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Farm Trial Results – Hay Fertilization Demonstration Project

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1.0 Objectives:

- To evaluate the use of broiler litter applied to hayland on a BC Interior farm.
- To demonstrate broiler litter value as a fertilizer replacement.
- To conduct a cost comparison of poultry manure to chemical fertilizer.

2.0 Design, Sampling, and Analyses:

This trial was conducted on two areas within one field. There were 5 treatments (identical for each area), a low and high rate of poultry manure, a low and high rate of fertilizer and a check treatment. In each area, treatments were laid out in a randomized complete block design with two reps. Area 1 represented a location in the field which had better physical and chemical characteristics for enhanced plant growth while Area 2 had more challenging characteristics.

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 (19-18-18) was applied at 100 (low rate) and 200 (high rate) lbs/ac, while the check treatment had no fertility addition.

Soil samples were taken at three times during the 2003 cropping season: May 8 (before manure application), June 17, and Sept 19, 2003.

Hay yield was calculated from the area represented by cutting a 2 foot wide strip through the middle of each plot.

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

3.0 Results:

3.1 Nutrients Applied to Each Treatment

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 – low rate	19	17	8.3	5	16	14	0
Fertilizer – high rate	38	35	17	10	32	28	0

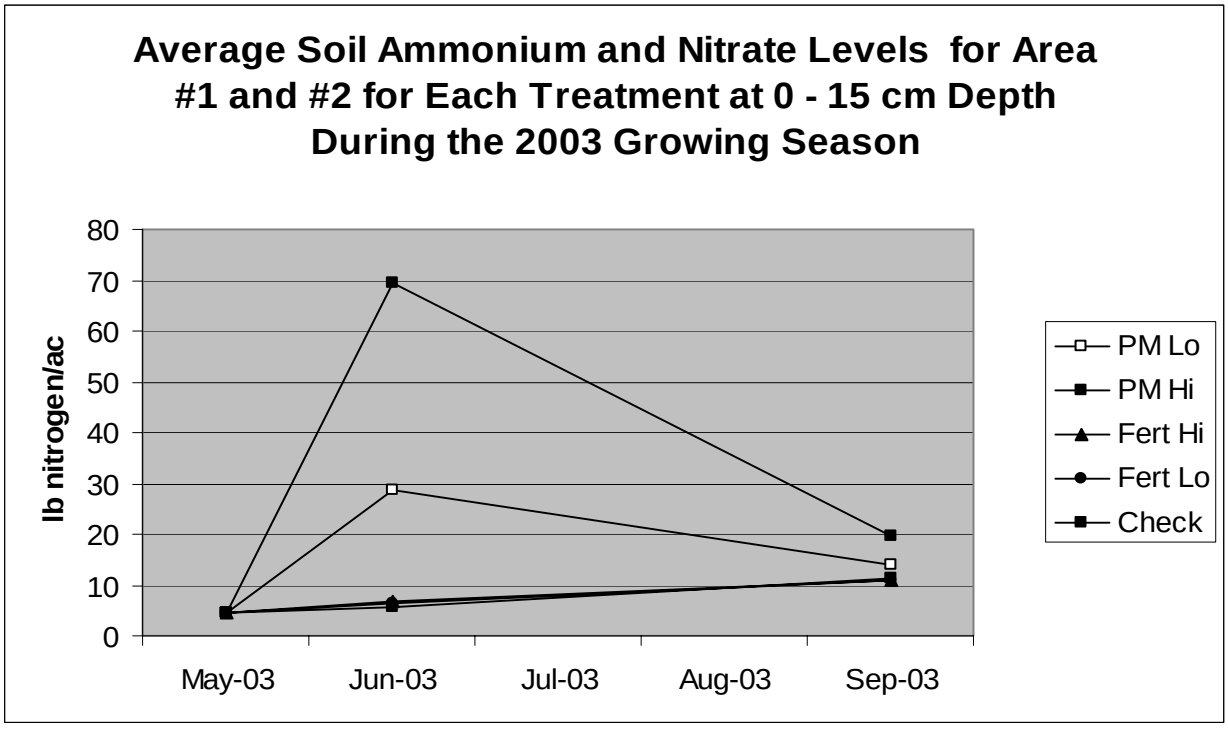
Table 2 Poultry Manure Analysis (as sampled – expressed as % unless otherwise indicated)

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	4.52 ppm
Total Sulphur	0.40 %	Sodium	0.327 %
P2O5	3.21 %	Moisture	18.8 %
K2O	1.57 %		

3.2 Soil Nitrogen - Response to Treatments

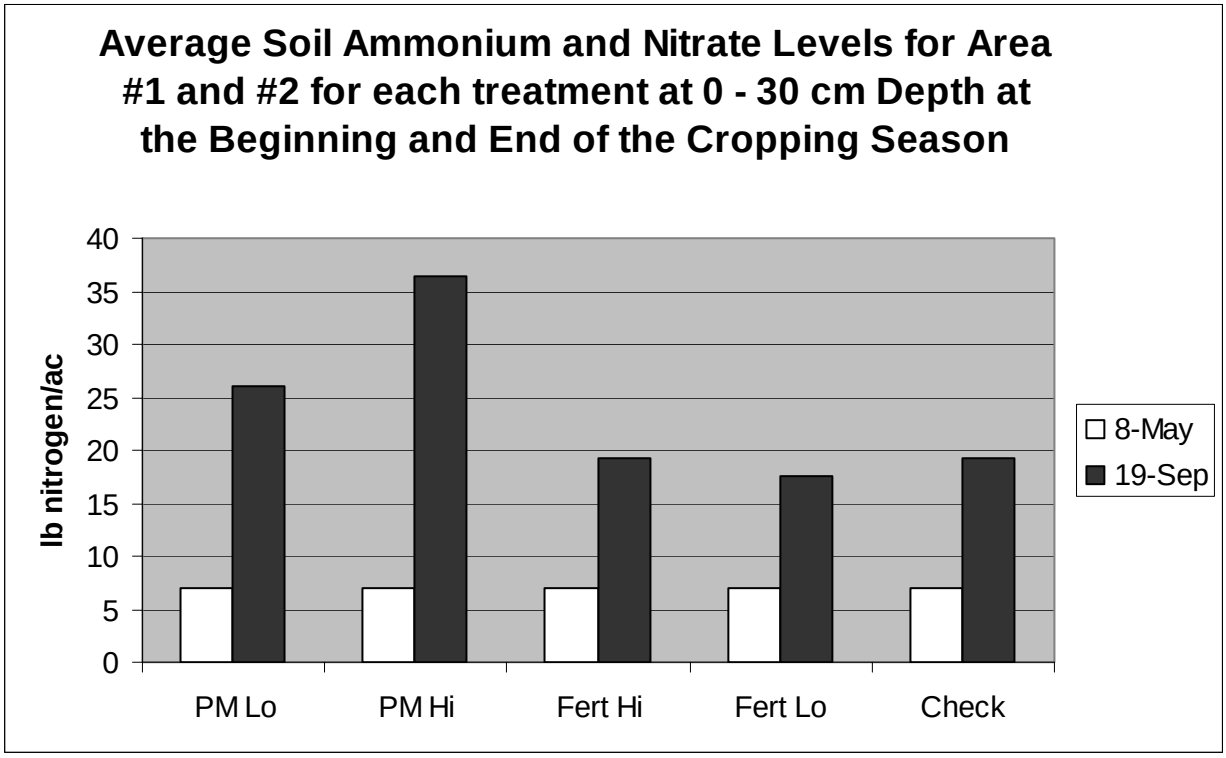
Figure 1 shows the change in soil nitrogen found at three different dates: for May 8 – before manure application to June 17 - after first cut, and September 19 - at season end.

Figure 1



Results from the June 17 sampling show a higher level of soil nitrogen available for crop uptake in both fields treated with poultry manure (29 lb N/ac for the 1ow rate and 63 lb N/ac for the high rate), while similar, but lower amounts were found for the check and both fertilizer treatments (about 5 lb N/ac). Average increases in available soil nitrogen for poultry low and high rates were 24 and 58 lb N/ac, respectively over the check and both fertilizer treatments.

Figure 2



From Figure 2, September soil sampling suggests a substantial amount of residual nitrogen exists for both low (26 lb N/ac) and high rates (36 lb N/ac) of poultry manure that is available for crop assimilation, in comparison to the check and both fertilizer treatments (about 18 – 19 lb N/ac). 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.

3.3 Hay Yield and Quality Results

In this evaluation, hay yield for the second crop was significantly affected by the excessively dry summer climatic conditions experienced from July until mid-September. Yields for the second cut were almost too low to harvest.

First Crop

For the first crop in Area #1, Figure 3 & 4 indicates that the highest average yield was found to be the same for both the high rate of fertilizer and poultry manure, while the lower rate of poultry manure yielded slightly lower. As shown in Figure 4, the high rate of poultry manure in Area #2 yielded about 39 % higher than the check treatment and about 5 – 9 % higher than the rest of the treatments.

For Areas #1 and #2 (Figures 3 & 4), in each area the highest crude protein content (about 30% higher) was found for both poultry manure treatments over both the fertilizer and check treatments. TDN was found to be similar between treatments.

Figure 3

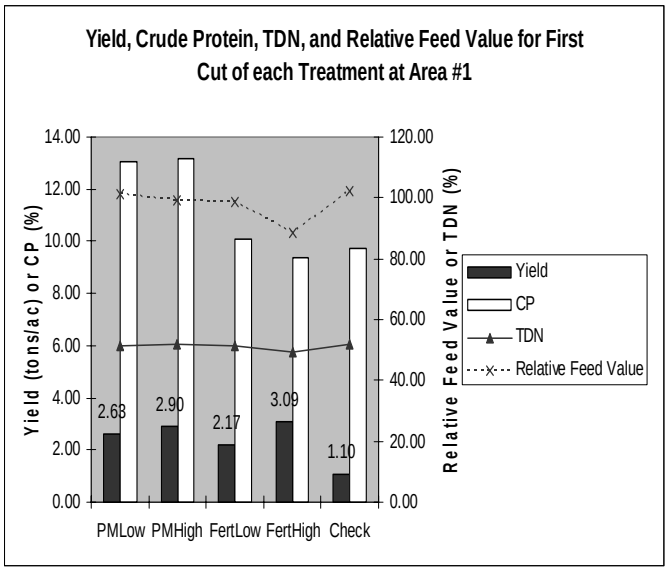
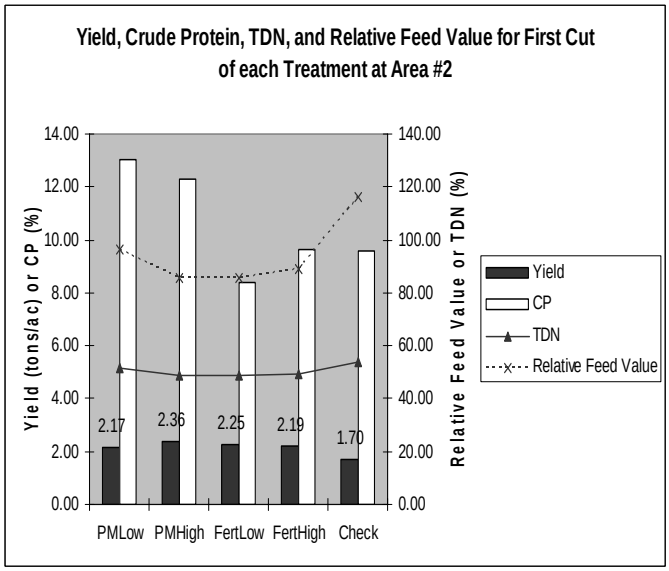


Figure 4



Second Crop

The second crop yielded much lower for all treatments and both areas (Figures 5 and 6). The only treatments with yields different from the check treatment were both poultry manure treatments in both area #1 and #2. The poultry manure treatments, although low in yield were consistently higher (by a factor of 2 – 10 times) than all other treatments for both areas. Yields were similar for both fertilizer and check treatments. The application of poultry manure appears to have slightly reduced the effect of the dry soil conditions on crop yield.

Figure 5

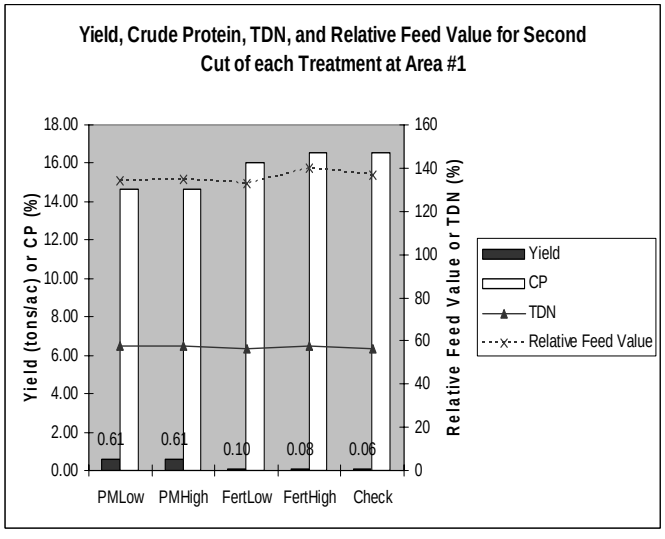
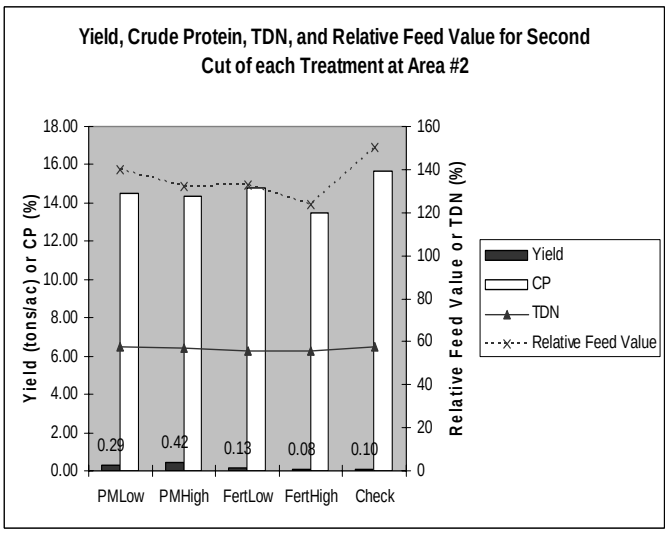


Figure 6



In a dry soil, nutrients when present are rendered less available. Figure 1 and 2 indicate substantially higher levels of soil nitrogen from poultry manure treatments. It is likely that this nitrogen was not able to be assimilated by the second crop due to the dry soil conditions.

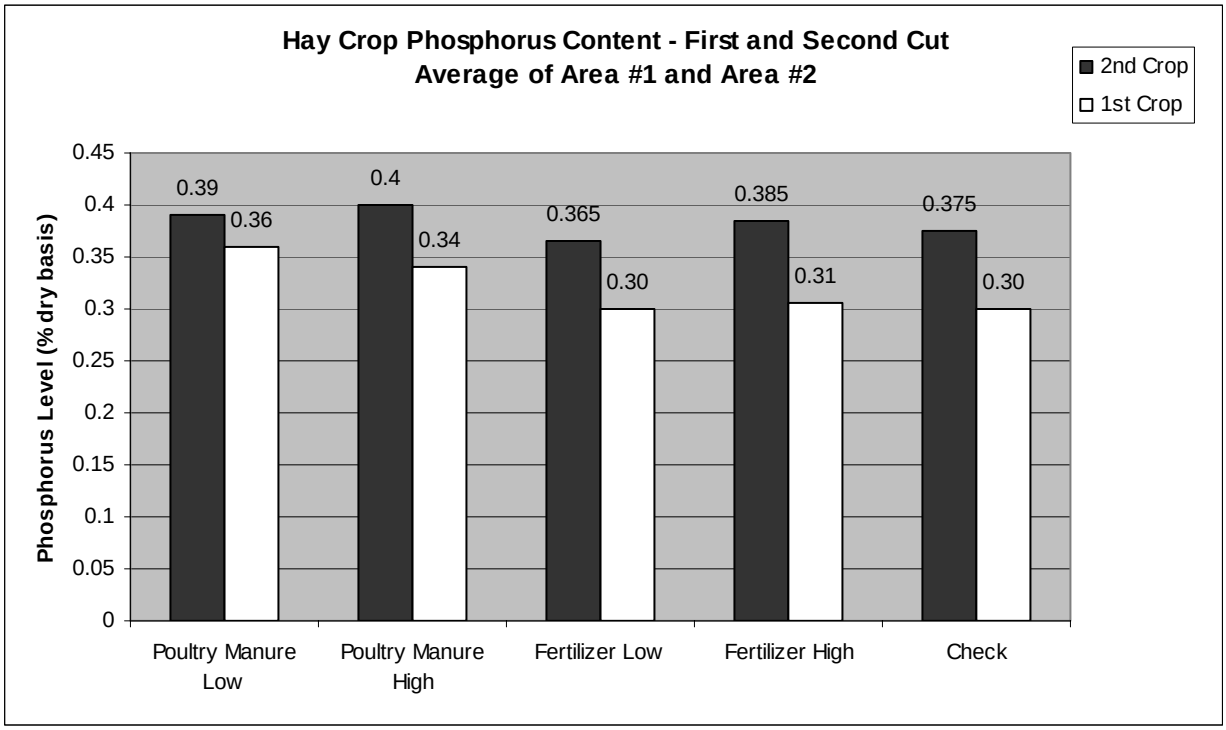
In a similar way to the first crop, TDN showed little response to the poultry manure treatments for the second crop.

3.4 Effect of Treatments on Other Nutrients

Crop Phosphorus

Figure 7 below identifies phosphorus levels found in the hay crop. Crop phosphorus level was enhanced by up to 21 % for the high poultry manure treatment over the check or fertilizer treatments for the first crop. The second crop showed a similar pattern with an increase of phosphorus level of up to 20 % in comparison to fertilizer and check treatments. An increase in crop phosphorus is considered to be nutritionally beneficial to cattle.

Figure 7



Grass Tetany – Potassium, Calcium, and Magnesium

One method of examining potential grass tetany problems in hay is to compare identified treatment crop magnesium levels to that of a reference value. Using this method, magnesium levels greater than a 0.2 % reference value are not considered risky and suggest that a nutritional imbalance which could result in grass tetany is not likely to occur. In this study, magnesium levels were found to be about 0.2 % for all treatments for the first crop and from 0.23 – 0.27 % from treatments for the second crop. Magnesium levels were considered adequate to good when considering the reduction of feed risk for 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 was in a similar range for all treatments. Average levels of potassium found were from 2.4 – 2.7 for all treatments for the first crop and 2.6 – 2.9 % for all treatments harvested from the second crop. All treatments had potassium levels lower than 3 %. Hay potassium is considered risky when levels exceed 3 %.

3.5 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 August. From Table 3, yields and the crop value achieved are tabulated based on a value of either $100/ton or $130/ton. Treatments, after considering product purchase and application costs, resulted in an increased crop return of $43.90 - $94.90/acre, and $49.20 - $87.60/acre for the poultry manure, and fertilizer treatments, respectively over that of the check

treatment. Return from treatment was sensitive to the value given to the hay crop. Due to the nature of the manure treatments (which were higher cost but higher yielding), as the value given to the crop increased, the manure treatments had the higher return. With the lowest value ($100/ton) for the hay crop, the high fertilizer rate had the highest return from treatment.

Table 3 Comparative Cost and Return from Manure and Fertilizer Treatments

	Treatments				
	Poultry Manure – Low Rate	**Poultry Manure – High Rate**	**Fertilizer – Low Rate**	**Fertilizer – High Rate**	**Check**
	- - - - tons/ac - - - -				
Yield (15% moisture) – 1st Crop	2.4	2.7	2.2	2.6	1.4
Yield (15% moisture) – 2nd Crop	0.45	0.52	0.12	0.08	0.11
Total Yield	2.9	3.2	2.3	2.7	1.5
	- - - - $/ac - - - -				
Market Value of Crop ($100/ton crop value)	290	320	230	270	150
Market Value of Crop ($130/ton crop value)	377	416	299	351	195
Differential Market Value[1] ($100/ton crop value)	140	170	80	120	na
Differential Market Value[1] ($130/ton crop value)	182	286	104	156	na
	- - - - $/ac - - - -				
Cost for Fertility Addition	72.4	102.4	20.8	41.6	na
Cost for Application	16.5	23.7	10	10	0
Total Fertility Costs	88.9	126.1	30.8	51.60	na
Return from treatment ($100/ton crop value)	**51.10**	**43.90**	**49.20**	**68.40**	**na**
Return from treatment ($130/ton crop value)	**93.10**	**94.90**	**73.20**	**87.60**	**na**

[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 $525 per load or $6.50 per cubic yard
- manure application rates of 3.5 and 5 tons per acre were considered equivalent to about 11 and 15.8 yards per acre respectively
- chemical fertilizer costs were calculated at $416/ton for the 19-18-18 blend used
- due to dry soil conditions, second crop yields were exceptionally lower than typical
- 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 $100/ton and $130/ton as noted

3.6 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.

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. As well, the forage stand in some areas within the plot boundaries was not as dense, or had a higher level of weed infestation than deemed desirable. This lower density affected the amount of response shown by crop yield to treatment. Since higher nutrient levels were found in the manure treatments over other treatments, if the forage stand had been denser likely a higher yield response would have been found.

4.0 Conclusions:

Since the second harvest was severely affected by dry soil conditions, it is very difficult to draw conclusions for this trial when there was no definitive crop yield and quality information. However, the following observations can be made from the results of this trial :

- Use of poultry manure as the fertility source increased crop crude protein content by as much as 30% for the first crop
- Soil nitrogen levels were highest for the manure treatments throughout the growing season
- Crop phosphorus showed a substantial increase (up to 21%) for both first and second crop through the use of poultry manure
- Average crop yield (Area #1 & #2) for the first crop was the highest for the high rate of fertilizer and the high rate of poultry manure while the low rate of poultry manure yielded the second highest.
- Average crop yield (Area #1 & #2), while low for the second crop was highest for poultry manure by a factor of 2 – 10 times that of the fertilizer and check treatments
- Risk of Grass Tetany was found to be low due to Magnesium and Potassium crop levels that were within acceptable limits across all treatments.

5.0 Recommendations:

Due to the extreme climatic factors which affected this trial, for recommendations to be made another season of evaluation would be required. However, this trial does show similar trends to trial results from other regions. In other regions, it has been shown that poultry manure application rates of 4 – 5 tons/ac have achieved substantial increases in crop quality and yield, along with higher returns as shown from a cost/benefit analysis. If forage fields are to be irrigated, poultry manure application at 4 - 5 tons per acre should provide an increase in yield and financial return as well.

Manure application on a sustained basis to the rotation hay crops on this farm should act to reduce the amount of fertilizer needed for the potato crop, especially phosphorus and potassium. Continued manure application will promote the establishment of higher nutrient levels in these fields yielding further fertilizer cost savings on succeeding crops.

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