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Project Title:

IMPACT OF DAIRY MANURE APPLICATIONS ON FORAGE



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1. Executive Summary

One area of both public and producer concern regarding nutrient management planning is the safe utilization of animal manures. In Ontario, risk assessment tools such as the ‘N index’ and ‘P index’ were primarily developed to assist producers in the identification of potential areas of nutrient loss associated with various production practices. These tools would also identify Best Management Practices (BMP) that would provide reasonable options for mitigation of negative environmental impacts resulting from nutrient applications to cropland. In the development of these indices, several areas were identified for which additional research would be desirable to improve our knowledge of nutrient utilization/losses under given production practices. Although there is considerable Ontario information available on forage crop nutrient contents (nitrogen, phosphorus, potassium) and potential removal, questions remain as to the effectiveness and potential benefits of split manure applications on nutrient utilization and losses, as well as impacts on forage stand characteristics. In particular, the benefits/risks associated with later season applications of manures (after 3rd cut) are not clearly understood. This project is addressing several questions pertaining to the application of liquid dairy manure (LDM) to alfalfa. Specifically, the impact of timing and application rate of LDM on alfalfa yield and nutrient uptake, soil test P and K levels, and the potential for nitrate-N movement through the soil. In addition the impact of LDM applications on stand composition is also being evaluated.

2. Research Results and Milestone Status:

Project objectives:

To examine the impact of rate and timing of dairy manure applications on:

- i)** the yield and nutrient content (N, P and K) of an alfalfa/grass forage crop
- ii)** stand composition of an alfalfa/grass forage crop
- iii)** soil nutrient levels (N, P and K) and potential soil nitrate losses.

Activities undertaken to date to achieve project objectives:

Experiments have been established at three sites, one on the Elora Research Station and two on the Ridgetown College Research Farm, on soils of differing textures. Each site was an established forage (alfalfa) stand. Liquid dairy manure (LDM) was applied at two rates (3,000 or 6,000 gallons/acre; or 33,600 and 67,200 litres/ha) either after 1st or 3rd cut, as well as a split application of 3,000 gallons/acre after 1st and 2nd cut (total of 6,000 gallons/acre applied). Manure analyses were conducted to determine the amounts of nutrient applied. Forage yields were measured at each of the three harvests which

occurred on June 16th, July 23rd and September 3rd at the Ridgetown sites and on June 16th, July 24th and September 8th at the Elora site. Tissue nutrient concentrations (excluding nitrogen) have been completed for each of the three harvests at the two Ridgetown sites, and are underway for the Elroa site. Soils were sampled (0-15 cm) for initial soil test P and K levels prior to manure applications in 2003. Soil sampling for nitrate-N (0-75 cm in 15-cm increments) was conducted in spring 2003 and fall 2003. Analyses of these soil samples have not yet been completed for all sites. Some delays in sample analyses have occurred due to unexpected problems associated with the laboratory facilities in the Department of Land Resource Science, at the University of Guelph. These problems have been corrected and the remaining samples analyses will be completed soon. No further delays are anticipated and preparations are underway for the coming growing season.

Table 1. Resources available to project

Resource	Level
Funding:	
CanAdapt	\$ 31,500
Total	\$ 31,500
Staff Resources:	
Professionals: I.P. O'Halloran, principal investigator	\$ 8,000 in kind

Results

There was no harvest x treatment ($p > 0.05$) interaction for any of the sites, indicating that forage yields varied similarly between harvests for each of the treatments at a given site. Forage yields were also not significantly ($p > 0.05$) affected by the treatments at any of the experimental sites. As treatments were applied to established alfalfa stands, dramatic treatments effects in the first year of the treatments are unlikely to be observed, especially for treatments in which manure applications were not made until after the 3rd cut. As expected, forage yields were significantly ($p < 0.001$) different between the three harvests, and the general trend was for yields to decrease from 1st to 3rd cuts although cuts 1 and 2 produced similar yields at the Ridgetown sand site.

For the two Ridgetown sites on which tissue nutrient contents have been completed, the concentration of nutrient in the forage tissue was unaffected by treatment, and there was no harvest x treatment interaction. For both Ridgetown sites, tissue concentrations of phosphorus and potassium significantly ($p < 0.001$) changed between harvests, and were above what would be considered a critical tissue concentration for these elements (i.e. all % Phosphorus (%P) values were > 0.28 and % Potassium (%K) values were above 2.1%). In general % P values were highest in the 1st cut, decreased in the 2nd cut and

increased in the 3rd cut, which undoubtedly reflects the changes in the availability of P in the soil and dry matter production of the crop. The %K tended to decrease from 1st to 3rd cut.

Table 2. Impact of harvest on forage yields for the three sites in 2003

Harvest	Yield (t/ha dry wt basis)		
	Ridgetown Clay	Ridgetown Sand	Elora
1 st cut	6.23a	6.96a	5.08a
2 nd cut	4.94b	7.19a	3.66b
3 rd cut	2.77c	5.54b	2.84c
Total	13.9	19.7	11.6

Total nutrient removed in the harvested crop was also unaffected by treatment and there was no harvest x treatment interaction. Amounts of nutrient removed varied between the different harvests, reflecting the general decrease in biomass production with the later harvests. The total amount of phosphorus removed by the crop over the growing season was 63 kg P /ha (57 lbs/acre) and 43 kg P/ha (38 lbs/acre) for the Ridgetown sand and clay sites, respectively. Similarly, potassium removal by the crop was 547 kg K /ha (488 lbs/acre) and 331 kg K /ha (295 lbs/acre) for the Ridgetown sand and clay sites, respectively. Comparing these nutrient removal rates to the amount of nutrient applied in the manure applications reveals that the crop has removed between 2-5 times more P and 2-9 times more K than added in the various manure treatments. These ranges of nutrient removal: nutrient applied ratios should enable a good assessment of treatment impact on subsequent crop yields (2004 growing season) and stand composition, as well as possible differences in soil test levels.

4. Reach

Although the primary target of this research is the producer that applies liquid dairy manure to produce a forage crop, results of this study will also be of value in terms Nutrient Management Planning. Following the 2004 growing season, final reports will be prepared and forwarded not only to the Ontario Forage Council, but also to the appropriate OMAF personnel as well as be made available on the Ridgetown College website.

5. Project Outcomes

The treatments to date have not affected crop yield or tissue nutrient concentrations, which as indicated before is not totally unexpected given the fact that established forage stands were used in the study. The impact of the treatments on the crop and soil properties in the following year (2004) will be the significant test of the treatments. Overall, the goal of the project is to address whether or not lower application rates and timing of manure application affect crop yield, nutrient availability/removal and crop composition. In addition, the potential impact of manuring practices on soil N levels, particularly in late fall, may also allow some assessment of management practices less likely to result in N losses from the soil.