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Lime and Tillage Research Project

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Abstract

Farmers growing corn and soybean in northwest Iowa have to consider the cost of ag lime when liming their soils. This is because of high limestone cost and the fact that the soils in northwest Iowa have high pH subsoil. The high pH subsoil moderates the potential negative effect on crop production from acid surface soil. Another factor that must be considered is the variable mixing of limestone into the soil with different tillage systems. The different amounts of soil mixing among no-tillage systems, ridge-tillage systems, and full-width tillage systems may affect the amount of limestone needed to correct soil pH and liming effect on crop yield.

Disciplines

Agricultural Science | Agriculture

Lime and Tillage Research Project

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Introduction

Farmers growing corn and soybean in northwest Iowa have to consider the cost of ag lime when liming their soils. This is because of high limestone cost and the fact that the soils in northwest Iowa have high pH subsoil. The high pH subsoil moderates the potential negative effect on crop production from acid surface soil. Another factor that must be considered is the variable mixing of limestone into the soil with different tillage systems. The different amounts of soil mixing among no-tillage systems, ridge-tillage systems, and full-width tillage systems may affect the amount of limestone needed to correct soil pH and liming effect on crop yield.

Materials and Methods

An experiment was designed to evaluate different rates of ag lime with three different tillage systems in 1994. The soils in the experimental area consist of Galva, Primghar, and Marcus soils, which are typical of the predominant upland soils in northwest Iowa. The initial pH of the surface 0–6 in. in the experimental area was 5.6 in 1993. The results of the ten years of this experiment are presented here.

Results and Discussion

Soil pH was increased with ag lime application in this experiment (Tables 1, 2, and 3), with higher ag lime rates resulting in more pH correction and higher pH. The pH increase initially occurred where the ag lime was physically placed through the 6-in. incorporation zone with a chisel plow and at the soil surface (0–2 in. depth) with no-tillage and ridge-tillage. Over time, soil pH also increased in the 2–6 in. depth with no-tillage and ridge-tillage, but the increase was not as large as in the surface two inches. With the highest application rates, the effect of ag lime on soil pH persisted over the time of the study, but soil pH was beginning to decrease toward the end. Also, soil pH returned back to the beginning soil pH level fairly quickly with the low application rates.

Soil pH information from 1995 and 1997 are reported in the 1999 Annual Progress Report for the Northwest Iowa Research Farms. The effect of tillage system on crop yields was analyzed for the 1994 to 1998 data and is reported in the 1999 Annual Progress Report. Soil pH information and crop yield information from 1999 and 2001 are reported in the 2002 Annual Progress Report.

Information from this experiment shows that low rates of limestone (1,000 or 2,000 lb/acre of ECCE) can increase soybean yields slightly in the short term with relatively small effects on soil pH (Table 4). It appears from this data that the high rates of limestone (4,000 or 6,000 lb/acre of ECCE) have a positive effect on soybean yield even after seven to ten years. However, the yield increase toward the end of the study was not as large as in earlier years. The highest rate of limestone (6,000 lb/acre of ECCE) did produce the highest soybean yields most years and for the 10-year average, and it maintained the soil pH above 6.0 over the period of study. Ag lime applications were effective when incorporation was minimal, for the no-tillage and ridge tillage systems, as there was no difference in yield response to ag lime application among the three tillage systems.

Ag lime application did not affect corn yield any year of the experiment (Table 5).

Table 1. Effect of ag lime on soil pH, fall 1999.

	No-Tillage		Ridge-Tillage		Chisel Plow	
	Sample Depth, inch					
ECCE	0-2	2-6	0-2	2-6	0-2	2-6
lb/acre	soil pH					
0	5.2	5.6	5.3	5.7	5.3	5.6
500	5.3	5.6	5.4	5.7	5.5	5.7
1000	5.5	5.7	5.4	5.7	5.7	5.8
2000	5.5	5.7	5.6	5.7	5.7	5.8
4000	6.0	5.8	6.1	5.8	5.9	5.9
6000	6.5	5.9	6.3	5.8	6.2	6.0

Table 2. Effect of ag lime on soil pH, fall 2001.

	No-Tillage		Ridge-Tillage		Chisel Plow	
	Sample Depth, inch					
ECCE	0-2	2-6	0-2	2-6	0-2	2-6
lb/acre	soil pH					
0	5.2	5.7	5.3	5.7	5.4	5.7
500	5.4	5.8	5.5	5.7	5.5	5.8
1000	5.6	5.9	5.5	5.8	5.6	5.8
2000	5.9	5.9	5.7	5.9	5.6	5.9
4000	6.1	5.9	6.0	6.0	5.9	6.0
6000	6.7	6.1	6.4	6.0	6.2	6.2

Table 3. Effect of ag lime on soil pH, fall 2003, average of north and south plot.

	No-Tillage		Ridge-Tillage		Chisel Plow	
	Sample Depth, inch					
ECCE	0-2	2-6	0-2	2-6	0-2	2-6
lb/acre	soil pH					
0	5.2	5.7	5.5	5.6	5.5	5.5
500	5.5	5.8	5.4	5.7	5.5	5.7
1000	5.6	5.7	5.5	5.7	5.4	5.5
2000	5.6	5.9	5.6	5.8	5.7	5.8
4000	6.1	5.8	6.4	6.0	5.6	5.7
6000	6.3	6.0	6.2	6.2	5.8	5.9

Table 4. Effect of ag lime on soybean grain yield.

Ag lime				Year			
ECCE	1994	1997	2000	2001	2002	2003	10-yr avg.
lb/acre							
0	35.2	49.6	46.2	44.1	35.7	42.8	43.3
500	35.5	50.2	46.3	43.3	34.6	43.1	43.6
1000	38.1	54.5	47.7	44.6	36.8	43.2	41.6
2000	38.2	54.1	48.0	44.5	37.3	44.2	45.6
4000	37.7	57.9	49.5	44.8	37.3	42.9	46.2
6000	38.7	57.2	49.7	45.2	37.7	43.9	47.0

Table 5. Effect of ag lime on corn grain yield.

Ag lime				Year			
ECCE	1994	1997	2000	2001	2002	2003	10-yr avg.
lb/acre							
0	171	153	144	156	141	174	152
500	168	150	141	152	140	173	151
1000	170	148	145	154	144	173	152
2000	170	148	140	151	138	172	151
4000	171	151	140	147	142	168	151
6000	166	149	140	154	142	169	151