Low Disturbance Shallow Manure Injection In Winter Wheat
(Interim Report)

Purpose:

Nitrogen losses from surface applied manure can be substantial. Micro ponding and soil “sealing off” when manure is applied all add to the challenge of maximizing manure utilization and reducing environmental losses. This project examines methods to reduce nitrogen volatilization and improve utilization by enhancing uniformity of application, when applying manure into existing wheat stands. The concept being investigated is the European methodology of “Low Disturbance Shallow Injection” technology.

Methods:

Two replicate field scale trials were initiated at 4 locations in 2012. The treatments are as follows:

1. Check (no manure or fertilizer)
2. Full rate manure shallow Injection
3. Full rate surface band applied manure
4. Full rate splash plate applied manure
5. 2/3 rate manure injection and 1/3 rate fertilizer
6. Full rate Fertilizer

Manure was applied on winter wheat fields in late March. Treatment 2 was injected using a Veenhuis Injection unit with V style press wheel openers at 7.5 inch spacing. The openers create a narrow trench 1-2 inches deep into which the manure is applied. For Treatment 3, the surface band manure treatment was applied by raising the openers out of the ground and applying the manure on the surface via the same band applicator used in Treatment 2 so that the manure was applied in 7.5 inch spaced bands. The manure did not cover the entire soil surface. For Treatment 4 the manure was applied broadcast via a splash plate that resulted in the entire soil surface being covered. Due to equipment limitations in the early season the splash plate treatment was included at only one location in 2012. The #5 treatment had manure injected in the same manner as treatment 1 but the rate was cut by 1/3. Urea fertilizer was then broadcast on the soil surface using a Valmar airflow applicator at a rate to replace the N not available in the lower manure rate. This low rate of fertilizer N should help overcome any manure application uniformity issues. With Treatment 6, urea fertilizer was broadcast to match nitrogen levels on manure treatments. Potash and phosphorus applied from manure were not matched in the full fertilizer treatment.

Ammonia loss was measured across all treatments via dosimeter tubes and pails adapted to allow for airflow after ammonia movement was measured. Soil nitrates were taken at heading and post-harvest to track soil nitrogen status and monitor potential environmental impact post-harvest. Disease levels were monitored throughout the growing season. Harvest measurements included yield, moisture, test weight, thousand kernel weights, and protein.

Results:

Leaf disease levels were low across all locations. Treatments 2 through 6 did not have a significant impact on most diseases but Treatment 1 (check) had significantly less powdery mildew. Low powdery mildew levels are easily explained as the stand in the check treatments was very thin due to a lack of nitrogen. Yield data is summarized in Table 1. Yields in the check strips were above expectations, likely due to high residual soil nitrate levels from repeated manure applications in previous years. Yields increased significantly with added nitrogen (>20 bu/ac). The manure application method had little impact on yield. Injected manure increased yields by ~3 bu/ac compared to banding the manure on the surface. This may be due to the relatively minimal amount of soil disturbance created by the Veenhuis opener used. The fertilizer treatments were the highest yielding in 2012, adding ~3 bu/ac over the manure injection treatment. There was little difference between applying 2/3 of the nitrogen from manure with 1/3 from fertilizer or applying 100% of the nitrogen from fertilizer.

These results differ from trials conducted from 2009-2011, where manure treatments or the 2/3rds manure 1/3 commercial fertilizer were the highest yielding. A fifth site of this trial was lost in 2012, where manure only treatments all showed the equivalent N deficiency as the check treatment. Why results in 2012 varied in this way has not been determined.

The Milverton site showed significantly better results using the injected manure. This site used a different injector than the other sites, and also applied extremely high rates of manure resulting is very high nitrogen applications (Table 2). With total applied nitrogen of 270 lbs./ac from manure, it is quite astounding that lodging was not an issue at this location.

Table 1: 2012 Yield Results from 5 locations in 2012

Treatment	Arthur	St. Thomas	London	Milverton	Average	Gain
Check	83.4	68.1	55.9	87.2	**73.6**	
Manure Injection	108.4	92.1	73.2	119.8	**98.4**	24.8
Surface Band Manure	109.3	92.2	77.9	102.6	**95.5**	21.9
2/3 Manure 1/3 Fert	119.7	92.5	80.1	117.7	**102.5**	28.9
Full Fert	125.6	95.9	77.7	108.2	**101.9**	28.2

The manure source and rate of application at each location are summarized in table 2 along with the manure analysis from each location.

Table 2: Manure Analysis

Site	Manure Source	Rate Applied (gal/acre)	Manure Analysis (lbs./1000 gal)		
			N	P	K
Milverton	Swine Finisher	7,500	37	13	28
Arthur	Swine Finisher	4,500	28	7	14
St. Thomas	Swine Farrow to Finish	4,000	23	8	17
London	Dairy	5,000	14	3	18

Figure 1:Picture of Manure Tanker with Shallow Incorporation Unit

Summary:

The yield difference between manure and fertilizer was slightly larger than previous studies have shown. The spring of 2012 was very unique with mid-March temperatures far above average and no rain. This provided an excellent opportunity to apply manure on dry soil. Manure was applied on the plots in late March. Temperatures during late March and early April were near normal but it remained extremely dry (40% of normal rainfall). This may have resulted in more volatilization and ammonia loss than normal, which could explain the yield gap between manure and fertilizer. Low disturbance shallow injection of the manure had no impact on volatilization losses. Further research is required before conclusions can be drawn about volatilization losses. Treatment yield results were variable across locations. There was a large response to fertilizer at the Arthur location, while the Milverton site responded most to injected manure. While injecting the manure at the London location problems with trash plugging between the injectors resulted in some of the wheat plants being pulled out which may have resulted the yield lag observed from the injection treatment at this location. The Milverton site applied 270 lbs./ac of nitrogen from manure but only 150 lbs./ac of nitrogen were applied in the full fertilizer treatment, as lodging potential from any higher applied fertilizer rates were considered to be too great a risk. Lodging proved not to be an issue, but the lower fertilizer N rates may explain the lower yields from that treatment.

Initial results show that injecting the manure has some potential for increasing wheat yields, due to reduced nitrogen losses. These results are only based on 1 year of data during an extremely dry growing season. Further research is required to evaluate nitrogen losses from different manure application techniques and potential plant damage that may occur from injecting manure into standing wheat. Soil nitrate samples were taken at heading and post-harvest to monitor soil nitrate levels but results are still pending.

Next Steps:

These results are the first year of three years planned for this trial. Treatment 4 (broadcast splash plate) will be included at every location in the final 2 years. A more aggressive coulter style injector has been developed and will be utilized in future trials. We will continue to track nitrogen losses after application and nitrate levels throughout the growing season. Anyone interested in participating in this trial is encouraged to contact Peter Johnson at peter.johnson@ontario.ca or Shane McClure at shane.mcclure@ontario.ca

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