Product Evaluations For Improving N Management

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Introduction

- N fertilizer is used at high rates in the corn belt to obtain high corn grain yields.
- N is applied as either ammonium (NH_4), nitrate (NO_3), or a combination of the two.
- NH_4 is transformed to NO_3 by bacteria that live in the soil.
- NO_3 can be lost by denitrification and/or leaching.

Introduction

- Much research has been done to develop N management strategies to maximize fertilizer N use efficiency by plants.

Objective

- The purpose of this paper is to present the results of studies on the efficacy of two fertilizer additives to increase N use efficiency.

Nitrification Inhibitors (NI's)

- Reduce the rate of transformation of NH_4 to NO_3.
  - NH_4 isn't susceptible to denitrification or leaching.
  - Maintaining fertilizer N in the NH_4 form during weather conditions that favor denitrification and/or leaching should result in higher N use efficiency.
  - Yield responses to additions of NI's to N fertilizer are not always observed because weather conditions don't always result in conditions that cause N losses.

Slow Release N Fertilizers

- Concept is the same as for NI's – to minimize the amount of fertilizer N in the soil as NO_3 during peak times for losses.
- In this case the mechanism is physical protection of the N fertilizer, i.e. Sulfur coated urea.
- New product, ESN, is a polymer coated urea. The thickness of the coating determines the rate of release of the urea.

Objectives

- NI Study
  - Given that climatic conditions don’t always favor N losses, to study the number of responses in corn grain yield must occur to pay for annual addition of NI to N fertilizer.

- Slow Release N study
  - Study the the effect of the application of polymer coated urea on corn grain yields.

Methods – NI’s

- The study was conducted for 10 years (1991 through 2000) near Ames, Iowa.
- The soils at the site were fine textured reasonably well drained and developed in glacial till parent material.
- Crops were continuous corn and corn following soybean.
- N fertilizer was applied in the Spring as either anhydrous ammonia (1991-1994) or aqua ammonia (1995-2000) at rates of 0, 50, 100, 150, and 200 lb N/a to continuous corn and 0, 40, 80, 120, 160 lb N/a to corn following soybean.

Methods – NI's (cont)

- Nitrapyrin applied at either 0 or 0.5 lb ai./a
- Measurements:
  - Corn grain yields
  - N content in the grain and N removal

Effect of N rate and nitrapyrin on the yield of continuous corn from 1991 through 2000 at Ames, Iowa.

N Rate	NI[1]	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
lb/a	lb/a	-----------------------------				bu/a					-----------------------------
0	0	136	144	15	100	86	48	32	25	42	76
50		112	164	28	145	112	91	43	33		44
100		119	179	34	163	145	147	57	77	109	76
150		127	174	40	181	169	164	79	86	101	79
200		119	178	43	176	187	184	96	96	107	96
Average		**123**	**167**	**32**	**153**	**140**	**127**	**61**	**63**	**90**	**74**
0	0.5	115	126	10	87	59	44	36	21	24	32
50		115	180	30	161	133	100	49	55		52
100		121	189	41	171	135	162	47	69	80	76
150		114	187	39	171	159	180	69	86	95	100
200		104	186	37	167	176	195	67	96	103	92
Average		**114**	**174**	**31**	**151**	**132**	**136**	**53**	**65**	**76**	**70**
Statistics											
N rate		ns	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.10	0.10	0.10
Nitrapyrin		ns	ns	ns	ns	ns	ns	ns	ns	0.04	ns

[1]Nitrapyrin

Grain yields of corn following soybean from 1991 through 2000 as effected by N rate and nitrapyrin.

N Rate	NI[1]	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
lb/a	lb/a	------------------------------------bu/a------------------------------------									
0	0	111	177	21	154	68	128	88	49	90	86
40		111	195	28	174	112	157	90	74	121	99
80		110	194	27	179	137	184	102	98	123	115
120		121	190	40	173	150	195	116	115	132	118
160		105	193	34	181	186	208	125	132	152	134
Ave.		**112**	**190**	**30**	**172**	**131**	**174**	**104**	**94**	**124**	**110**
0	0.5	121	183	28	126	77	141	87	56	75	77
40		123	193	37	159	124	166	95	83	123	103
80		121	194	32	176	125	180	84	83	147	108
120		119	185	38	175	142	186	98	115	130	129
160		126	196	36	171	173	213	146	141	155	119
Ave.		**122**	**190**	**34**	**161**	**128**	**177**	**102**	**96**	**126**	**107**
Statistics											
N rate		ns	0.04	0.08	<0.01	<0.01	<0.01	0.10	0.10	0.10	0.05
Nitrapyrin		ns	ns	ns	ns	ns	ns	0.10	ns	ns	ns

[1]Nitrapyrin

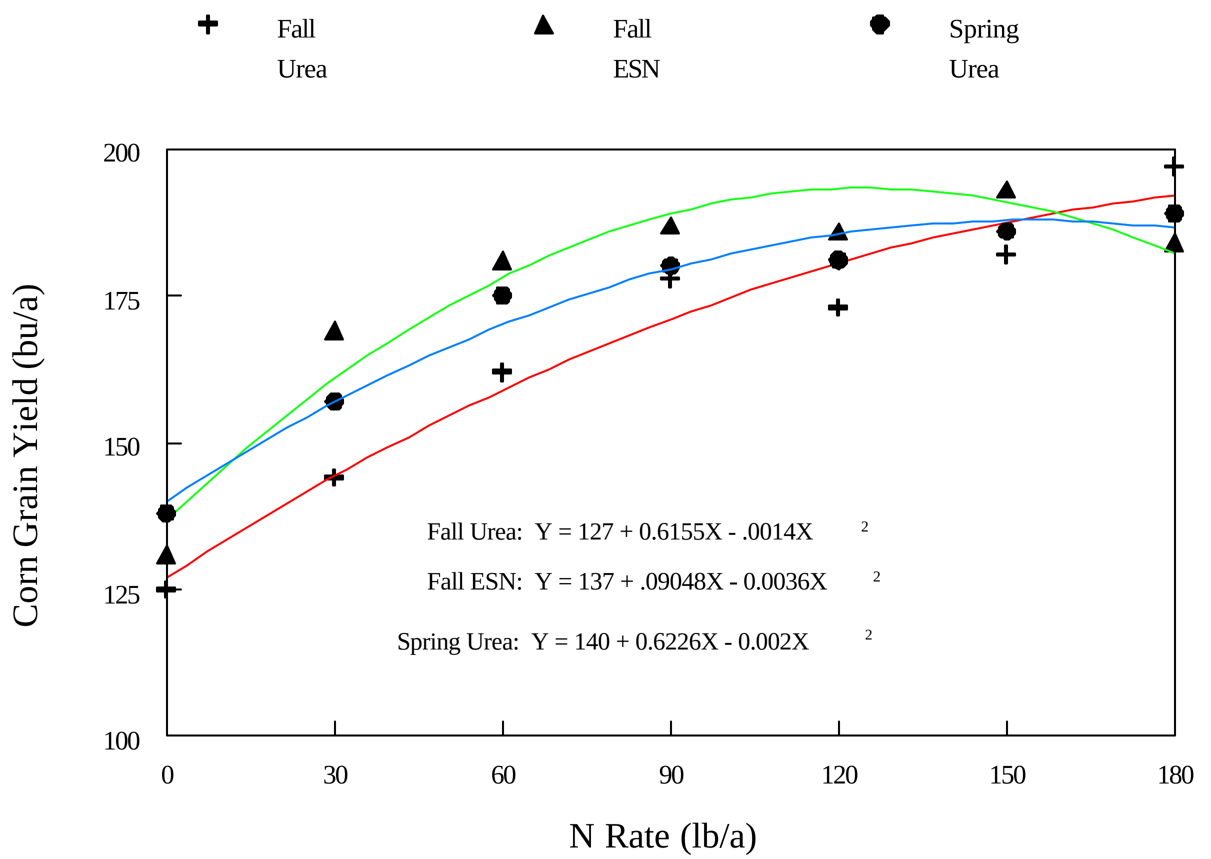
Results – NI's

- Response to N rate nearly every year in both crop rotations.
- No response to addition of NI.

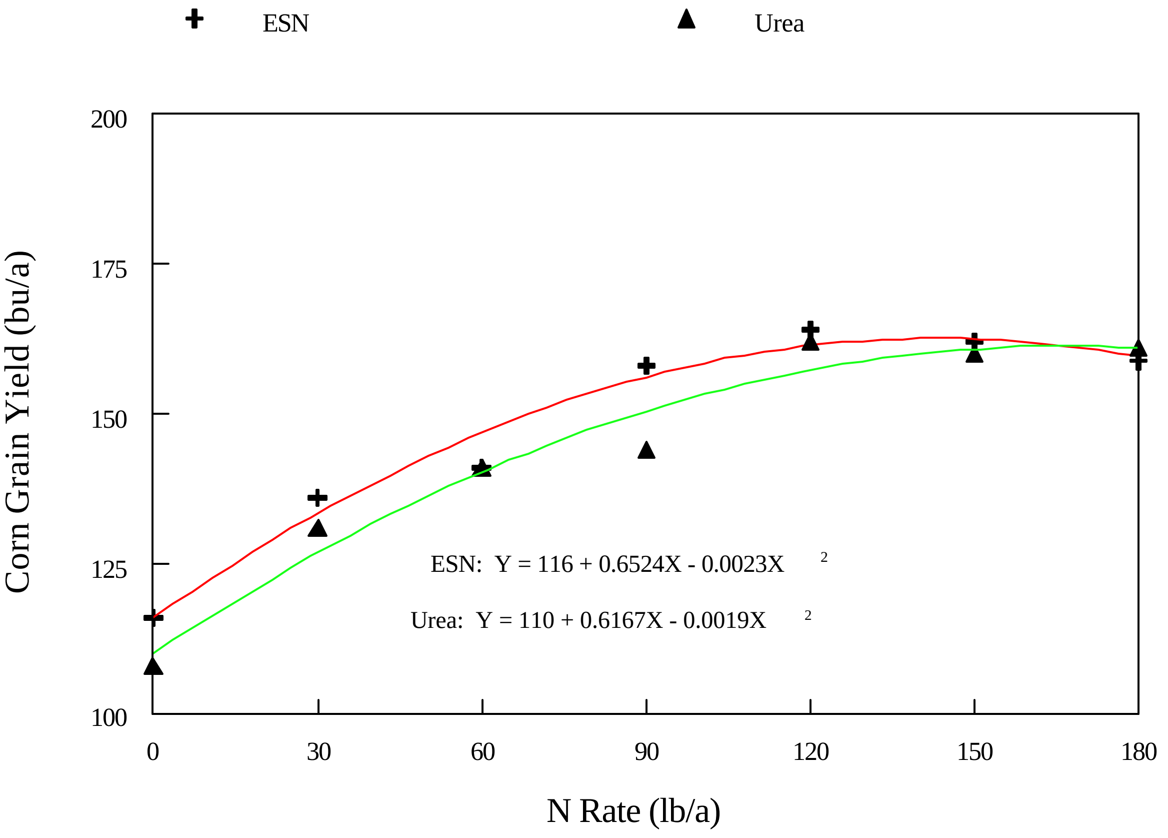
Methods – ESN

- Fall N application
  - Located in NC Iowa on a fine-textured, reasonably well drained soil developed in Loess parent material.
  - Previous crop: soybean.
  - N applied as both urea and ESN at rates of 0, 30, 60, 90, 120, 150, and 180 lb N/a in Fall 2002 and urea applied at the same rates the following spring.
  - Measurements
    - Whole-plant yield and N conc.
    - Grain yield and N conc.

Fall ESN Study, Fall vs Spring Application



Spring Applied ESN Study



Results - ESN

- Fall Study
  - Response to N rate at all times of application
  - Yields of Fall ESN and Spring urea treatments were the same even though the Spring urea was not incorporated.
  - Yields of Fall ESN and Spring urea treatments were higher than Fall urea treatments.
- Spring Study
  - Response to N rate at both sites
  - Yields of ESN were higher than urea treatments at one site but not the other.

Conclusions – NI Study

- Based on 10 years of data:
  - Profitable responses to addition of nitrapyrin to Spring applications of anhydrous ammonia should not be expected every year.
  - Decreases in grain yield were observed so careful consideration of the possible consequences of nitrapyrin use on fine-textured soils of the Midwest is warranted.
  - Annual use of nitrapyrin reduced profit by the cost of of the material.

Preliminary Conclusions – ESN Study

- Fall Application
  - N fertilizer use efficiency (bushels/lb applied N) was increased by the use of ESN.
  - This material may be a reasonable replacement for Fall applied anhydrous ammonia.
- Spring Application
  - ESN increased N fertilizer use efficiency at one site but not the other.
- More data, collected under different environmental conditions, are required before recommendations can be made

Note

In all cases grain yield response to N rate was greater than response to addition of nitrapyrin or use of ESN.

Determining and applying optimum N rates is the most important aspect of N fertilizer management.