

SOIL 4234
SOIL 4234 Laboratory

Managing Acid Soils

Overview:

Soil acidity may limit production of some crops because they can not tolerate the toxic effect of aluminum (Al^{+++}) and manganese (Mn^{++} and Mn^{+++}) metal ions. Solubility of these ions increases greatly when soil pH decreases below about 5.5. Productivity of soils with pH below 5.5 may be improved by liming them to raise the pH or adding other materials, which decreases the activity of toxic ions. Farmers often observe several months' delay from the time they apply lime until the soil pH has changed. This delay is believed to be a result of low solubility of lime and inadequate neutralizing of exchangeable acidity when lime is not mixed well with the soil.

Objectives:

In this exercise we will examine how different liming materials, and gypsum influence soil pH initially, and over time.

Materials:

1. Acid soil (pH 4.5, BI 6.9)
2. Ground aglime (ECCE = _____%).
3. Pelleted lime (ECCE = _____%).
4. "Liquid" lime (ECCE = _____%).
5. Technical grade gypsum ($CaSO_4 \bullet 2H_2O$).
6. 30-cm clear plastic tubes, capped end, 4.34 cm diameter.
7. pH meter, disposable 1-ml pipettes, graduated cylinders.

Table 1. Treatment Structure:

Trt / bench	Product	Application	Timing (weeks)	Rate (t) x
1 / 1	Ag Lime	Surface	3	1
2 / 1	Ag Lime	Mixed / Tillage	3	1
3 / 2	Ag Lime	Mixed / Tillage	1	1
4 / 2	Pelletized Lime	Surface	3	1
5 / 3	Pelletized Lime	Mixed / Tillage	3	1
6 / 3	Pelletized Lime	Mixed / Tillage	1	1
7 / 4	Liquid Lime	Surface	3	1
8 / 4	Liquid Lime	Mixed / Tillage	3	1
9 / 5	Liquid Lime	Mixed / Tillage	1	1
10 / 5	Gypsum	Surface	3	1
11 / 1	Gypsum	Mixed / Tillage	3	1
12 / 1	Gypsum	Mixed / Tillage	1	1
13 / 2	Ag Lime	Mixed / Tillage	3	.5
14 / 2	Ag Lime	Mixed / Tillage	3	2
15 / 3	UAN	Mixed / Tillage	3	1000
16 / 3	UAN	Mixed / Tillage	3	2000

Procedures:

Treatment Preparation. Lime materials will be added at the amount (X) of effective calcium carbonate equivalent (ECCE) lime required to raise the soil pH to 6.8 (see pg 45 of Oklahoma Soil Fertility Handbook). A one-ton per acre rate of material is approximately equal to 1.00 g per tube. Calculate and record the amount of each material to add. Students/ benches will be assigned to trts and then prepare treatments according to the grouping in Table 1, groups 1-5 Lab Section 1, groups 5-7 Lab Section 2.

For Trts, 1,4,7,10: Fill tube with soil to approx 9 inches in depth. Add the liming material then 1 inch of water.

For all other treatments: Fill tube with soil to the 6 inch mark. Dump this soil into a bowl. Add the liming material into the bowl and mix thoroughly. Add 3 inches of new soil to the tube then place the soil mixed with lime into the tube. After this add 1 inch of water.

pH Measurements:

1. weigh 12.0 g of moist mixture into a plastic cup
2. add 12 mL distilled water
3. cover, gently shake or stir, allow to stand for 10 minutes
4. gently shake or stir and determine pH
5. record pH in Table 2

Table 2. Results

Treatment	Amount of lime / type	0-1 inch profile pH	1-6 inch profile pH	6-9 inch profile pH
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

Observations and Discussion:

1. The amount of ECCE lime required to change the soil to pH 6.8 would be _____ ton/acre, and to change the pH to 5.5 would be _____ ton/acre.
2. The most effective material, at the 1.0 X rate, was _____, added to the soil by _____ (mixing or surface applying). (See your Figure 2 plot)

3. The least effective, acid neutralizing, material added to soil was _____.

Explain why this material was ineffective:

4. Explain why pH of the soil + lime mixtures was not immediately 6.8 or higher after one week.

5. Explain why mixing of lime and soil is important to neutralizing soil acidity.

6. If the aglime were only 60% ECCE, the amount required to raise the soil to pH 6.5 would be _____ tons/acre.

7. The reason a clay soil has the greatest buffer capacity than a sandy soil is because this soil has more

_____.