YIELD RESPONSE TO WINTER APPLICATION OF CHICKEN MANURE

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Background

Several large poultry confinement sites have been established in north central Iowa during the past ten years. Many farmers are applying the chicken manure during the fall and winter months as a fertilizer source. Although not desirable, applications have been made to frozen soils and snow covered fields. In 2000 an experiment was started to evaluate yield response to chicken litter applied to snow-covered fields. The objective of the experiment was to document yield responses to applications made during the winter and spring at two different rates. The focus was on response to nitrogen from manure rather than phosphorus or potassium.

Materials and Methods

The experiment was conducted at the ISU Northern Iowa Research Farm located near Kanawha, Iowa, from 2000 through 2003. Manure was hand applied to small plots in early February and in mid-April. The plots were field cultivated immediately following the April application to incorporate the treatments. The goal was to provide 150 lb./acre of nitrogen; therefore a 3.5 ton/acre application rate was established using manure analysis information provided by the manure supplier. A half rate (1.75 ton/acre) winter application and a half rate spring application were added to the experiment in 2001. The 3.5 ton/acre application rate was used as the base rate for the remainder of the experiment. Late spring soil nitrate samples were taken by collecting cores from each plot and combining them into a single treatment sample. Fall nitrate stalk samples were from each plot and analyzed separately. Stalks samples were not taken in 2000 due to severe lodging. Plots were machine harvested and yields were calculated on a dry matter basis. Residual yield responses for both soybeans and corn were determined.

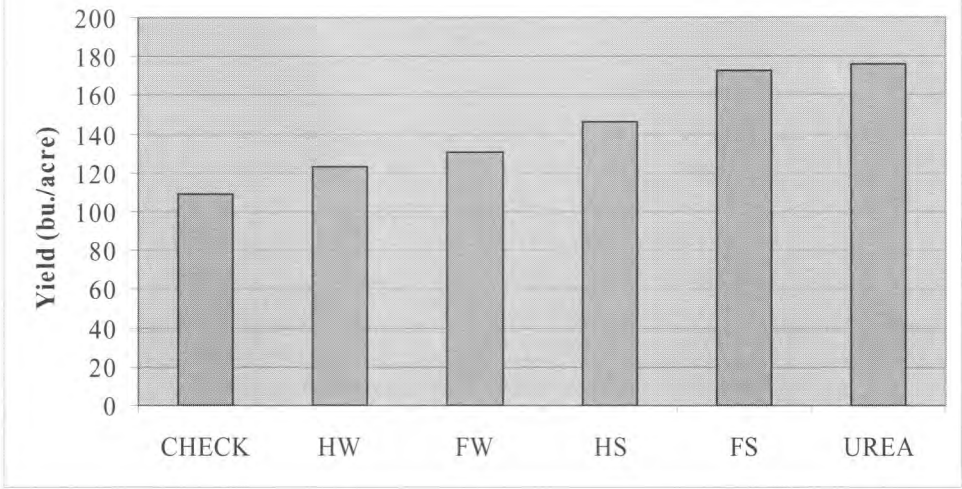
Results and Discussion

Manure analysis is provided in Table 1. With the exception of the April 2000 analysis, average nitrogen analysis was 48 lb./ton. Yield responses are provided in Tables 2 – 5. In 2000 both winter and spring manure treatments were statistically the same as the urea treatment. The soil nitrate levels in the winter manure plots were half of the spring manure and the spring urea plots. This indicates that considerable nitrogen was apparently lost from the winter manure application.

The 2001 winter manure applications were applied on top of 8 inches of snow. 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 an LSNT of 10.3 ppm; and the urea application had a LSNT of 14.9 ppm. Both

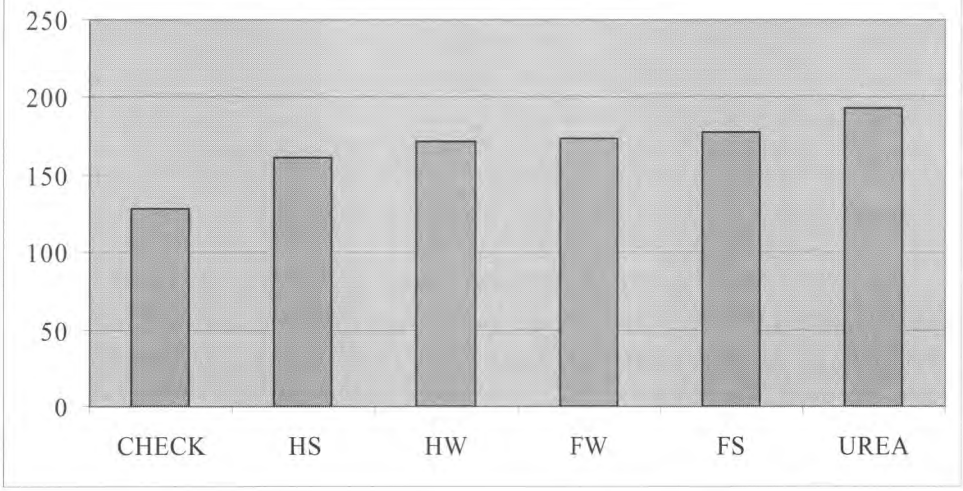
were well below the critical LSNT level of 25 ppm, but well above the other treatments. A similar trend was noted for the fall stalk test results. The low yields, low LSNT values, and low fall stalk nitrate results from the winter applications all indicate that significant amounts of nitrogen appear to have been lost from winter manure applications.

Chart 1. Yield Response -- 2001



Legend: HW – half rate, winter application
HS – half rate, spring application
FW – full rate, winter application
FS – full rate, spring application

Chart 2. Yield Response -- 2002

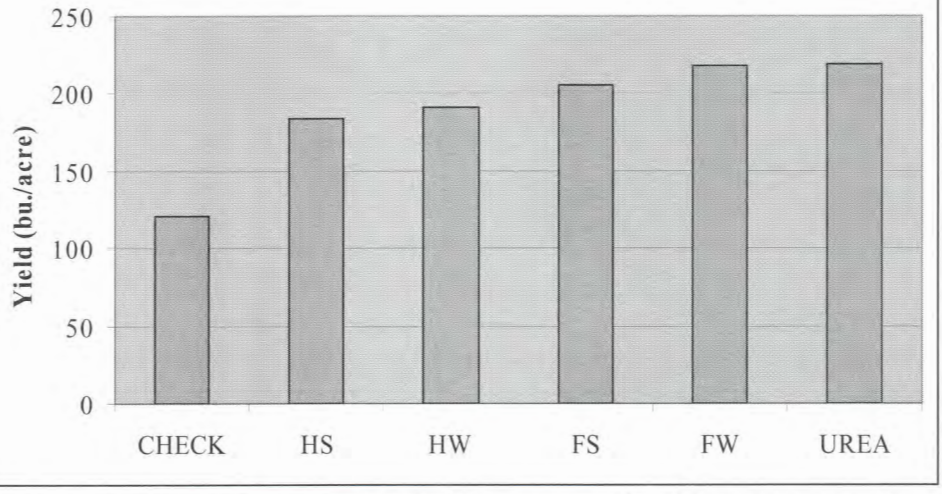


Legend: HW – half rate, winter application
HS – half rate, spring application
FW – full rate, winter application
FS – full rate, spring application

The 2002 results indicate that the yields appear to reflect the amount of nitrogen applied. The manure analysis indicated that each ton of manure contained 47 lb. of nitrogen. A 1.75 ton/acre application provided 82 lb. N per acre; a 3.5 ton/acre application provided 164 lb. N per acre. ISU Extension publications state 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 per acre, and the half rate applications would provide 53 lb. N per acre. Yield response appears to be directly related to the amount of available nitrogen provided by the manure or urea application.

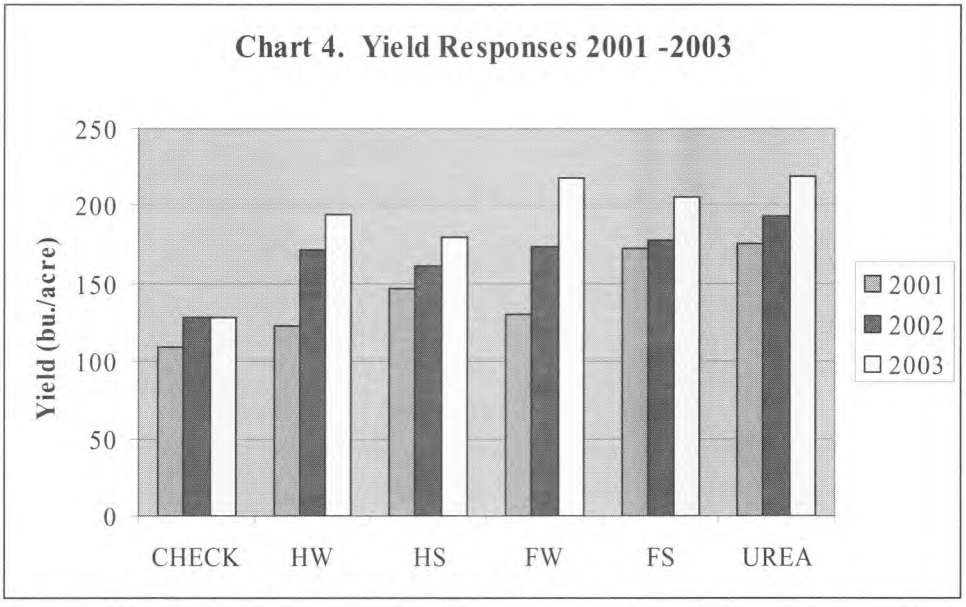
The yields attained in all manure treatments and the urea treatment ranged from 184 to 219 bushels per acre in 2003. The check yield was 128 bushels per acre. The LSNT results indicated that very little soil nitrate was present in the spring under the manure treatments. The stalk nitrate test values 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.

Chart 3. Yield Response -- 2003



Legend: HW – half rate, winter application
HS – half rate, spring application
FW – full rate, winter application
FS – full rate, spring application

Yield responses from 2001-2003 are shown in Chart 4. Yields attained in the half rate-winter application were less than the yields from the half rate-spring application; the full rate-spring yielded more than the half rate-spring; and the urea treatments always provided the highest yields.



Legend: HW – half rate, winter application
HS – half rate, spring application
FW – full rate, winter application
FS – full rate, spring application

Corn and soybean yield responses to residual effects of manure applications are shown in Tables 6 and 7. 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 appear 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 appeared to be equivalent to yields attained in plots receiving urea.

Acknowledgements

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References

Killorn, R., and J. Lorimor. 1999. Managing manure nutrients for crop production. PM-1811. Iowa State University Extension. Ames, Iowa.

Table 1. Manure analysis 2000 -- 2003

	Manure analysis	Moisture (%)
Reported analysis 2000	42-105-98	
2000 (April sample)	106-103-57	19.3
2001	47-87-51	35.3
2002	47-94-58	32.7
2003	56-77-80	30.7
2003 (March sample)	47-84-50	31.0
Reported analysis 2003	65-86-55	15.0

Table 2. Yield response to manure applications made in 2000

Treatment	Application rate/acre	LSNT (ppm)	Yield (bu./acre)[1]
Winter manure	3.5 T.	17.9	172.5 a
Spring manure	3.5 T.	32.7	175.6 a
Spring urea	135 lb.	39.5	168.1 a
Control	----	13.8	132.1 b

1. Groups signified by the same letter are statistically the same. (P=.05)
2. Applied on 2 inches of snow.
3. Manure analysis: 106-103-57

Table 3. Yield response to manure application made in 2001.

Treatment	Application rate/acre	LSNT (ppm)	Stalk nitrate (ppm)	Yield (bu./acre)[2]
Urea	135 lb.	14.9	618 a	176.0 a
Full rate – spring (HS)	3.5 T	10.3	37 b	172.9 a
Half rate – spring (HW)	1.75 T.	5.8	<20 b	146.5 b
Full rate – winter (FW)	3.5 T.	6.8	<20 b	130.5 bc
Half rate – winter (HW)	1.75 T.	6.9	28 b	123.0 cd
Control	------	4.7	<20 b	109.5 d

1. Groups signified by the same letter are statistically the same. (P= .05)
2. Applied on 8 inches of snow.
3. Manure analysis: 45-87-51.

Table 4. Yield response to manure application made in 2002.

Treatment	Application rate/acre	LSNT (ppm)	Stalk nitrate (ppm)	Yield (bu./acre)[1]
Winter – full	3.5 T.	16	23	174 ab
Spring – full	3.5 T.	16	121	178 ab
Winter – half	1.75 T.	13	28	116.6
Spring – half	1.75 T.	13	<20	138.4
Urea	135 lb.	44	1153	193 a
Check	-----	13	<20	128 c

1. Groups signified by the same letter are statistically the same. (P= .05)
2. Applied on 4 inches of snow.
3. Manure analysis: 47-94-58

Table 5. Yield response to manure application made in 2003.

	Treatment	Application rate/acre	LSNT (ppm)	Stalk nitrate (ppm)	Yield (bu./acre)[2]
1	Half rate – spr	1.75 T.	6	14	183.9
2	Half rate – wtr	1.75 T.	11	21	191.1
3	Full rate – spr	3.5 T.	8	15	205.4
4	Full rate – wtr	3.5 T.	6	23	217.6
5	Urea	135 lb.	25	1942	218.8
6	Check	---	3	11	127.8

1. Groups signified by the same letter are statistically the same. (P= .05)
2. Applied on 4 inches of snow.
3. Manure analysis: 47-94-58

Table 6. 2003 corn yield response manure applications made in 2001.

TREATMENT	YIELD (bu./acre)
Half rate – spring	123.4
Half rate – winter	131.5
Full rate – spring	126.4
Full rate – winter	112.6
Urea	114.4
Check	120.9

Table 7. 2002 corn yield response from manure applications made in 2000

TREATMENT	YIELD (bu./acre)
Full rate – spring	139.5
Full rate – winter	153.8
Urea	135.5
Check	125.3