Soil Fertility Considerations

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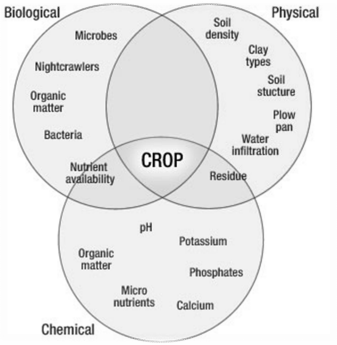
Outline

- Soil fertility
  - Definition
  - Soil types
- What nutrients do my plants need?
  - Grasses
  - Legumes (N-fixers)
  - Other dicots
- What fertilizer(s) will you use?
  - Liming agents
    - Hydrated, Ag-lime, Wood ash, others
  - N, P, K, and the rest of the gang…
    - Liquid versus dry formulations
    - Quick-release versus controlled release
    - Slow release
      - Manures vs. biosolids versus composts

Soil Fertility….



Soils common to south/central Florida

Flatwood soils (Spodosols)
Organic matter and Al layer (spodic horizon) in the subsoil. They are typically poorly drained and are in in flatwoods.

Deep sands (Entisols)
Generally young, sandy soils that show little or no horizon development.

Soils common to north Florida

Red soils (Ultisols)
Contain greater clay and a low amount of base cations (K, Ca, Mg). The deep soils range from well-drained on upland ridges to very poorly-drained soils.

Red soils (Alfisols)
Similar to ultisols but contain greater amounts of base cations. Limestone sometimes occurs below the clayey zone.

Organic Matter

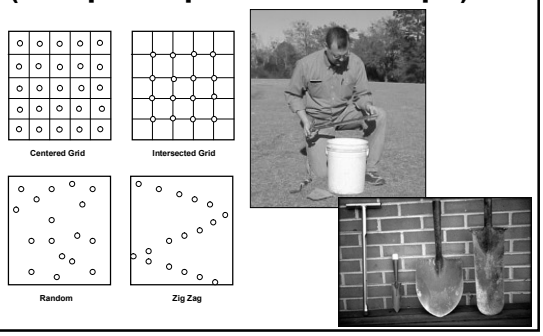
- Properties
  - High fertility and nutrient storage capacity
  - Optimal microbial activity and mycorrhizal associations
  - Rich, dark color
- Benefits
  - Improved aeration and permeability in clay soils
  - Improved water holding and nutrient retention capacity in sandy soils

Soil Sampling

- **Sample soil 6 - 8 inches deep at least every 2 – 4 years (periodic deeper sampling may be useful).**
- **Composite ~ 10 samples per 10 acre field.**
- **Air-dry composite sample prior to packaging and shipping for analysis.**
- **BEWARE: Extraction methods may vary among labs so results may also vary.**
- **Lime as required!!**

Example for sampling a field or plot

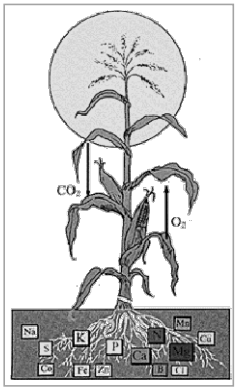
(each point represents a subsample)



What to feed a plant?

Plant Essential Nutrients

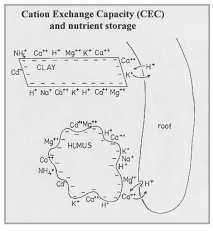
Nutrient	Ionic form in soil solution
N	NH_4^+, NO_3^-
P	PO_4^{3-}
K	K^+
Ca, Mg	Ca^{2+}, Mg^{2+}
S	SO_4^-
Cu, Mn, Fe, Zn	Cu^{2+}, Mn^{2+}, Fe^{3+}, Zn^{2+}
B, Mo, Cl	H_3BO_3, MoO_4^{2-}, Cl^-



Plant Essential Nutrients

(solution and exchangeable)

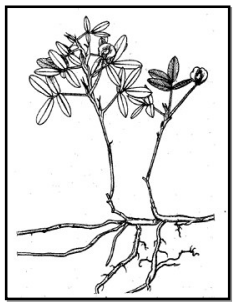
Available nutrient is a portion of the total nutrient in soil.

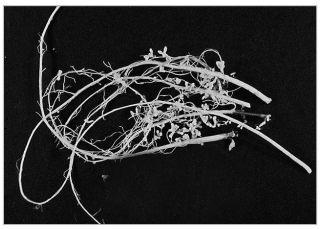


Nutrient Removal by Forages in Florida (example values)

Pound of Nutrient	Bahiagrass (5 ton)	Bermudagrass (5 ton)	Per. Peanut (5 ton)
Nitrogen (N)	**160**	**215**	**355**
Phosphate (P_2O_5)	53	60	55
Potash (K_2O)	223	240	229
Magnesium (Mg)	24	23	**54**
Sulfur (S)	19	26	18
Calcium (Ca)	32	37	**145**

N-fixing Legumes





Nutrient Removal by Forages in Florida

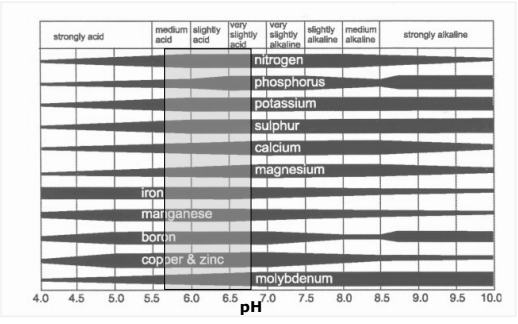
Pound of Nutrient	Bahiagrass (5 ton)	Bermudagrass (5 ton)	Per. Peanut (5 ton)
Manganese (Mn)	1.5	0.8	1.3
Iron (Fe)	0.6	0.6	0.4
Zinc (Zn)	0.31	0.27	0.23
Boron (B)	0.04	0.04	0.28
Copper (Cu)	0.07	0.06	0.04
Molybdenum (Mo)	trace	trace	trace

Pasture Nutrients

- Nitrogen volatilizes so it must be replaced!
- Potash is returned but it may leach.
- Phosphorus is returned but is susceptible to run-off.
- Sulfur is susceptible to leaching.

Lime and Fertilizers

Soil pH Effect on Nutrient Availability



Liming

Particle Size

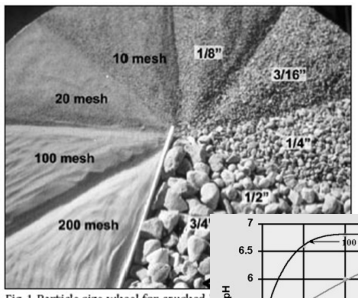
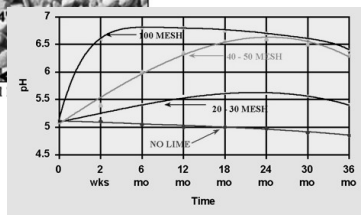


Fig. 1. Particle-size wheel for crushed Association, Washington, D.C.).



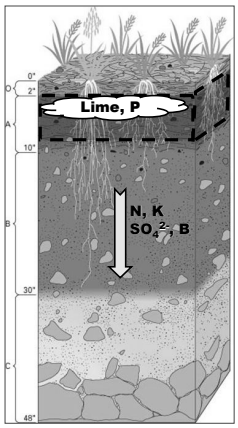
Liming Ability

Liming Materials	Typical CCE (%)
Calcite (pure)	100
Calcitic limestone	75 - 100
Dolomitic limestone	75 - 108
Aragonite	95 - 100
Hydrated lime ($Ca(OH_2)$)	120 - 136
Marl	50 - 90
Burned lime (CaO)	178
Flue dust	60 - 80
Wood ash	30 - 70
Basic slag	50 - 70
Other Materials	
Calcium nitrate	20
Potassium nitrate	23
Rock phosphate	10
Gypsum (land plaster)	0
Urea	-83*
Ammonium sulfate	-110*
Diammonium phosphate	-70*
Humus	9
Milorganite	10
Sludges	20 - 80

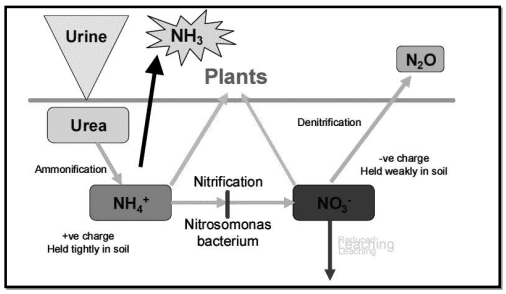
*Materials that acidify.

What are we managing?

- **Upper 6 to 8 inches.**
- **Some nutrients (phosphorus) and limestone (carbonates) will remain near the surface.**
- **Some nutrients (nitrates, potassium, sulfate, boron) will leach out of the surface soil.**



Urea-N can volatilize!



NH_3 loss from bahiagrass sod (Leon fine sand, pH 5.8)

N SOURCE	NO LIME	1 TON 4 M PRIOR
AS	0.5 %	19.7%
UREA	29%	36%
AN	0.3%	3.4%

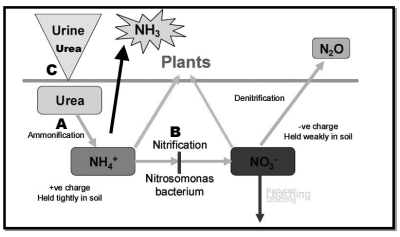
Jerry Sartain, 2004

Inhibiting N availability

A. Urease inhibitors (Agrotain)

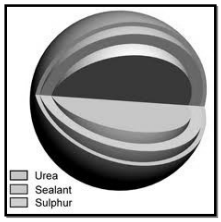
B. Nitrification inhibitors (Agrotain, N-serve, Super-U)

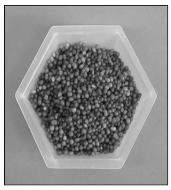
C. Controlled release (coated urea



Dry Urea

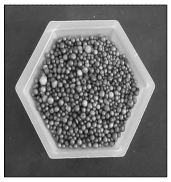
Sulfur coated urea





Polyon

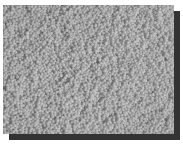
- 40% N
- Polyurethane coated urea
- N release influenced by
  - coating thickness
  - diffusion rate
  - soil temperature
- good for both warm and cool season
- Coating is abrasive resistant

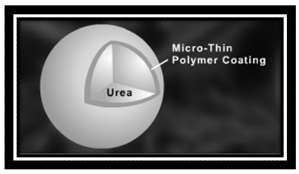


Osmocote

- Usually a coated N P K fertilizer
- N release by diffusion
  - temperature sensitive
  - release rates vary; 3-8, 9-19, and 11-12 months
- Once coating hydrated material must remain moist or coating cracks eliminating control release properties

ESN SmartNitrogen





Legumes as N fertilizer

Legume	Fixed-N (lbs)	Value per Acre (N = 25 cents/lb)	Value per Acre (N = 45 cents/lb)	Value per Acre (N = 65 cents/lb)
Alfalfa	150 - 300	$38 - $75	$68 - $135	$98 - $195
Red Clover	75 - 200	$19 - $50	$34 - $90	$49 - $130
White Clover	75 - 150	$19 - $38	$34 - $68	$49 - $98
Annual Legume*	50 - 150	$13 - $38	$23 - $68	$33 - $98

**Annual legumes include vetch, lespedeza, crimson clover and arrowleaf clover.*

Adapted from source: Gary Lacefield, Extension Forage Agronomist, University of Kentucky

Potential N Contributions

Management	Yield	N contribution
Monoculture	----------(pounds per acre)----------	
Drought or low fertility		
Cowpea, Winter pea	500 to 1,000	15 to 30
White clover	500 to 1,000	15 to 40
Good conditions		
Cowpea, Winter pea	1,000 to 1,500	50 to 95
Alfalfa/red, arrowleaf, crimson clovers	2,000 to 3,000	100 to 150
Mixed with Grass		
Thick stand		
Alfalfa/red, arrowleaf, crimson clovers	1,500	30 to 60
Vetch	2,000	40 to 60
Hop clover	1,000	15 to 30
Scattered (1 plant/yd^2)		
Alfalfa/clovers/vetch	100	1 to 5

Oklahoma Cooperative Extension, PSS-2590

Need micronutrients? Suggested Application Rates…

- Boron = 0.5 lb/ac
- Copper = 3.0 lb/ac
- Zinc = 3.5 lb/ac
- Iron = 3.5 lb/ac
- Manganese = 3.0 lb/ac

Let's play plant detective…