RL0496
Interim Report
February, 1999

Manure Application on Forages

Abstract

In order to manage manure on forage land better, producers need information about application rate and timing, and the effect of application on soil and forage quality. In the third year of a 5-year study, liquid hog and solid beef feedlot manure were applied to alfalfa and timothy crops. The manure was applied at five rates in the spring and fall. Yield, soil and feed quality samples were taken to measure the effect of the manure applications on forage crops and soil. The beef feedlot manure was surface-spread and the liquid hog manure was injected with coulters.

The application of manure at the Lethbridge site did not affect alfalfa yield. The application of manure at the Airdrie site affected timothy yield. An increase in manure rate resulted in increased yield except for the highest manure application rate where response dropped slightly. Lodging of the timothy crop occurred mainly with the high, liquid and spring manure application rates.

Alberta
AGRICULTURE, FOOD AND
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Introduction

Intensive livestock operations generate large quantities of manure. Sustainable management of this by-product has become a major challenge for producers. In many parts of the province, forage crops occupy a significant portion of land available for manure application. Unfortunately, little is known, in Alberta, about the agronomic and environmental impacts of spreading manure on forage crops. In order to manage manure on forage land better, producers need information about application rate, timing and the effect of application on soil and forage quality. Liquid hog and solid beef feedlot manure will be applied to alfalfa and timothy crops at five rates in the spring and fall. Yield, soil and feed quality samples will be taken to measure the effect of manure applications on forage crops and soil. Interim reports were written on the results of the Lethbridge site, which started in 1996. The Airdrie site was added in 1997. The study will continue for two more years.

Experimental Procedure

Experimental sites are an irrigated alfalfa crop located northeast of Lethbridge and a timothy crop located east of Airdrie. The alfalfa crop is under irrigation in the Lethbridge Northern Irrigation District.

The experiment is a 2 x 2 x 5 factorial in a randomized complete block design with four replications. Each site consists of 80 plots. Plots are 7.5 x 15 m (25 x 49 ft), with 5 m (16 ft) borders. A 5 m (16 ft) strip is used between replicates.

Table 1 outlines the levels of factors used in the study. The beef feedlot manure was surface-spread and the liquid hog manure was injected with coulters. Manure subsamples were analysed for nutrient content.

Table 1.

Factor	Level
Manure Application Time (2)	Spring, Fall
Manure Type (2)	Liquid Hog, Solid Beef Feedlot
Application Rate (5) (available nitrogen)	0, 67, 134, 202 and 269 kg/ha (0, 60, 120, 180 and 240 lb/ac)
Volume Liquid Manure Application Rates	0, 42047, 84095, 126142, 168189 L/ha (0, 3743, 7486, 11229, 14972 gal/ac)
Mass Solid Manure Application Rates	0, 30.6, 61.2, 91.8, 122.3 tonne/ha (0, 12.2, 24.4, 36.5, 48.7 ton/ac)

Soil samples were taken from each plot prior to spring manure application. Samples were taken in six increment depths to a total depth of 1.5 m (4.9 ft). Soil samples were analysed for nutrient content, pH and electrical conductivity. Yield samples were taken with a walk-behind harvester at Lethbridge and a self-propelled harvester at Airdrie. The walk-behind unit cut a 0.6 m (2 ft) and the self-propelled harvester a 1.5 m (4.9 ft) strip through the centre of each plot. Harvest subsamples were dried to determine moisture content. Forage samples were analysed for protein, nitrate, acid detergent fibre, selenium and trace elements.

Table 2 lists operations performed during 1998.

Table 2.

Operation	Date	
	Airdrie	Lethbridge
Soil sampling	April 21	April 15
Spring liquid manure application	April 23	April 16
Spring solid manure application	April 22	April 17
Harvest - first cut	July 27, 28	June 24
Harvest - second cut	--	Aug. 11
Fall liquid manure application	Sept. 22	Sept. 8
Fall solid manure application	Sept. 23	Sept. 9

The liquid manure injector consisted of five K-Hart coulter assemblies mounted on a three-point hitch toolbar. Spacing of coulters was 30.5 cm (12 in). A 7.6 cm (3 in) trash pump was used to deliver manure to the coulters. The application rates were varied by speed. A speed of 8 km/h (5 mph) was used for the 269 kg/ha (240 lb/ac) application rate.

The solid beef feedlot manure was spread with a box-type spreader. The manure was weighed with load cells mounted on the spreader and the correct amount evenly spread over the plot.

A 63 kW (85 hp) tractor was used to tow both manure applicators.

Results

An analysis of variance (ANOVA) was applied to the data. Mean alfalfa yields for the Lethbridge site are presented in **Figure 1**. Differences in alfalfa yield between application times and type or rate of manure were not significant.

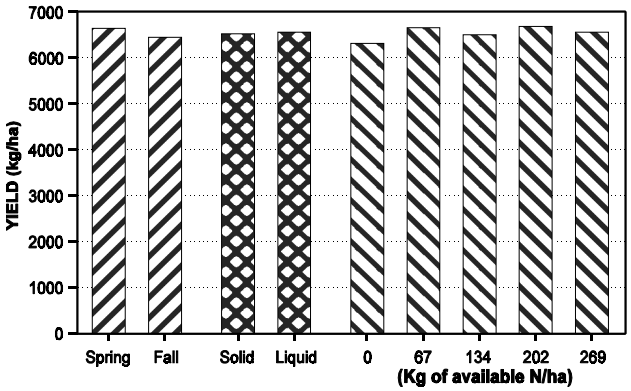

Figure 1. Effect of Manure-type, Application Time and Rate at Lethbridge - 1998.

Mean crop yields for the Airdrie site are presented in **Figure 2**. Differences in timothy yield between various manure rates were highly significant. Treatments with the same letter do not have significantly different means. A comparison of means showed a significant difference between the three highest manure rates and zero rate. The crop yield increased with every manure rate increase except the highest rate where response dropped slightly. Differences in timothy yield between application times and manure-type were not significant.

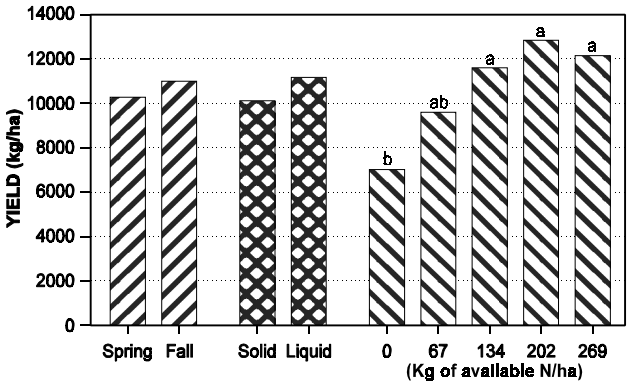

Figure 2. Effect of Manure-type, Application Time and Rate at Airdrie - 1998.

Lodging of the timothy crop was common at the Airdrie site and was recorded prior to harvest. The results are listed in **Table 3**. The number and percent of lodged plots of each treatment are listed. Lodging occurred with high, liquid and spring manure application rates.

Table 3.

Treatment	Number of Lodged Plots	Percent of Lodged Plots of Each Treatment
Application rate:		
0	0	0
67	4	25
134	8	50
202	12	75
269	13	81
Manure-type:		
Liquid	27	68
Solid	10	25
Application Time:		
Spring	24	60
Fall	13	33

Soil and forage feed quality samples were analysed. The results will be studied in the future. Soil samples will track nutrients from the manure to determine which nutrients the crop is using.

Figure 3 shows monthly rainfall during the season for each site. The Lethbridge site also received 100 mm (8 in) of moisture through irrigation during the season. Total rainfall at Lethbridge was 287 mm (11.3 in) and at Airdrie 314 mm (12.4 in). No runoff was observed at the Airdrie site during a heavy rainfall.

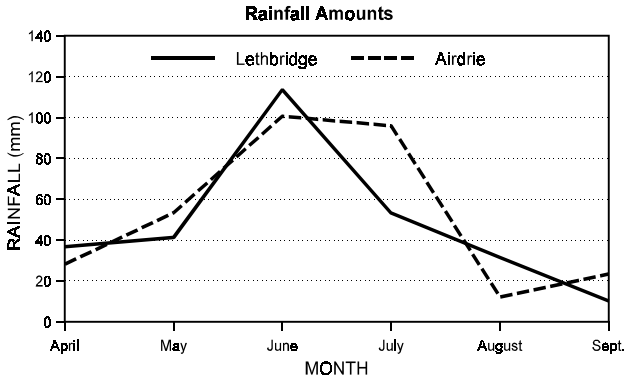

Figure 3. Monthly rainfall for the Lethbridge and Airdrie Sites.

The manure sample analysis for 1998 is listed in **Appendix 1**.

Discussion

The application of manure at the Lethbridge site did not affect alfalfa yield. An observation made during the first harvest was manure-applied plots were

greener, taller and thicker than plots with little or no manure. This, however, did not result in any statistical differences.

The application of manure at the Airdrie site affected timothy yield. An increase in manure rate resulted in increased yield except for the highest manure application rate where response dropped slightly. Lodging of the timothy crop occurred with high, liquid and spring manure application rates. Lodging of spring-applied plots was probably more frequent than fall-applied due to extra manure application on spring-applied plots.

During harvest at the alfalfa site, more weeds in manure-applied plots were observed than plots with no manure. Future monitoring will determine if manure application results in increased weed growth.

Summary and Conclusions

The application of manure at the Lethbridge site did not affect alfalfa yield. Application of manure at the Airdrie site affected timothy yield. An increase in manure rate resulted in increased yield except for the highest manure application rate where response dropped slightly. Lodging of the timothy crop occurred with high, liquid and spring manure application rates.

References

Blaine Metzger, *Manure Application on Irrigated Alfalfa Forage*, Project RL0496, January 1997.

Alberta Farm Machinery Research Centre, *Manure Application on Forages*, Project RL0496, January 1998.

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Appendix 1
Manure Sample Analysis for 1998

		Lethbridge Spring	Airdrie Spring	Lethbridge Fall	Airdrie Fall
SOLID	Moisture (%)	63.4 59.7 37.9 63.0	57.2 63.4 46.9 46.0	45.3 44.6 51.2	36.6 41.8 37.4 39.0
	Average	56.0	53.4	47.0	38.7
	NH4-N (ppm)	1264 1320 1032 1152	166 320 163 247	2772 3236 3104	408 276 598 448
	Average	1192	224	3037.3	432.5
	Total N (%)	0.94 1.11 0.89 0.96	0.52 0.41 0.41 0.35	1.00 1.16 1.00	0.86 0.88 0.85 0.94
	Average	0.97	0.42	1.05	0.88
	Total P (%)	0.31 0.39 0.27 0.33	0.16 0.12 0.13 0.12	0.39 0.39 0.36	0.34 0.31 0.31 0.33
	Average	0.32	0.13	0.38	0.32
LIQUID	Moisture (%)	86.9 88.5 88.2	96.9 97.5 95.7	94.6	94.6
	Average	87.8	96.7	94.6	94.6
	NH4-N (ppm)	2210 2250 2140	3050 3140 3050	2990	2312
	Average	2200	3080	2990	2312
	Total N (%)	0.31 0.38 0.31	0.51 0.48 0.44	0.29	0.45
	Average	0.33	0.47	0.29	0.45
	Total P (%)	0.08 0.12 0.09	0.16 0.12 0.13 0.12	0.12	0.13
	Average	0.10	0.13	0.12	0.13