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Corn Response to Urea-N and Pelletal Limestone in 1999

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Abstract
Acidification from ammonium-nitrogen (N) fertilizers is inevitable in soil because nitrification (conversion of ammonium-N to nitrate-N) yields acidic hydrogen ions [H+]. Where N fertilizers are applied, soil fertility specialists recommend that soil sampling be undertaken every three to four years to determine (1) soil acidity, (2) if soils are acid, the amount of liming material needed to neutralize that acidity and restore soil pH to a desired level, and (3) the amount of plant nutrients available from a soil to recommend needed fertilizer. This experiment was undertaken to determine if a pelletal limestone (PLP) product, SuperCal 98, combined with urea fertilizer and banded in soil would prove beneficial to corn.

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Introduction

Acidification from ammonium-nitrogen (N) fertilizers is inevitable in soil because nitrification (conversion of ammonium-N to nitrate-N) yields acidic hydrogen ions [H^+]. Where N fertilizers are applied, soil fertility specialists recommend that soil sampling be undertaken every three to four years to determine (1) soil acidity, (2) if soils are acid, the amount of liming material needed to neutralize that acidity and restore soil pH to a desired level, and (3) the amount of plant nutrients available from a soil to recommend needed fertilizer. This experiment was undertaken to determine if a pelletal limestone (PLP) product, SuperCal 98, combined with urea fertilizer and banded in soil would prove beneficial to corn.

Materials and Methods

A site at the Northwest farm was chosen that had grown soybeans in 1998 and that had tested moderately acid (5.8 – 6.0 pH) and possessed adequate phosphorus (P) and postassium (K) values of 27 and 213 lbs/acre, respectively. The site was planted with DeKalb Bt hybrid. Urea and PLP treatments were side-dress applied four weeks after corn had emerged. A complete factorial combination was used of urea (0, 50, 100 and 150 lbs N/acre) and PLP combined at a ratio of 100 lbs N to 185 lbs effective calcium carbonate equivalent (ECCE) – see Tables 1 and 2 for treatments. This ratio of N to ECCE is capable of neutralizing acid H^+ produced by nitrification of ammonium-N resulting from hydrolysis urea in soil. The corn plots consisted of four row, each spaced 30 in. apart and 70 ft long. The plots were combine harvested; the grain was weighed and moisture contents obtained on the combine. A one pound subsample was collected to be returned to Ames. The grain samples were analyzed at the ISU Grain Quality Laboratory where protein, oil, starch and kernel density measurements were reported. Following harvest, eight inches of stalk beginning eight inches above the ground were collected from six plants in each plot and transported back to Ames for drying and analysis of chloride (Cl), nitrate-N, inorganic-P, and sulfate-sufur contents by water extraction and ion chromotography methods. A 0.1 ***N*** hydrochloric acid extraction was conducted to determine calcium, magnesium and K contents of the stalk samples too.

Results and Discussion

Results from this experiment are reported in Tables 1 and 2. Plots receiving no N yielded an average of 151 bushels per acre. The addition of 50, 100 and 150 lb per acre of N incrementally increased yields about nine, seven and two bushels per acre, respectively. Grain protein content increased significantly ($P>0.05$) with increasing rates of N application and the addition of PLP. Grain oil and starch contents generally declined with increasing N applications and PLP addition. Stalk tissue analysis showed less nitrate-N contents with PLP combined with 50 - 150 lbs of N than with N alone. Stalk tissue Cl content and inorganic- P contents were likewise reduced with the addition of PLP to urea fertilizer. This experiment showed that banded applications of a PLP with urea can increase corn grain protein content, an important quality for corn to be fed to livestock.

Acknowledgments

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Table 1. Corn response to urea-nitrogen and pelletal limestone[a].

		Harvest and grain quality data					
Urea-N[b]	Super-Cal 98	Moisture	Yield	Protein	Oil	Starch	Kernel density index
pounds/acre		percent	bushels/acre	----------percent----------			
0	0	13.7	151	6.6	4.3	61.6	1.28
0	93	13.6	152	6.4	4.1	62.0	1.28
0	185	13.6	150	6.4	4.2	62.0	1.27
0	278	13.6	152	6.6	4.3	61.7	1.28
50	0	13.7	162	7.2	4.2	61.2	1.28
50	93	13.6	159	7.4	4.0	61.2	1.28
100	0	13.6	167	7.4	4.1	61.1	1.28
100	185	13.5	168	7.7	4.1	60.9	1.28
150	0	13.6	167	7.2	4.2	61.2	1.28
150	278	13.6	171	7.8	4.0	60.8	1.28
Maximum		14.0	191	8.0	4.6	62.7	1.29
Minimum		13.3	144	5.7	3.8	60.5	1.27
Average		13.6	160	7.1	4.1	61.4	1.28
Standard deviation		0.1	10	0.6	0.2	0.5	0.00

[a]Response data are the average of six replications. Summary statistics of all data are given at the bottom of the table.
[b]Values given are pounds of nitrogen.

Table 2. Post-harvest corn stalk response to urea-nitrogen and pelletal limestone[a].

Urea-N[b]	Super-Cal 98	Chloride	Nitrate-Nitrogen	Inorganic Phosphorus	Sulfate-sulfur	Calcium	Magnesium	Potassium
pounds/acre		----------parts per million----------						percent
0	0	1,847	388	512	104	841	1,158	1.40
0	93	1,572	23	267	55	993	1,352	1.22
0	185	1,772	1	283	101	871	1,155	1.29
0	278	1,857	15	341	63	958	1,308	1.28
50	0	1,402	409	225	57	897	1,160	1.25
50	93	934	1,111	83	130	753	988	1.13
100	0	1,318	205	224	280	827	1.062	1.21
100	185	825	631	153	35	960	1,233	0.85
150	0	1,173	1,500	184	96	937	1,216	1.27
150	278	738	2,065	92	163	870	1,165	1.07
Maximum		3,513	4,543	998	722	1,220	1,704	2.33
Minimum		252	1	10	1	377	420	0.46
Average		1,344	412	236	101	891	1,180	1.20
Standard deviation		690	962	256	134	201	305	0.37

[a]Response data are the average of six replications. Summary statistics of all data are given at the bottom of the table.
[b]Values given are pounds of nitrogen.