Impact of Manure Timing on Nutrient Availability and Nitrogen Loss in Wheat

Purpose:

To assess the nutrient availability (yield) and nitrogen loss from manure and commercial nitrogen applied to winter wheat crops in early spring.

Manure application to various crops in the rotation is an alternative to applying all manure ahead of a corn crop. Potential nutrient loss, compaction, labour, time and/or equipment limitations, as well as land availability and manure storage requirements make manure application to crops other than corn an economic alternative.

There are many questions that remain about nutrient availability based on time of application and potential nitrogen loss associated with method of application, incorporation and weather conditions.

Predicting manure nutrient availability has traditionally been based on nutrients available for a corn crop (mid June to mid August uptake), but when applied to winter wheat (mid May to late June uptake) availability appears to be lower. This is likely due to cooler soil conditions, but may also be associated with ammonia loss. This project focuses on manure nutrient availability compared with nitrogen ammonia loss when various types of manure are applied to winter wheat in early spring.

Methods:

Seven, two replicate sites were established from Ripley to Wardsville Ontario. Manure types applied included solid poultry (broiler), liquid hog, and liquid dairy.

Surface applied manure application was compared to surface applied commercial nitrogen (applied as close together as possible) at rate that would provide the same total nitrogen. As well each site had a two-thirds manure 1/3 commercial N treatment.

Nitrogen loss was measured at application using dosimeter tubes (ammonia traps) while nutrient uptake was measured based on yield. Crop quality was also assessed by wheat quality samples and field lodging. Ammonia traps – dosimeter tubes, set 1 ft above the surface attached to rebar and covered with a somewhat perforated white pail (12 to 14 per field) were set up seconds after manure and/or nitrogen application to each treatment. Tube readings were taken every day for 10 days after application.

Figure 1: Ammonia Measurement Apparatus

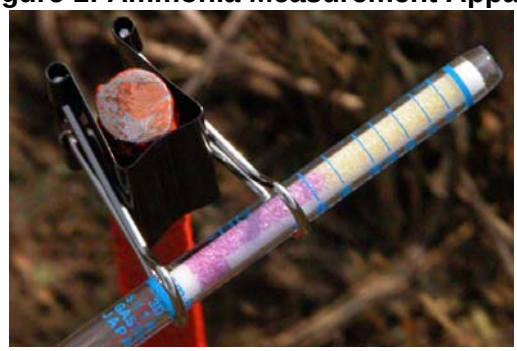

Figure 2: Field Layout of Ammonia Dosimeter Apparatus

Replicated treatments at each site included:

- 90 lbs N as manure
- 90 lbs N as commercial N
- 60 lbs N as manure, 30 lbs as commercial N
- No manure or commercial N

All manure and commercial nitrogen treatments were applied between March 15th and April 23rd. Heavy rainfall in late April/early May was experienced at most sites. Some loss of N due to denitrification was of concern.

Results:

Wet conditions following application, coupled with much below normal temperatures, and wet conditions for May and June, likely reduced availability of the nitrogen from the manure. In some cases, this had severely negative results (Ripley, Bryanston). At the St. Agatha site, nitrogen applied in the manure treatment was significantly higher than fertilizer N applied, making those results questionable.

Yield results are variable. In some cases, manure was able to supply all the nitrogen necessary for high yield (Embro, Wardsville, St. Thomas). At Ripley, where the manure only treatment failed drastically, the strategy of 2/3 manure plus 1/3 fertilizer overcame much of the yield loss associated with manure only. At Stratford, this 2/3 manure, 1/3 fertilizer strategy yielded significantly more than either manure or fertilizer treatments alone.

On average, the strategy of 2/3 manure, 1/3 fertilizer was able to mitigate failures and maintain yields. Bryanston is the only exception to this generalization.

Table 1: Yield Results

	Full Fertilizer	Full Manure	2/3 manure 1/3 Fertilizer	Check
Ripley	100.0	63.9	91.4	40.1
Embro	64.5	68.3	68.6	50.5
Wardsville	76.0	77.0	74.9	47.2
Stratford	68.1	66.5	77.9	53.7
Bryanston	60.3	52.1	50.9	30.7
St. Agatha	75.9	82.1	69.5	
St. Thomas	72.4	77.0		

Table 2: Yield Averages

	Full Fertilizer	Full Manure	2/3 manure 1/3 Fertilizer	Check
Avg 7 sites	73.9	69.6		
Avg 6 sites	74.1	68.3	72.2	
Avg 5 sites	73.8	65.6	72.7	44.4

Protein levels were increased significantly by manure applications at both the Wardsville and St. Agatha site. Wardsville had a manure application problem, and a second application was made later in the season which may be responsible for the protein bump. St. Agatha had significantly higher N application from the manure, which is the probable cause for higher protein. The only site which showed a protein decline from manure was Ripley, where the manure seemed not to supply much N at all, despite what should have been available.

In general terms, manure applications increase grain protein in wheat.

Table 3: Protein Results

	Full Fertilizer	Full Manure	2/3 manure 1/3 Fertilizer	Check
Ripley	9.0	8.5	8.4	8.6
Embro	10.3	10.1	10.2	9.9
Wardsville	10.3	11.5	11.4	9.7
Stratford	9.5	9.7	9.6	9.4
Bryanston	11.2	11.3	11.0	10.6
St. Agatha	9.7	10.6	9.5	
St. Thomas	10.6	10.7		

Table 4: Protein averages

	Full Fertilizer	Full Manure	2/3 manure 1/3 Fertilizer	Check
Avg 7 sites	10.1	10.3		
Avg 6 sites	10.0	10.3	10.0	
Avg 5 sites	10.1	10.2	10.1	9.6

Summary:

From this data set, application of manure on wheat gives variable results. In some instances full availability of the manure nitrogen to the wheat crop looks plausible, in other trials there appears to be almost nil contribution from manure nitrogen. Based on these results, no firm recommendations can be made. However, the strategy of 2/3 manure, 1/3 fertilizer, continues to show promise as a way to avoid disasters when using manure on wheat.

Next Steps:

This project will continue in 2010.

Acknowledgements:

We are indebted to all the co-operators. Many thanks to the summer assistants - Mike Vanhie, Allison Fleming, and Dan Docking. Special thanks to technician Shane McClure and Marian Desjardine. This project would not be possible without the financial support of the Environmental Sustainability Directed Research program of the Ontario Ministry of Agriculture, Food and Rural Affairs, and the Middlesex Soil and Crop Association.

Project Contacts:

Peter Johnson
OMAFRA, Stratford
peter.johnson@ontario.ca

Christine Brown,
OMAFRA, Woodstock
christine.brown1@ontario.ca

Location of Project Final Report:

Peter Johnson
OMAFRA, Stratford
peter.johnson@ontario.ca