a fertilizer replacement.
- To conduct a cost comparison of poultry manure to chemical fertilizer.

Design, Sampling and Analyses:

This trial was conducted on two areas within one field. There were 4 treatments , a low and high rate of poultry manure, a farm rate of fertilizer and a check treatment. Treatments were laid out in a randomized complete block design with three reps.

In this demonstration, treatments were applied on May 8, 2003. Poultry manure (litter) was applied at 3.5 (low rate) and 5 (high rate) tons/acre, fertilizer (23-8-14) was applied at 400 lbs/ac, while the check treatment had no fertility addition.

Soil samples were taken at three times during the 2003 cropping season: May 3 (before manure application), June 19, and Sept 26, 2003.

Hay yield was calculated from the area represented by cutting a 2 foot wide strip through the middle of each plot. Yield was sampled on June 19, 2003. A second yield measurement was not possible due to very dry field conditions which did not allow further grass growth for another sampling.

Soil and hay samples were sent to Norwest Labs, Langley, B.C. for analysis.

Results:

Treatments

Nutrients Applied

Table 1 indicates nutrient application and manure application rates including estimates for nutrient availability for the trial, while Table 2 identifies the nutrient content of manure applied.

Table 1 Nutrient Application Rates and Estimated Availability at the Trial Site

Treatment	Total Nitrogen	Available Nitrogen	Total Phosphorus	Available Phosphorus	Total Potassium	Available Potassium	Poultry Litter
	---------- lb / ac ----------						- tons /ac -
Poultry Manure – low rate	319	160	225	115	110	100	3.5
Poultry Manure – high rate	460	230	325	165	160	145	5
Fertilizer	92	83	32	13	56	53	na

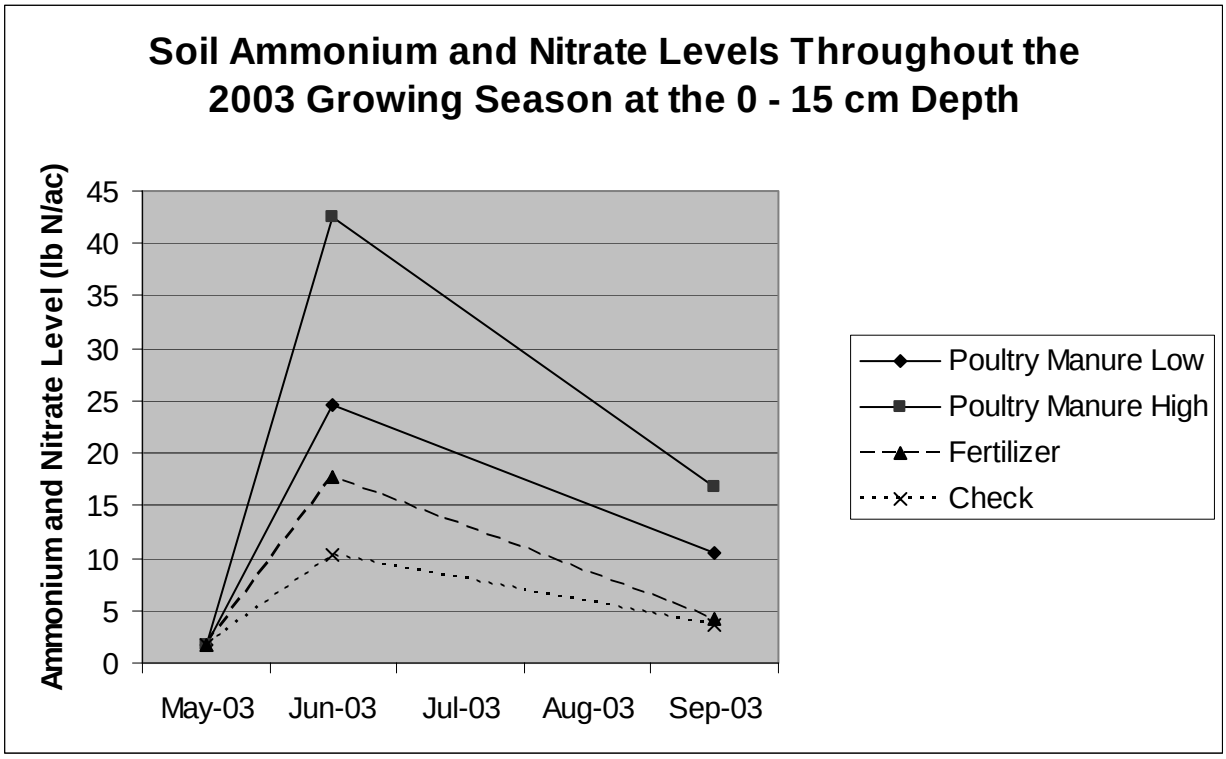
Table 2 Poultry Manure Analysis (as sampled – expressed as % unless otherwise indicated)

Elemental Composition	Concentration (as sampled)	Elemental Composition	Concentration (as sampled)
Total Nitrogen	4.56 %	Magnesium	0.469 %
Organic Nitrogen	3.94 %	Calcium	1.55 %
pH	7.0 %	Selenium - estimated	5 ppm
Total Sulphur	0.40 %	Sodium	0.327 %
P2O5	3.21 %	Moisture	18.8 %
K2O	1.57 %		

Soil Nitrogen - Response to Treatments

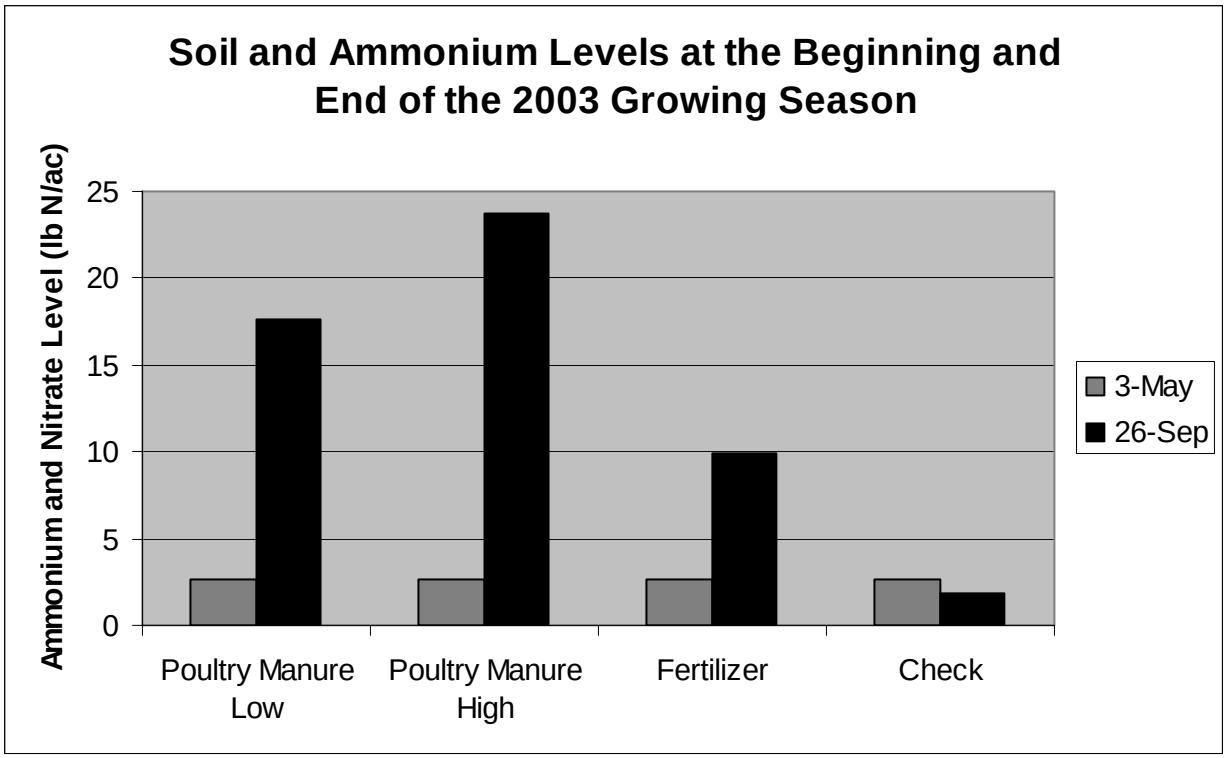
Figure 1 indicates the increase in soil nitrogen in the top 15 cm of soil found at three different dates: May 13– before manure application; June 19 - after first cut; and Sept. 26– at season end.

Figure 1



From Figure 1, results from the June 19 sampling show a higher level of soil nitrogen available for crop uptake in both low and high rates of poultry manure (24.6 lb N/ac for the low rate and 42.6 lb N/ac for the high rate) with correspondingly lower amounts for the check (10.3 lb N/ac) and fertilizer treatment (17.7 lb N/ac). The addition of poultry manure increased the available nitrogen in mid-June by about 14 lb N/ac, and 32 lb N/ac for the low and high rates, respectively over that of the check treatment while the fertilizer treatment resulted in an increase of about 7 lb N/ac.

Figure 2



From Figure 2, September soil sampling suggests a substantial amount of residual nitrogen exists for both low and high rates of poultry manure that is available for crop assimilation. The dry climatic conditions evident this season influenced soil nitrogen levels in at least two ways. Firstly, grass growth was curtailed after the first cut which did not allow a proper evaluation of second cut yields, and secondly, it is likely that release of nitrogen from the manure treatments was hindered due also to low soil moisture conditions. If more rainfall had occurred during this trial, then a considerable amount of the residual nitrogen could have been used to increase crop growth, and a greater amount of nitrogen could have been released from the manure treatments.

Hay Yield and Quality Results

In this evaluation, hay yields for first crop were higher for poultry manure treatments by 1.5 tons/ac for the low rate and 1.6 tons/ac for the high rate over that of the Check treatment. Fertilizer treatment yields were 1.2 tons/ac above the check treatment (see Fig.3). Yield for second crop was too small to be sampled because of poor re-growth due to extremely dry soil conditions.

Hay crude protein content followed a somewhat similar pattern to yield. A higher crude protein content for poultry manure treatments was found for the low rate (18.2 %) and high rate (19.1 %) than was noted for the fertilizer (15.4 %) and check (12.7 %) treatments.

Hay yield and/or crude protein content results reflect soil nitrogen sampling results at the mid-June soil sampling date. In the case of the poultry manure treatments, soil nitrogen levels were higher than the other treatments. These higher nitrogen levels resulted in both a higher crop yield and crude protein content of the crop.

From Figure 4, both Relative Feed Value and TDN indicators suggest that the feeding value of the grass harvested from both poultry manure plots is greater than that of the check or fertilizer treatments. The highest score was achieved by the low rate of poultry manure for both indicators.

Figure 3

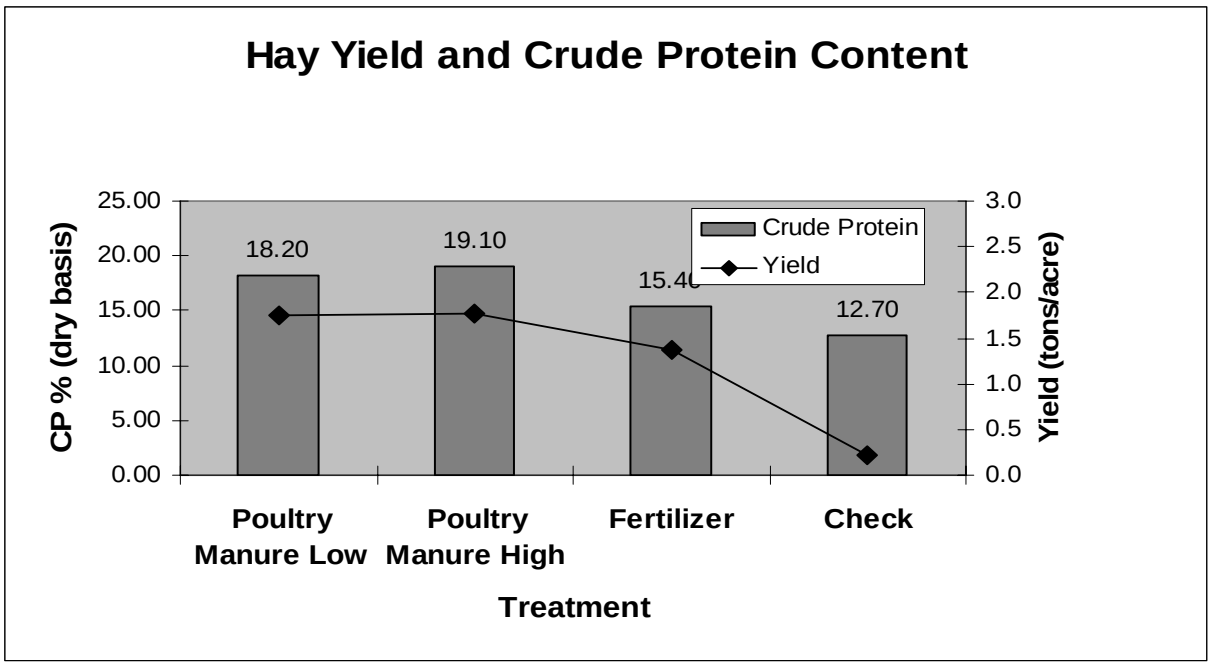
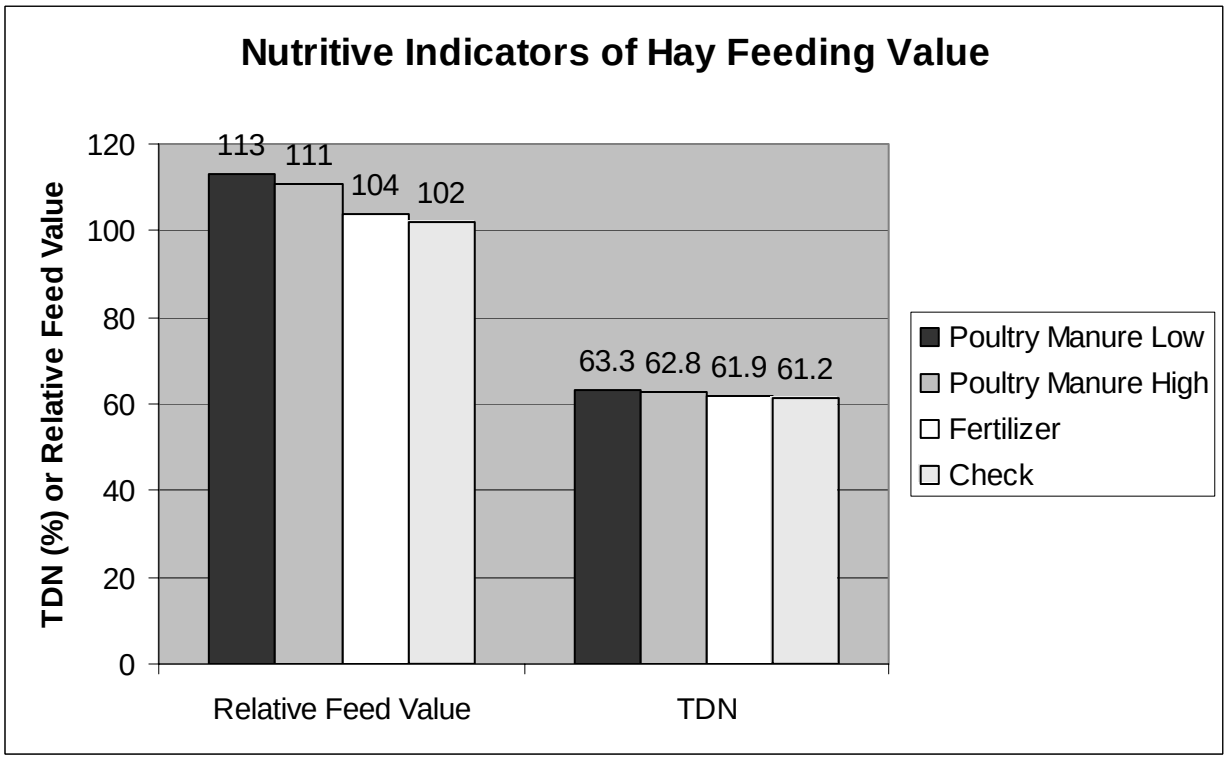


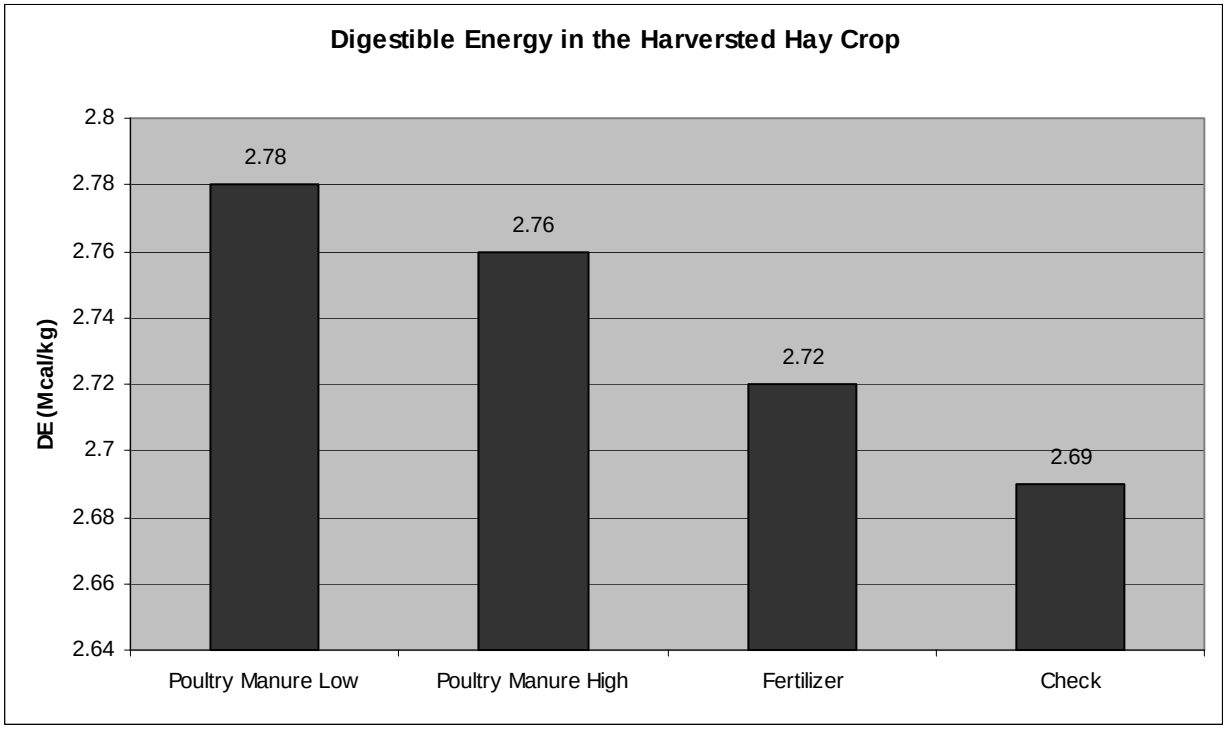
Figure 4



Digestible Energy

Below, Figure 5 shows average Digestible Energy values for the hay crop. Digestible Energy, appeared to be slightly higher for the poultry manure treatments over both the fertilizer and check treatments.

Figure 5

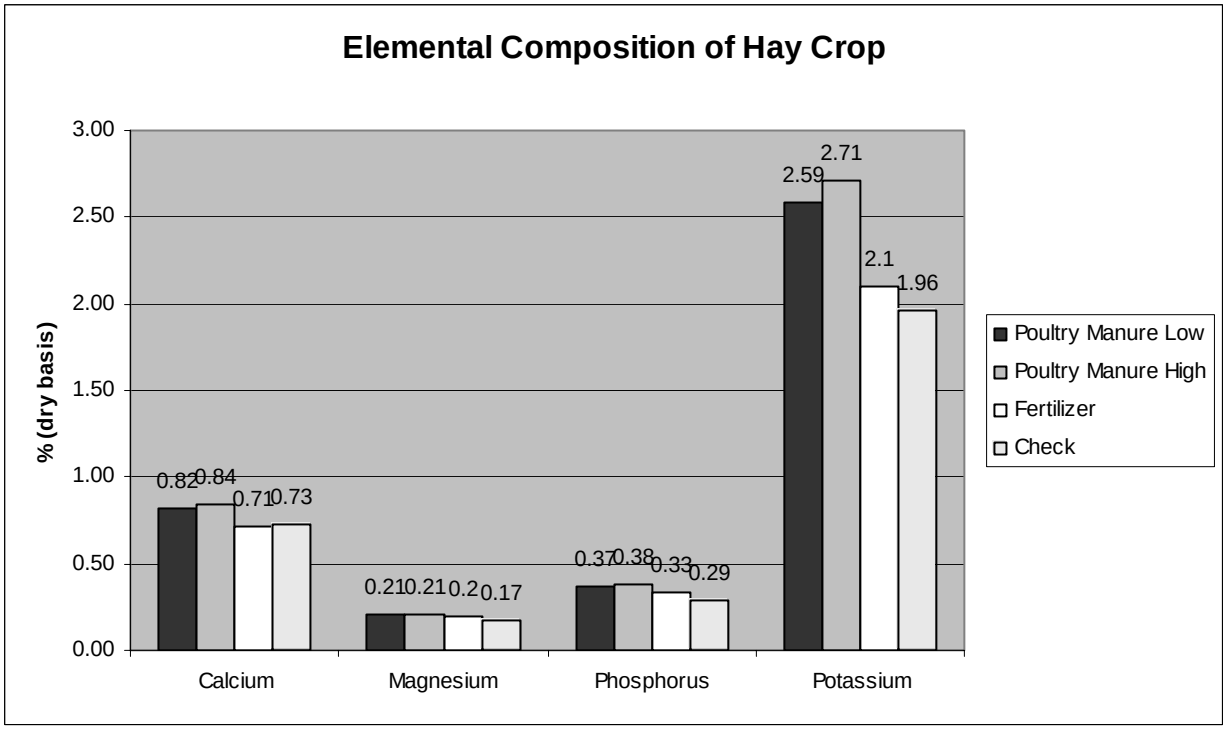


Effect of Treatments on Other Nutrients

Crop Phosphorus

Figure 6 below identifies potassium, magnesium, calcium, and phosphorus levels found in the hay crop. Crop phosphorus level was enhanced by 15 – 29 % through addition of poultry manure at both rates used in this study over both the fertilizer and check treatments. An increase in crop phosphorus is considered to be nutritionally beneficial to cattle. In addition, both rates of poultry manure resulted in higher crop calcium levels.

Figure 6



Grass Tetany

One method of examining potential grass tetany problems in hay is to compare identified crop magnesium level to that of a reference value. Using this method, magnesium levels greater than 0.2 % are not considered risky and suggest that a possible nutritional imbalance is not likely to occur possibly resulting in grass tetany. In this study, magnesium levels were found to be 0.17, 0.21, 0.21, and 0.20 % for the check, poultry manure low rate, poultry manure high rate and fertilizer treatments, respectively. While the check treatment had the lowest magnesium level, little difference was found in magnesium level between the three treatments and all were close to 0.2 %. As such, they were considered marginal as a feed risk from the standpoint of inducing grass tetany in cattle.

Hay potassium content can also effect a nutritional imbalance possibly leading to grass tetany. In this trial, hay potassium content varied for all treatments. Average levels of potassium found were 1.96, 2.59, 2.71, and 2.1 % for the Check, Poultry Manure low, Poultry Manure high, and Fertilizer treatments, respectively. All treatments had potassium levels significantly lower than 3 %. Hay potassium is considered risky when levels exceed 3 %.

Poultry Manure Use - Cost versus Benefit

Table 3 shows a simplified cost/benefit analysis for Fields #1 and #2 of the manure, chemical fertilizer and control treatments for a single cut of hay in July, and a hypothetical second crop of hay with an estimated yield reduction of 30 % lower than the fist crop. From Table 3, yields and the crop value achieved are tabulated. These yields resulted in an increased crop value from applied treatments of $570/acre, and $400/acre for both of the poultry manure, and fertilizer treatments, respectively over that of the check treatment. After subtracting actual fertilizer product costs and estimated application costs, an actual return to treatment cost of $312.35 - $335.50/ac and $197.50 for the Poultry Manure and Fertilizer treatments, respectively, was generated.

Table 3 Comparative Cost and Return from Manure and Fertilizer Treatments

	Poultry Manure – Low rate	Poultry Manure – High Rate	Fertilizer	Check
		- - - - tons/ac - - - -		
Yield 1st Crop (15% moisture)	2.1	2.1	1.6	0.3
Yield2nd Crop (15% moisture) - Estimated	1.5	1.5	1.1	0.3
Total Yield	3.6	3.6	2.7	0.6
		- - - - $/ac - - - -		
Market Value of Crop	685	685	515	115
Differential Market Value[1]	570	570	400	na
		- - - - $/ac - - - -		
Cost for Fertility Addition	83	119	77.50	na
Cost for Application	16.50	23.65	10	0
Total Fertility Costs	99.50	142.65	87.50	na
Return from treatment	**470.50**[12]	**427.35**	**312.50**	**115**

[1] Differential Market Value - the difference in crop market value (accruing from yield increase) obtained from that treatment over the check or control treatment

Cost and Benefit factors used in the analysis were as follows:

- delivered manure cost was considered to be $750 per load or $7.50 per cubic yard or $23.80/ton
- manure application rate of 3.5 tons and 5 tons per acre was considered equivalent to about 11 and 15.8 yards per acre, respectively

- chemical fertilizer costs were considered to be $425/tonne for 23-8-14 analysis fertilizer used in test.
- manure application cost was estimated to be $1.50 per cubic yard
- no benefit was given to higher nutrient quality of hay achieved through manure application or to increased soil quality and nutrient status through the long-term addition of manure
- value of hay crop was considered to be $190/ton
- although no actual harvest was realized for the second crop due to the dry weather conditions, yield was estimated to be the same as the first harvest minus 30 %

Other Considerations

Residual nutrients - In this analysis, no mention has been made for the residual nitrogen value contributed from poultry manure to the crop in succeeding years. In the year after application, poultry manure is considered capable of releasing an amount equivalent to about 20 % of the total nitrogen (after losses) applied during the year of application. If this amount were factored in calculations, further cost-savings would result in the future, since manure application rates could be reduced. As well, phosphorus levels in the soil will slowly increase over time and increase the phosphorus level in the crop.

Fertilizer results – some caution is required in extrapolating the fertilizer treatment yield to the second crop since soil sampling results indicated that less chemical fertilizer nitrogen would be available to the second crop than for the poultry manure treatments. With less fertilizer nitrogen available, yields could be lower than the 30 % yield reduction assumed in the economic analysis in this report.

Crop Quality – no additional value was given to the harvested crop for increased crude protein content, higher phosphorus levels, etc. Due to the difficulty in attaching such a value, the reader of this report will have to assign a value based on his/her own experience.

Conclusions:

Yields and crop quality were increased through use of poultry manure over that of the fertilizer and control treatments. Both poultry manure treatment rates yielded similarly. Since both treatments yielded similar amounts, the highest return was achieved at the lower rate of 3.5 tons/acre due to lower input costs. Generally, the highest crop quality resulted from the poultry manure treatment.

Risk of Grass Tetany was found to be low due to magnesium and potassium crop levels that were within acceptable limits across all treatments.

The cost versus benefit comparison for the rates used were positive for the poultry manure treatment. Return from fertility treatment was from $115.00 to $158.00/acre greater than the return for the fertilizer treatment in this trial. This return included the delivered manure product and application cost.

Recommendations:

Poultry manure application at 3.5 or 5 tons per acre provided a considerable cost saving for nutrient inputs in hay production relative to chemical fertilizer or no fertility input. For continued application of poultry manure, a lower application rate of 3.5 – 4 tons/acre should continue to increase yields as higher nutrient levels become established in these fields and yield further cost savings.

Acknowledgements

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