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Yield Responses to Winter Application of Chicken Manure

John D. Holmes
Iowa State University, jdholmes@iastate.edu

David Rueber
Iowa State University, drueber@iastate.edu

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Abstract
An experiment was conducted from 2000–2003 to document yield responses to chicken manure applications made during the winter and spring at two different rates. The focus was on response to nitrogen from manure rather than from phosphorus or potassium.

Disciplines
Agricultural Science | Agriculture

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David Rueber, superintendent

Introduction

An experiment was conducted from 2000–2003 to document yield responses to chicken manure applications made during the winter and spring at two different rates. The focus was on response to nitrogen from manure rather than from phosphorus or potassium.

Materials and Methods

The experimental layout was a randomized complete block design. Manure was hand-applied to small plots in February and April. The urea was applied in April. The goal was to provide 150 lb nitrogen/acre; therefore, a 3.5 ton/acre application rate was established using manure analysis information provided by the manure supplier. Half rate winter and spring applications were added in 2001. Late spring soil nitrate samples and fall nitrate stalk samples were taken annually. Stalk samples were not taken in 2000 due to severe lodging. Plots were machine harvested and yields were calculated on a dry matter basis.

Results and Discussion

Manure analysis is provided in Table 1. With the exception of the April 2000 analysis, the average nitrogen analysis was 48 lb/ton. Yield responses are provided in Tables 2 and 3. Higher rates of manure attained higher yields, and spring applications tended to be higher than winter applications. Average yield from the urea treatment was significantly higher than the manure treatments.

In 2000 the actual manure analysis was much higher than the analysis provided by the supplier; therefore, actual nitrogen rates were much higher than desired. Yields from all treatments were statistically the same due to the high nitrogen application rates.

The winter manure applications in 2001 were applied on top of 8 inches of snow compared with 2 inches in 2000 and 4 inches in both 2002 and 2003. Treatment responses are provided in Table 4. The winter applications yielded less than the spring-manure and the spring-urea applications. The late spring soil nitrate test results were low for all 2001 treatments. The full rate spring manure application had a Late Spring Nitrate Test (LSNT) of 10.3 ppm; and the urea application had a LSNT of 14.9 ppm. Both were well below their respective critical LSNT levels (15 ppm for the manure treatments and 25 ppm for the urea treatment), but well above the other treatments. A similar trend was noted for the fall stalk test results. The low yields, low LSNT values, and low fall stalk nitrate results from the winter applications all indicate that significant amounts of nitrogen seem to have been lost from winter manure applications.

The winter manure applications in 2001 were applied on top of 8 inches of snow compared with 2 inches in 2000 and 4 inches in both 2002 and 2003. The manure analysis indicated that each ton of manure contained 47 lb of nitrogen. A 1.75 ton/acre application provided 82 lb N/acre, and the 3.5 ton/acre application provided 164 lb N/acre. ISU Extension publication Pm-1811 states that 65% of the nitrogen in poultry manure is available during the first year following application. If 65% availability is assumed, the full rate application would provide 107 lb N/acre, and the half rate applications would provide 53 lb N/acre. Yield response seems to be directly related to the amount of available nitrogen provided by the manure or urea application.

The yields attained in all manure treatments and the urea treatment ranged from 184 to 219 bushels/acre in 2003. The check yield was 128

bushels/acre. Again, yield response seems to be directly related to the amount of available nitrogen provided by the manure. The LSNT results indicated that very little soil nitrate was present in the spring for the manure treatments. The stalk nitrate test values were all very low for the manure treatments. Only the urea treatment was above the critical level for the LSNT and in the optimum level for the stalk nitrate test.

Corn yield responses to residual effects of manure applications are shown in Table 5. No residual benefits from manure applications were noted. Yields attained were similar to the check yields in the current year plots.

Conclusions

Manure tends to be highly variable in consistency and analysis. Winter manure applications may provide less nitrogen than spring manure applications in some years. The spring soil nitrate test did not seem to accurately predict the need for additional nitrogen when manure was applied to the plot. Although the stalk nitrate sample results were extremely low, the full rate manure plot yields seemed to be equivalent to yields attained in plots receiving urea.

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Table 1. Manure analysis 2000–2003.

	Manure analysis	Moisture (%)
Reported analysis		
2000 (Reported analysis)	42-106-58	34.4
2000	106-103-57	19.3
2001	47-87-51	35.3
2002	47-94-58	32.7
2003	56-77-80	30.7
2003 (Reported analysis)	65-86-55	15.0
2003 (March sample)	47-84-50	31.0

Table 2. Average response to manure application, 2000-2003, Kanawha, IA.

Treatment	Late spring nitrate test	Fall stalk nitrate test	Yield (bu/a)
Spring – half rate	8	13 b	162.5 b
Winter – half	14	24 b	162.8 b
Spring – full rate	19	56 b	183.0 ab
Winter – full	16	49 b	173.5 ab
Urea	31	1238 a	189.0 a
Check	9	12 b	124.3 c

Table 3. Yield response to manure application, 2000-2003, Kanawha, IA.

Treatment	Rate/acre	2000	2001	2002	2003	Average
Spring – half	1.75 T.	------	146 b	161 b	184 b	162.5 b
Winter – half	1.75 T.	------	123 cd	171 ab	191 ab	162.8 b
Spring – full	3.5 T.	175 a	173 a	178 ab	205 ab	183.0 ab
Winter – full	3.5 T.	172 a	131 bc	174 ab	218 a	173.5 ab
Urea	135 lb.	168 a	176 a	193 a	219 a	189.0 a
Check	------	132 b	110 d	128 c	128 c	124.3 c

Table 4. Yield response to manure application made in 2001.

Treatment	Application rate/acre	LSNT (ppm)	Stalk nitrate (ppm)	Yield (bu./acre)
Urea	135 lb.	14.9	618 a	176.0 a
Spring – full	3.5 T	10.3	37 b	172.9 a
Spring – half	1.75 T.	5.8	<20 b	146.5 b
Winter – full	3.5 T.	6.8	<20 b	130.5 bc
Winter – half	1.75 T.	6.9	28 b	123.0 cd
Control	------	4.7	<20 b	109.5 d

Table 5. Residual corn yield responses to manure applications.

Treatment	2002 yield response to application made in 2000	2003 yield response to application made in 2001
Half rate – spring	------	123.4
Half rate – winter	------	131.5
Full rate – spring	153.8	126.4
Full rate – winter	139.5	112.6
Urea	140.7	114.4
Check	125.3	120.9
Statistical significance	NS	NS