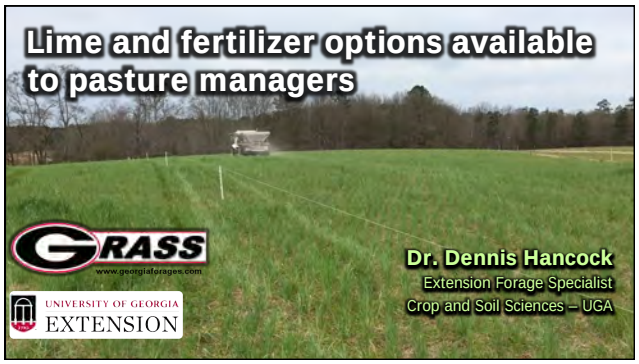
2018 Georgia Grazing School:
Lime and fertilizer options available to pasture managers

Dr. Dennis Hancock
Prof. & Forage Ext. Specialist



Fertilizer Bag

Guaranteed Analysis 19-19-19

Total Nitrogen (N)	19.00%
10.6% Ammoniacal Nitrogen	
8.4% Urea nitrogen	
Available Phosphoric Acid (P_2O_5)	19.00%
Soluble Potash (K_2O)	19.00%
Sulfur (SO_4)	12.00%
Calcium (Ca)	0.05%
Magnesium (Mg)	0.04%
Boron (B)	0.01%
Copper (Cu)	0.02%
Iron (Fe)	0.10%
Total Manganese (Mn)	0.02%
Molybdenum (Mo)	0.0005%
Zinc (Zn)	0.05%

Common Nitrogen Sources

Nitrogen Source	Content	Approx. CCE*
Ammonium Nitrate	34-0-0	-61
Amm. Sulfate	21-0-0-24	-110
Anhyd. Ammonia**	82-0-0	-148
UAN Solution		
32% (35% U + 45% AN)	32-0-0	-55
28% (30% U + 40% AN)	28-0-0	-49
Urea	46-0-0	-81
Urea (Sulfur-coated)	38-0-0-16	-118
Poultry Litter	3-3-2	~10

* Approximate $CaCO_3$ (limestone) equivalent per 100 lb of product. For example, it will take 61 lbs of pure lime to neutralize the acidifying effect that ammonium nitrate has on the soil.
** Must be injected into the sod. Not recommended for forage production.

Other Common Fertilizer Sources

Nutrient Source	N	P_2O_5	K_2O	S	Ca	Mg	Comments
	---------- % ----------						
Diammonium Phosphate	18	46	-	-	-	-	Commonly called DAP; used to provide P and part of N needs.
Monoamm. Phosphate	11	48	-	-	1	-	Commonly called MAP; used to provide P and part of N needs.
Triple Superphosphate	-	46	-	2	14	-	Usually used in blends with other fertilizers.
Murate of Potash	-	-	60	-	-	-	One of most widely used fertilizers. Common in blends.
Poultry Litter (Broiler)	3	3	2	1	2	-	Highly variable. Only 50% of N is available.
Cattle Manure	1.5	1.5	1.2	-	1.1	0.3	Data represent feedlot. Manure from barn will be lower in N.
Sulfate of Potash Magnesia	-	-	21	23	0	11	Second most common form of K fertilizer.

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Biosolids

- Digested, composted, and lime stabilized
- Lime stabilized biosolid
  - Analysis approx. 4-5-0.2 (only 30% of N available)
  - Usually about 400 lbs ag lime per dry ton
- Permit required to apply
- No cost to landowner



Chris Teutsch, Virginia Tech

Pelleted Biosolids

- Dried and pelleted biosolids
- Handles like a granular fertilizer
- Analysis of 6-6-0.6 (30% of N available)
- Cost is about $50 per ton spread
- Limited availability



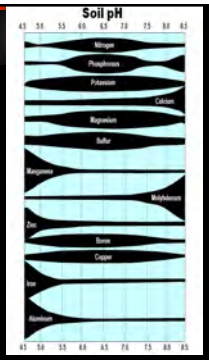
Chris Teutsch, Virginia Tech

DO NOT cut back on lime!

Get your priorities right!

1. Lime is still job #1.
   - Nutrient availability
   - Soil structure
   - Soil biological activity
   - Aluminum toxicity

How Soil pH Affects Availability of Plant Nutrients

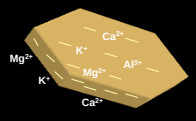


The difference of a soil pH of 5.6 vs. 6.2:

Nutrient	Amt. Used Annually (Lbs/acre)	Unit Price ($/lb)	Dec. in Efficiency	Value of Decrease ($/acre)

How Soil Holds Nutrients

Soil Particle

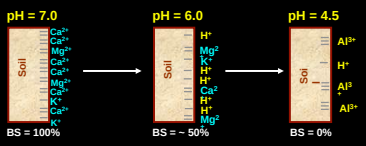


CEC = 10

Organic Matter

CEC = 200

Soil Acidity and CEC



Strength of cations:
$Al^{3+} > H^{+} > Ca^{2+} > Mg^{2+} > K^{+}$

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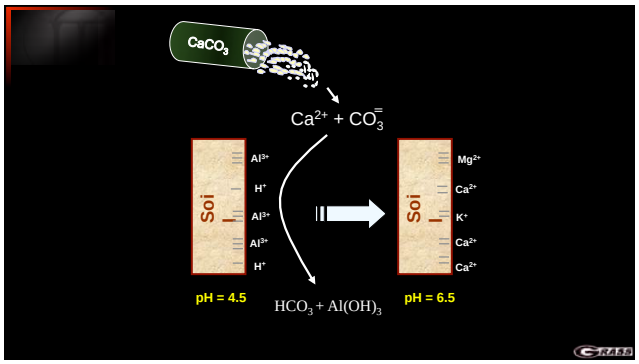

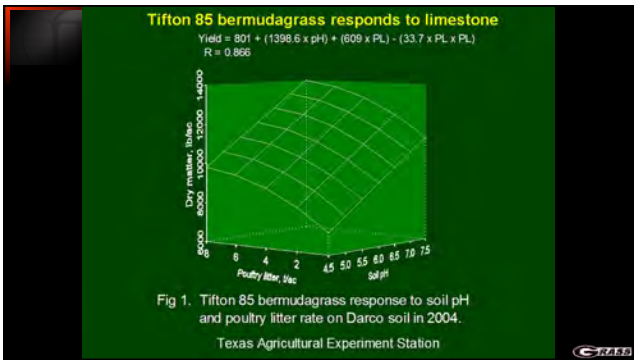

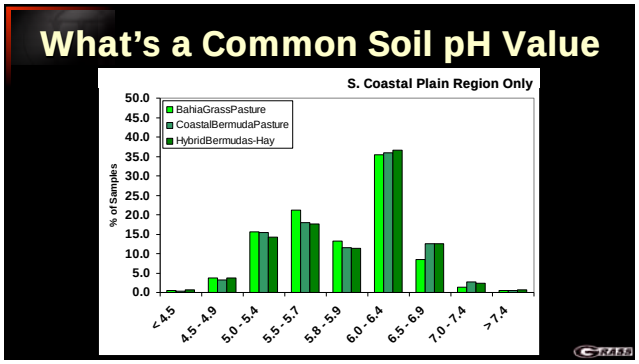

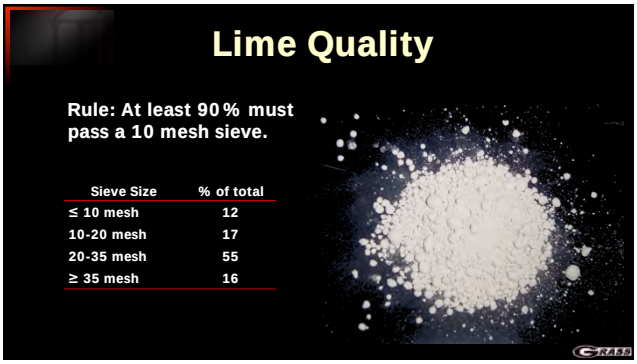

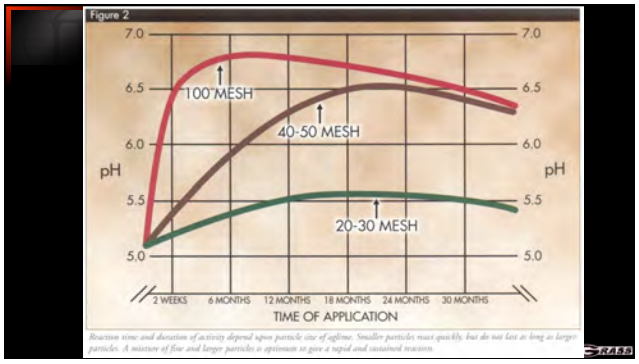

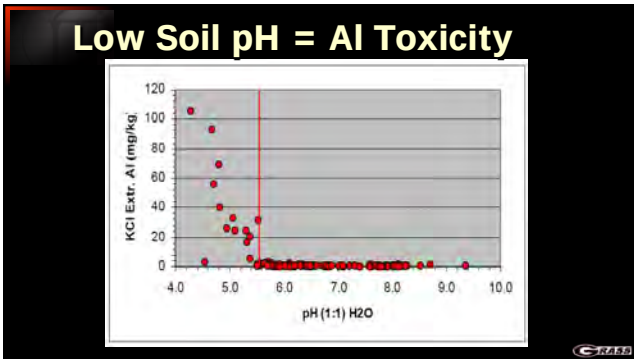

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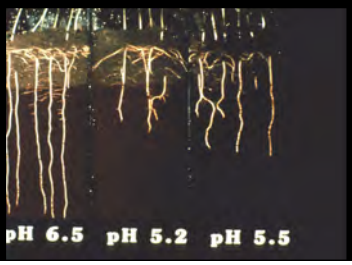
Soil pH Problems Exacerbate a Drought



Paper Mill Lime Mud

Table 1. Typical concentrations of nutrients and minerals in lime mud from pulp and paper mills compared to agricultural lime.

Minerals	*Lime Mud**	*Agricultural Lime*
Nitrogen (%)	0 - 0.2	0.01
P_2O_5 (%)	1 - 1.2	0.06
K_2O (%)	0.2 - 1.4**	0.13
Calcium (%)	28 - 50**	31
CCE (%)	91 - 100	80 - 100
Magnesium (%)	0.2 - 1.0**	5
Sulfur (ppm)	0.19***	na
Boron (ppm)	7.91***	na
Copper (ppm)	3 - 66	10
Zinc (ppm)	4 - 93	113

"Recyclime"

Paper Mill Lime Mud

"Recyclime"

Table 2. Trace metals concentrations in lime mud and agricultural lime.

Minerals	*Lime Mud**	*Agricultural Lime****
Arsenic (ppm)	1.71**	<1 - 3
Cadmium (ppm)	bd - 0.5	<0.1 - 1.1
Lead (ppm)	bd	1.3 - 130
Mercury (ppm)	<0.05**	<0.01 - 0.02
Molybdenum (ppm)	bd - 0.1	0.3 - 0.5
Nickel (ppm)	3.3 - 71	7.0 - 17
Selenium (ppm)	bd - 7.6	<1

Wood Ash

Table 1. Range in elemental composition of industrial wood ash samples and ground limestone.

Element	Wood Ash*	Limestone**
Macroelements	---- Concentration in % ----	
Calcium	15 (2.5-33)	31
Potassium	2.6 (0.1-13)	0.13
Aluminum	1.6 (0.5-3.2)	0.25
Magnesium	1.0 (0.1-2.5)	5.1
Iron	0.84 (0.2-2.1)	0.29
Phosphorus	0.53 (0.1-1.4)	0.06
Manganese	0.41 (0-1.3)	0.05
Sodium	0.19 (0-0.54)	0.07
Nitrogen	0.15 (0.02-0.77)	0.01

Wood Ash

Table 1. Range in elemental composition of industrial wood ash samples and ground limestone.

Element	Wood Ash*	Limestone**
Microelements	---- Concentration in mg/kg ----	
Arsenic	6 (3-10)	—
Boron	123 (14-290)	—
Cadmium	3 (0.2-26)	0.7
Chromium	57 (7-386)	6.0
Copper	70 (37-207)	10
Lead	65 (16-137)	55
Mercury	1.9 (0-5)	—
Molybdenum	19 (0-123)	—
Nickel	20 (0-63)	20
Selenium	0.9 (0-11)	—
Zinc	233 (35-1250)	113
Other Chemical Properties		
$CaCO_3$ (%)	43 (22-92)	100
pH	10.4 (9-13.5)	9.9
Total solids (%)	75 (31-100)	100

Poultry Litter & Liming

- Calcium in PL provides some liming value
  - about 1/10th strength of limestone
- NW Georgia after 4 years
  - PL at 4 t/ac pH= 5.76
  - NO_3NH_4 (no lime) pH= 5.18
- NE Georgia after 5 years
  - PL at 4 t/ac pH= 6.6
  - NO_3NH_4 + lime pH= 6.0

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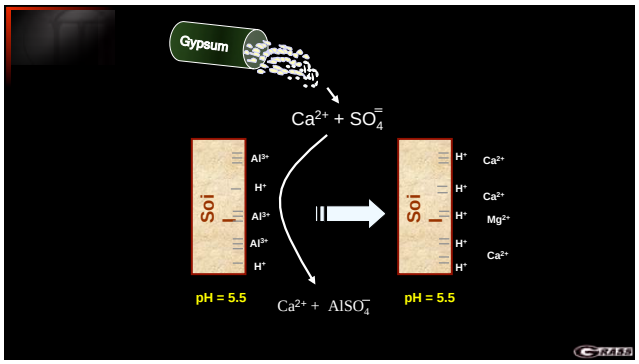
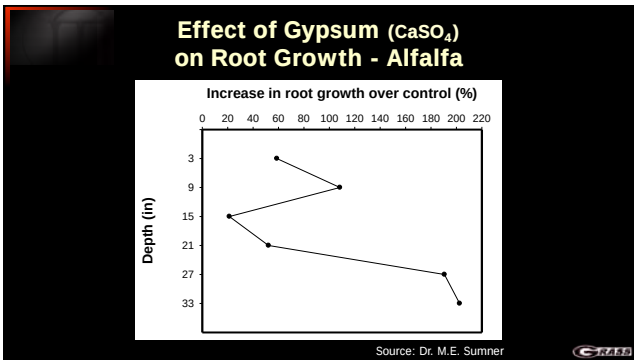


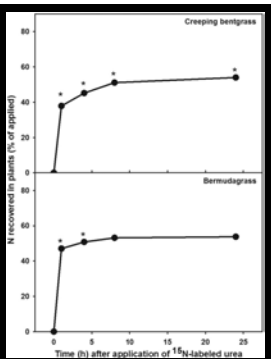


Foliar Fertilizer Applications

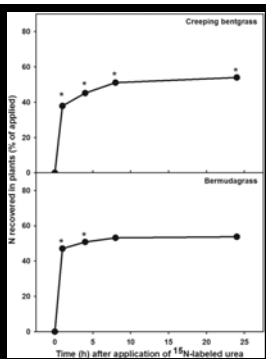
- Even if the product is 100% efficient (likely isn't)
- The most a plant can take up across via the leaves is the equivalent of 10-12 lbs/acre of the nutrient
  - Works for many micro-nutrients (small quantities needed)
  - Not feasible for macro-nutrients without multiple applications. (large quantities needed)

Foliar Fertilization for Forage Crops?

- Over 50% of applied N is absorbed in < 5 hrs.
- But, this is at relatively low rates
  - Avg. over 4.5 and 11 lbs of N/ acre in this study.
  - Stiegler et al., 2010. Crop Sci. 51:1253-1260.



- Even if 60% absorption, at rate of 11 lbs/acre, that's only 6.7 lbs of N absorbed foliar.
  - Highest rate of absorption I could find in literature.
- At higher rates, foliar fertilizers often burn (salt or chemical injury) the plant tissue
- In a separate study (Totten et al., 2008. J. Plant Nutr. 31:972-982), no consistent difference in clipping yield of turf.



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Other Highly Questionable Products

- "Liquid lime"
  - Requires too much product to show a significant pH change
- Liquid calcium "$CaCl_2$"
  - Adds calcium but does nothing to pH and the added Ca is only effective if pH is in 6.3+ and it is low.