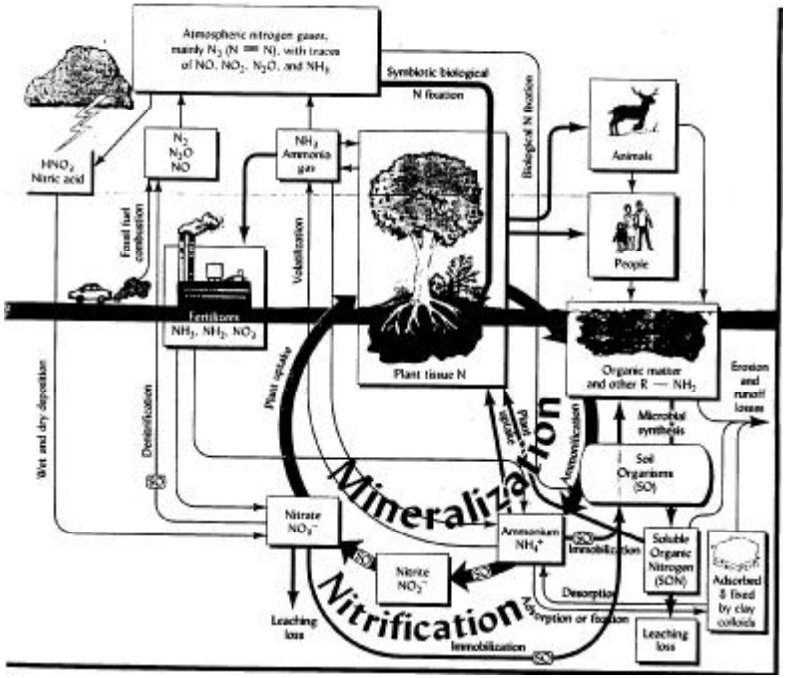
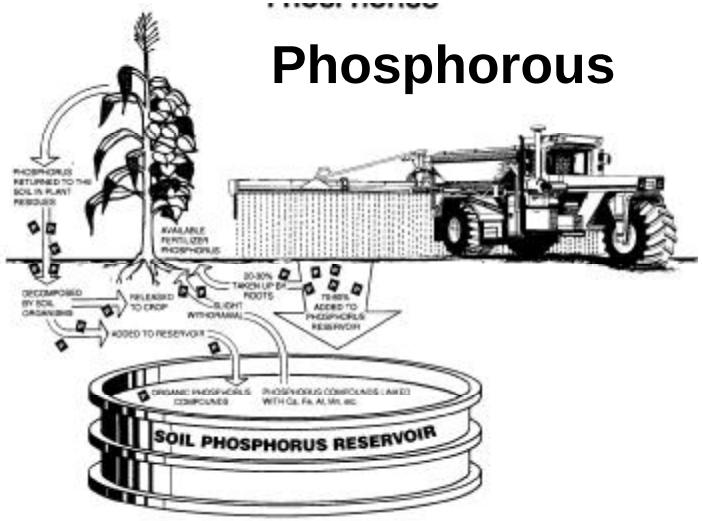
Cotton Fertility

Glen Harris
University of Georgia (Tifton)

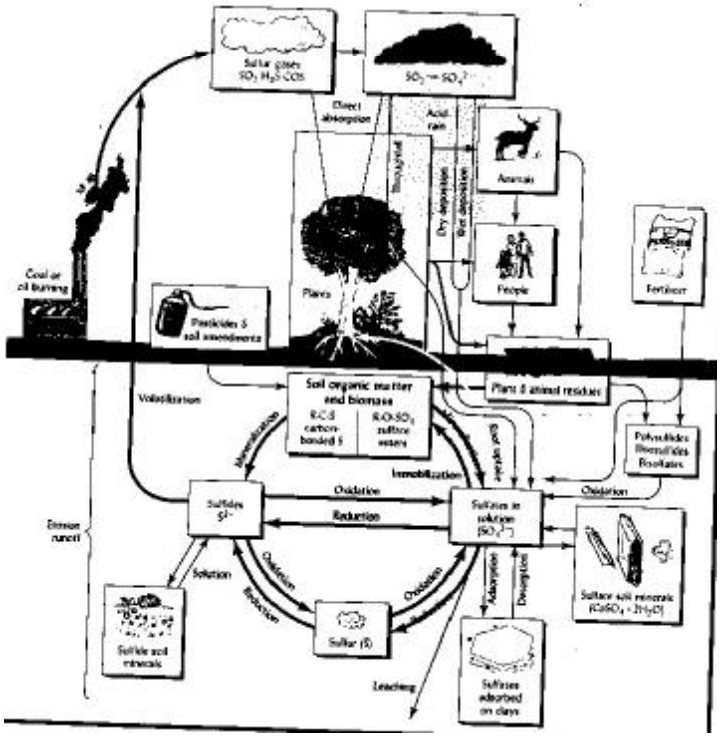
Nitrogen



Phosphorous



Sulfur



Forms Taken Up by Plants

N- Nitrate (NO_3^-) and ammonium (NH_4^+)
P – Phosphate (HPO_4^-)
S – Sulfate (SO_4^-)

How They Get to Plant Roots

N- mass flow (some diffusion)
P – diffusion (root interception?)
S – mass flow

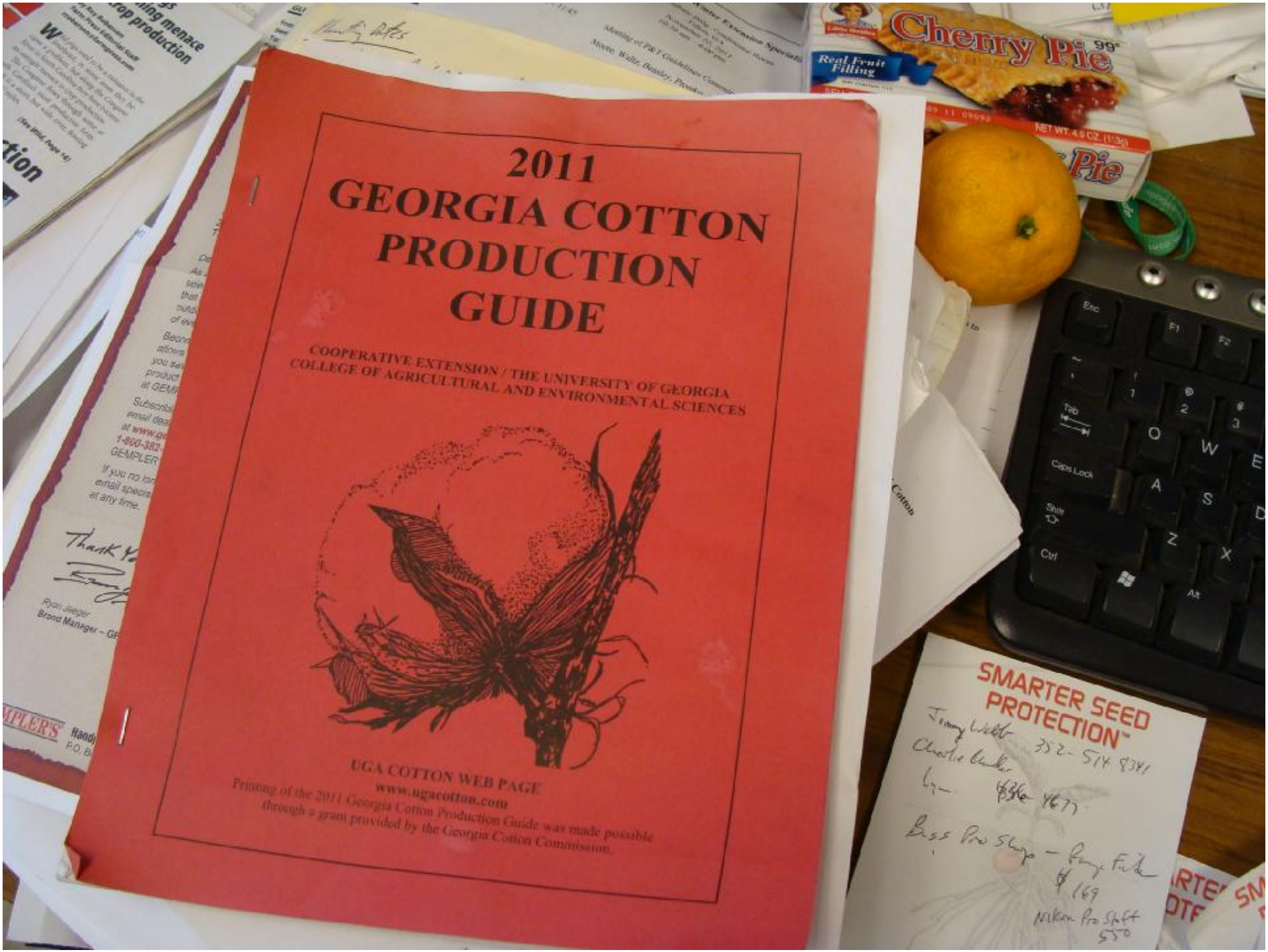
Role in Plants

N- protein, chlorophyll, photosynthesis
P – energy, ATP, photosynthesis
S- protein, chlorophyll, photosynthesis

Teaching in Tifton (est. 2003 -)


5 Bale
Cotton !

How To Make 5-Bale Cotton… (and Other Lies !)


2011
GEORGIA COTTON
PRODUCTION
GUIDE
COOPERATIVE EXTENSION / THE UNIVERSITY OF GEORGIA
COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES
UGA COTTON WEB PAGE
www.ugacotton.com
Printing of the 2011 Georgia Cotton Production Guide was made possible through a grant provided by the Georgia Cotton Commission.
Cherry Pie
Real Fruit Filling
SMARTER SEED PROTECTION™

Products Tested on Cotton in 2011

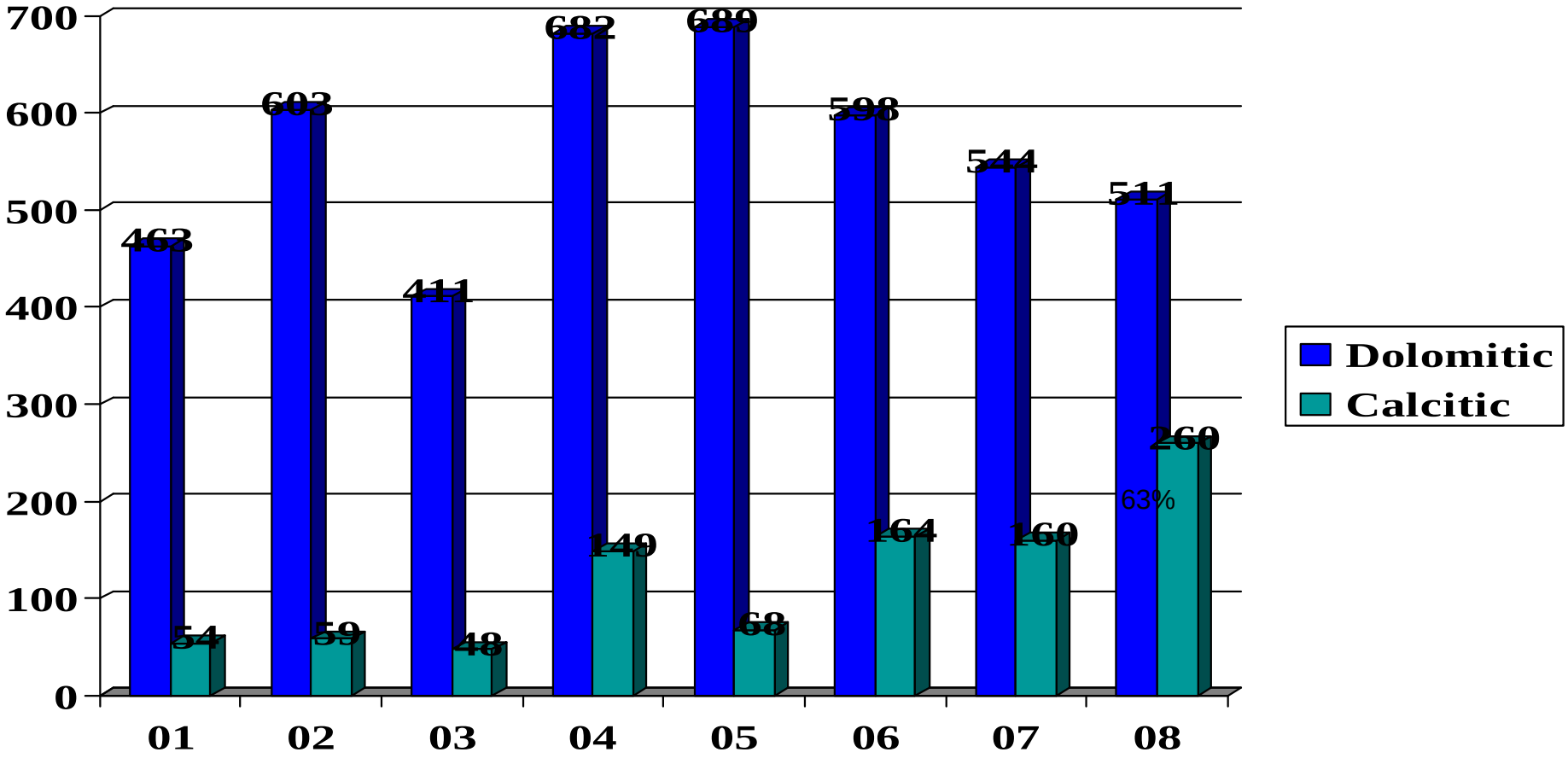
Agrotain
Nutrisphere
Nstay (and StayN)
Nzone
Agrinos
Locomotive
ReinforceK
Soil Set
Grain Set
Sysstem KDL
Sysstem Mn
Wood Ash
Monty’s Joy Juice
pH-AGRA


PLAN GRA
Gives Your Plants The Boost To Produce
pH-AGRA™


PLANT-AGRA
pH-AGRA™
Get your pH up!
GUARANTEED ANALYSIS
Plant food: Calcium Carbonate (BY WEIGHT 10%

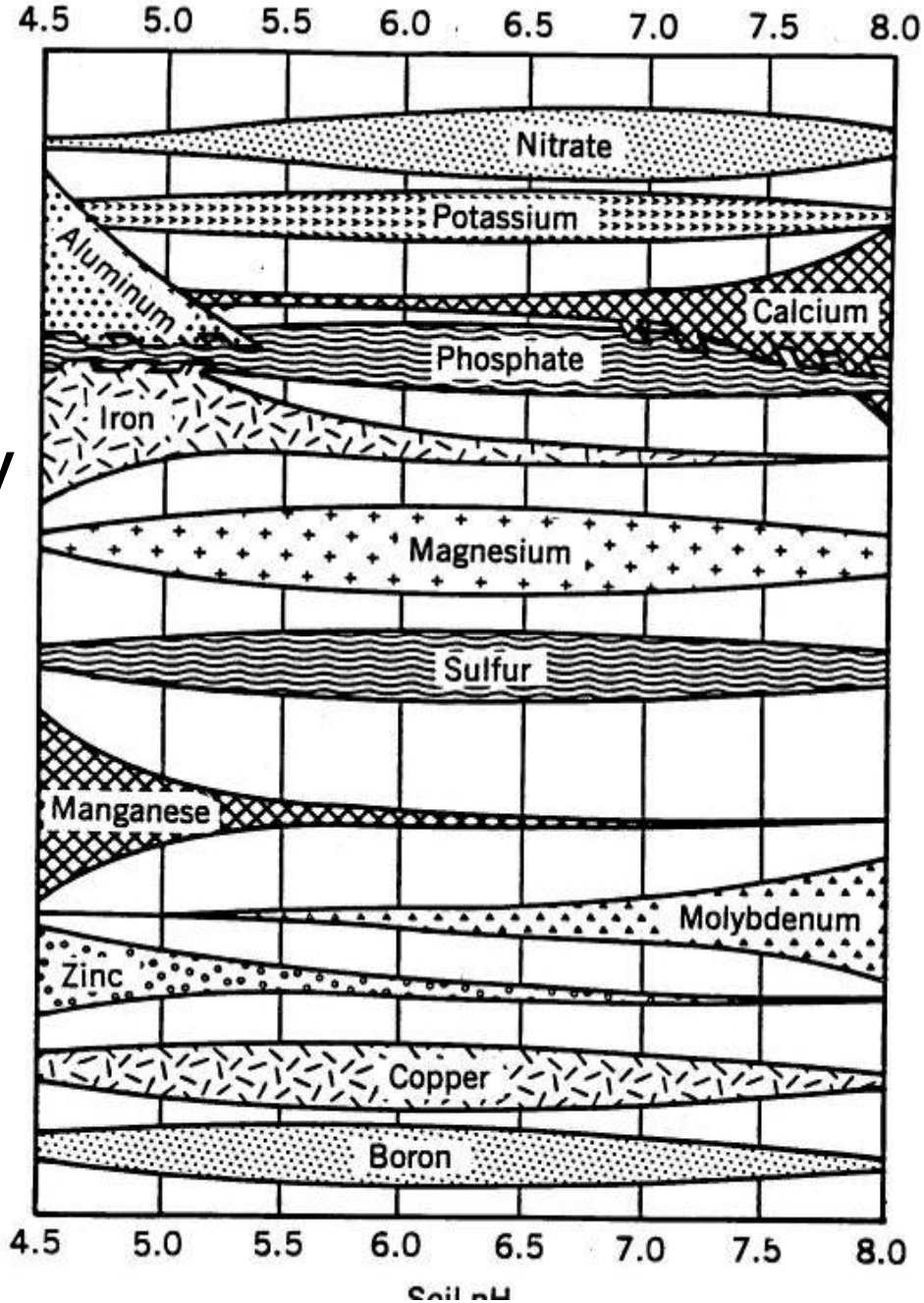

FREE
CAT

Tons of Calcitic and Dolomitic Lime Sold in Georgia (2001-08)

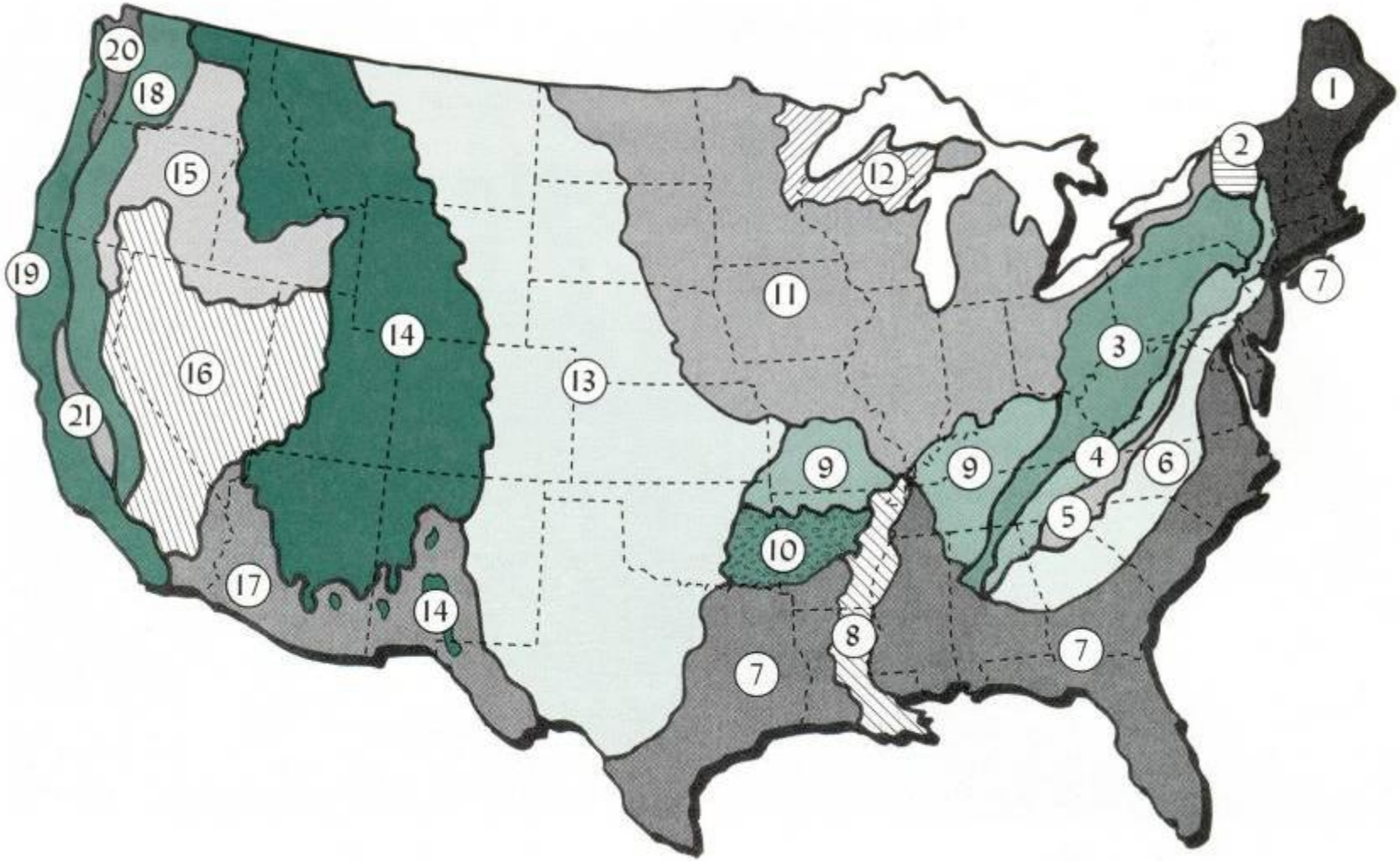


Why Lime?

Nutrient Availability
Nutrient Unavailability
Provide Ca and Mg
Nitrogen Fixation
Biological Activity



Source: Foth and Ellis
Soil Fertility



Soil Regions of the United States

Georgia Soils

- In General

- Ultisols
- Highly Weathered
- Poorly Buffered
- Acidic (Low pH)
- Low Fertility
- Low Organic Matter

Alabama


"UGA Fertilizes by Yield Goal –
Doesn't Work With Cotton"
Nothing

Nitrogen Management

Rate

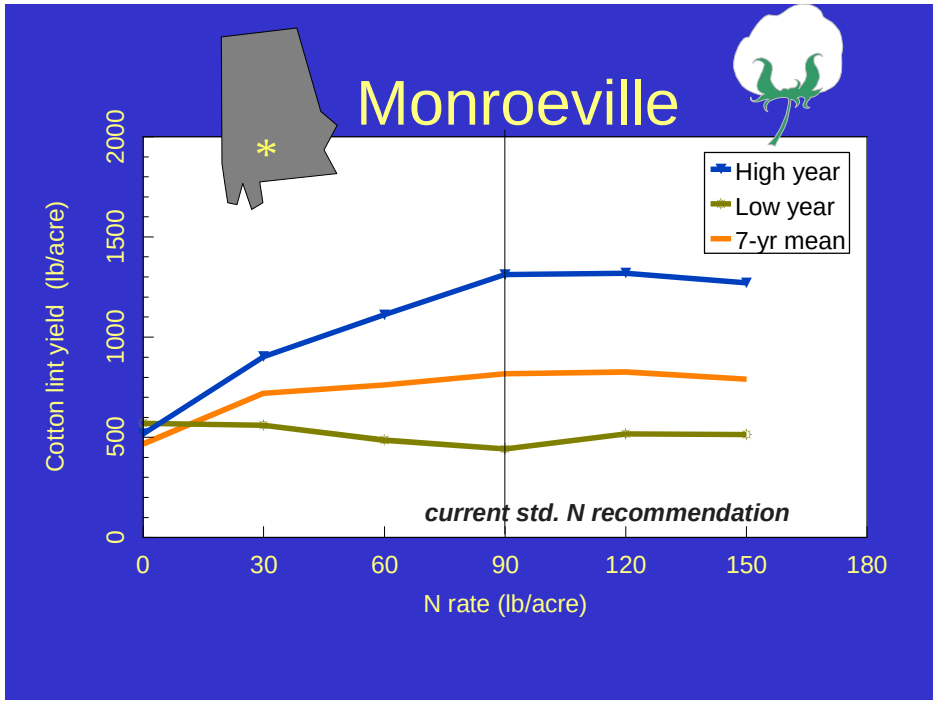
By Yield Goal

Georgia

Nitrogen Recommendations for Cotton
Based on Yield Goals

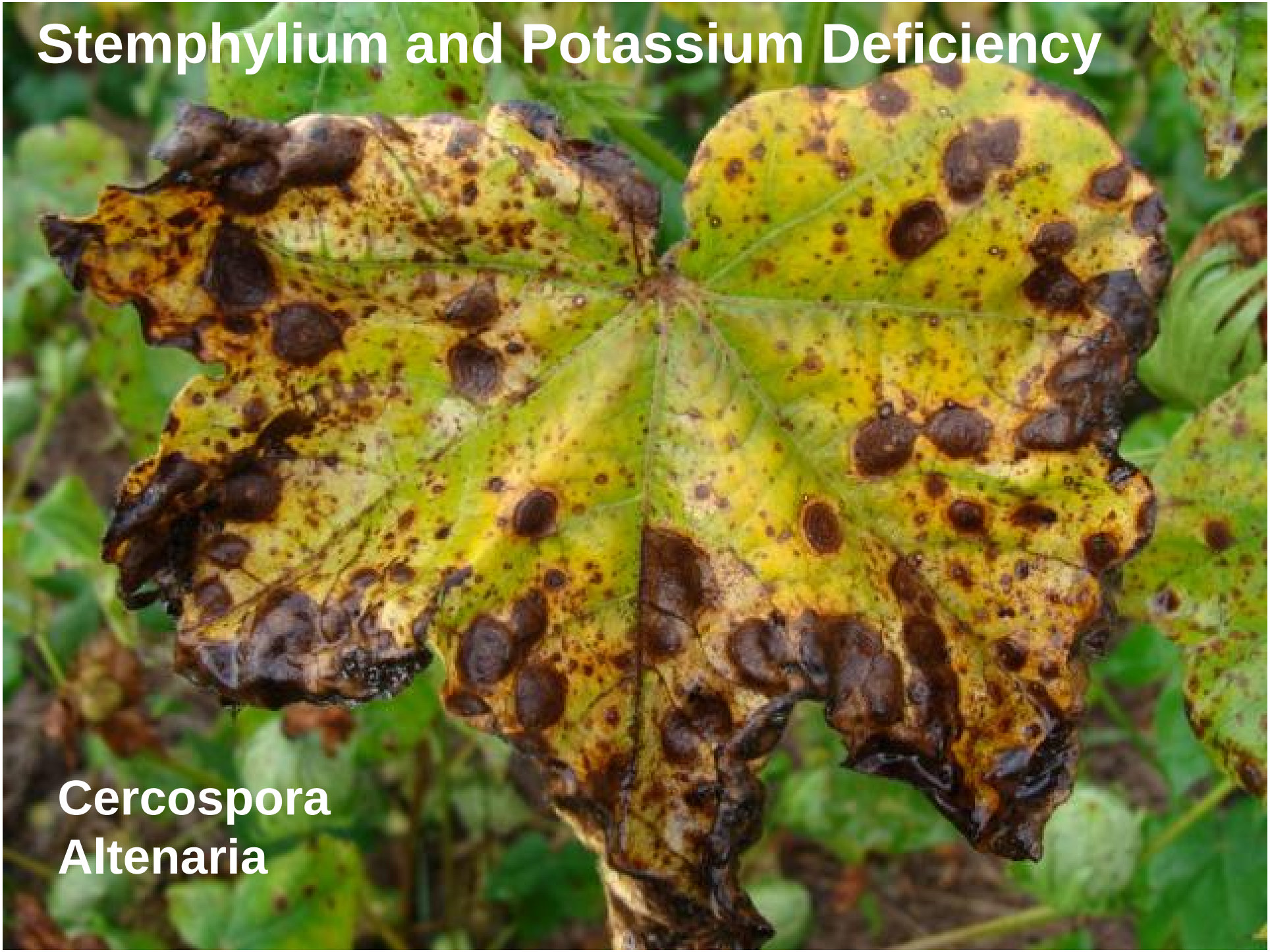
Yield Goal (lbs lint/a)	N Rate (lb/a)
750	60
1000	75
1250	90
1500	105

Alabama

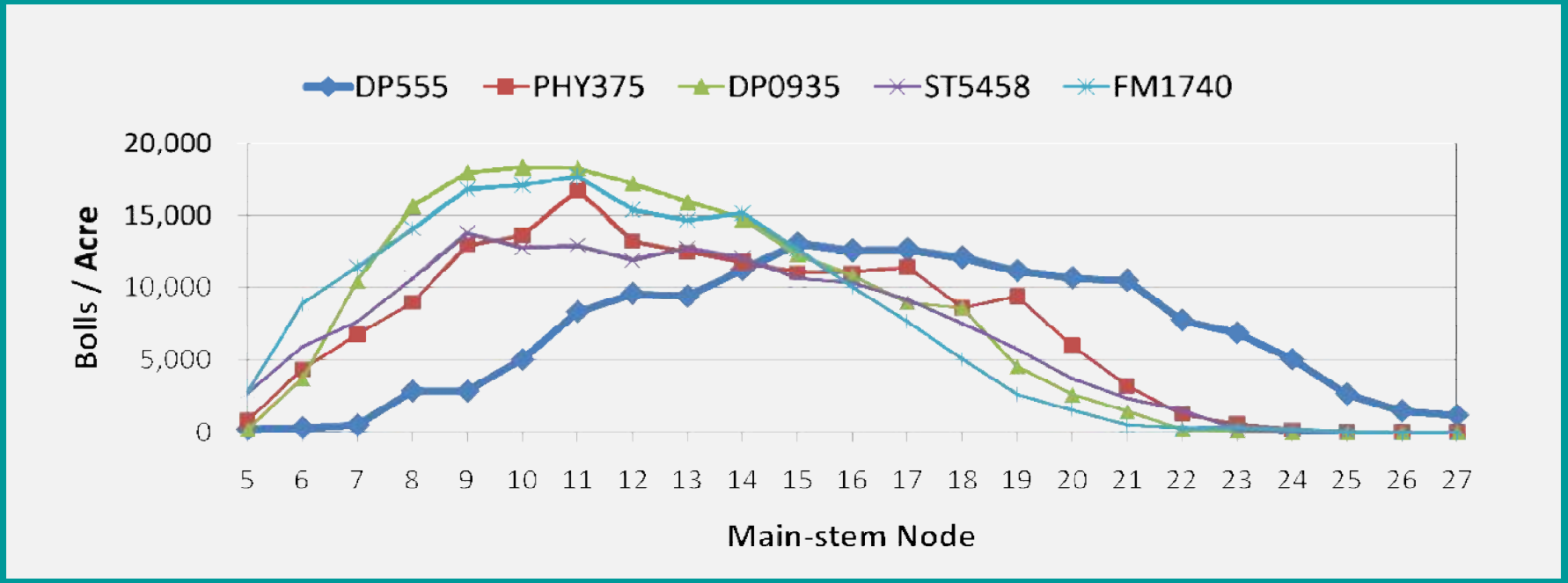


Essential Plant Nutrients

Non-Mineral	Primary (or Macro)	Secondary	Micronutrient
Carbon (C)	Nitrogen (N)	Calcium (Ca)	Boron (B)
Hydrogen (H)	Phosphorous (P)	Magnesium (Mg)	Manganese (Mn)
Oxygen (O)	Potassium (K)	Sulfur (S)	Zinc (Zn)
			Copper (Cu)
			Iron (Fe)
			Molybdenum (Mo)
			Chlorine (Cl)

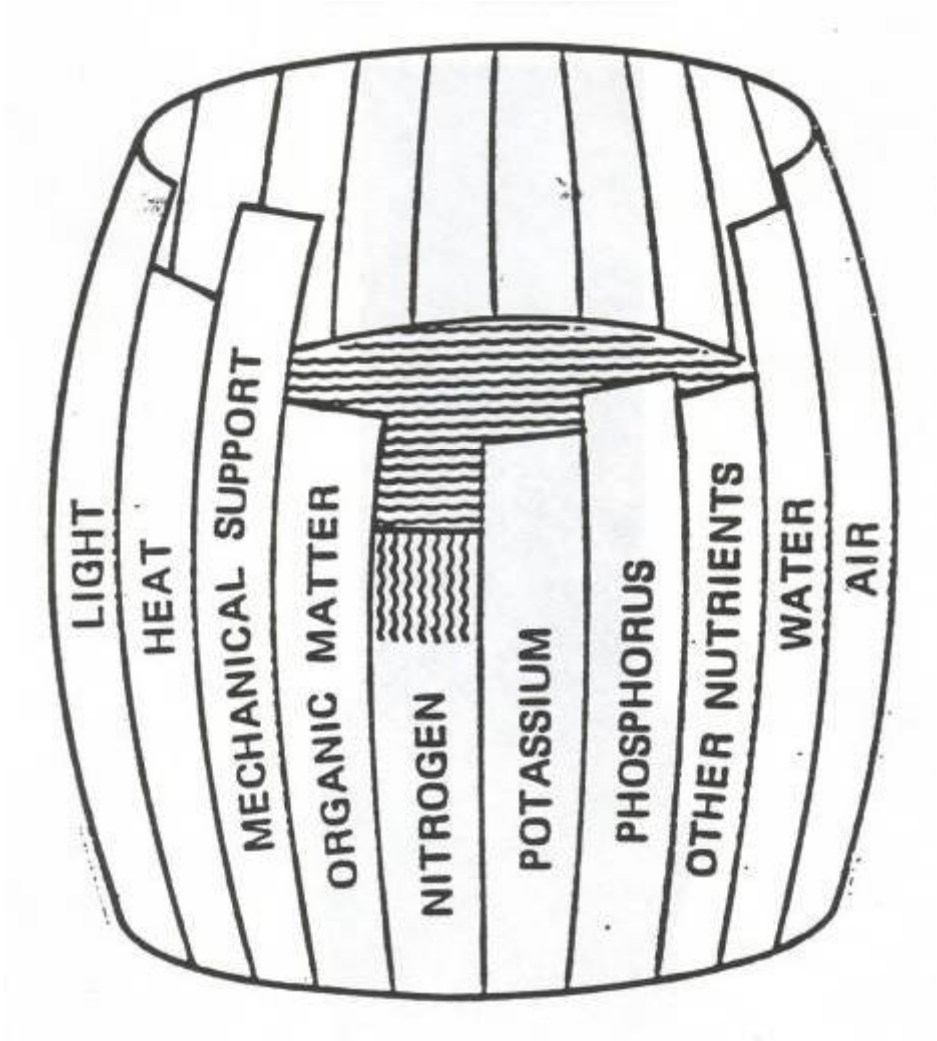

Stemphylium and Potassium Deficiency
Cercospora
Altenaria

Boll Production Compared to DP 555 BG/RR (1st Position)



Guy Collins, Jared Whittaker and Glen Ritchie – University of Georgia- Tifton
2009 Unpublished data

Liebig's Law of the Minimum



Important Facts About P

- Worldwide – Can be Deficient
  - Ex. Africa, South America
  - Bonemeal to P like Guano for N

Excess = Environmental Problem

- Eutrophication – Natural vs. Cultural

Essential to Plants and Animals

- ATP (Adenosine triphosphate) = Energy

Deficiency/Mobility in Plants

- Stunted Plants
- Purpling
- Delayed Maturity

- Mobile in Plant
  - Older leaves show symptoms

Important to seedling root growth

Ex. Why use in starter fertilizers

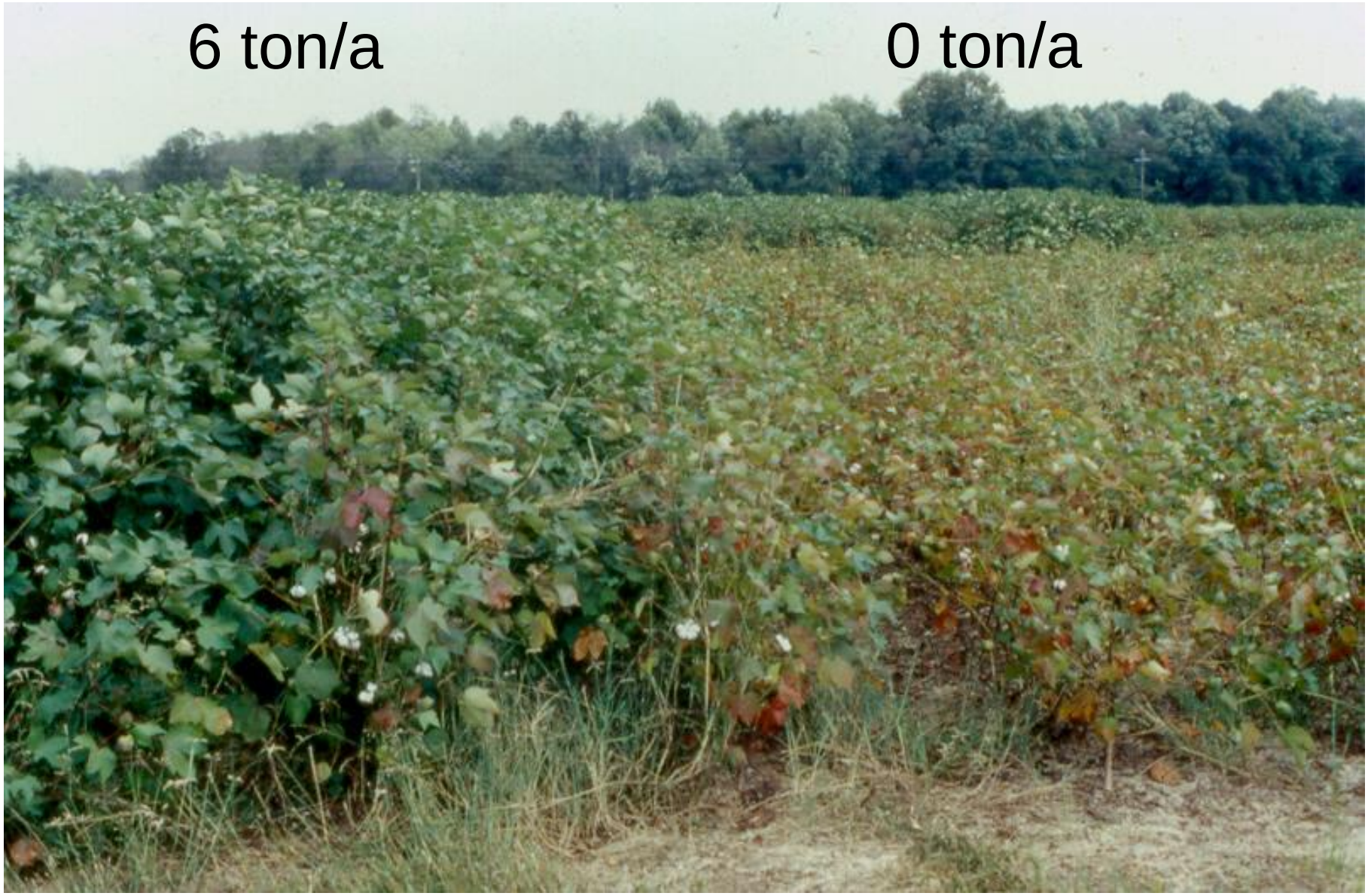
Poultry Litter In Georgia

- # 1 Broiler State in U.S.
- Approx. 1.5 Million Tons/litter/yr
- Contains approx. 45,000 tons N, 25,000 tons P, 30,000 tons K

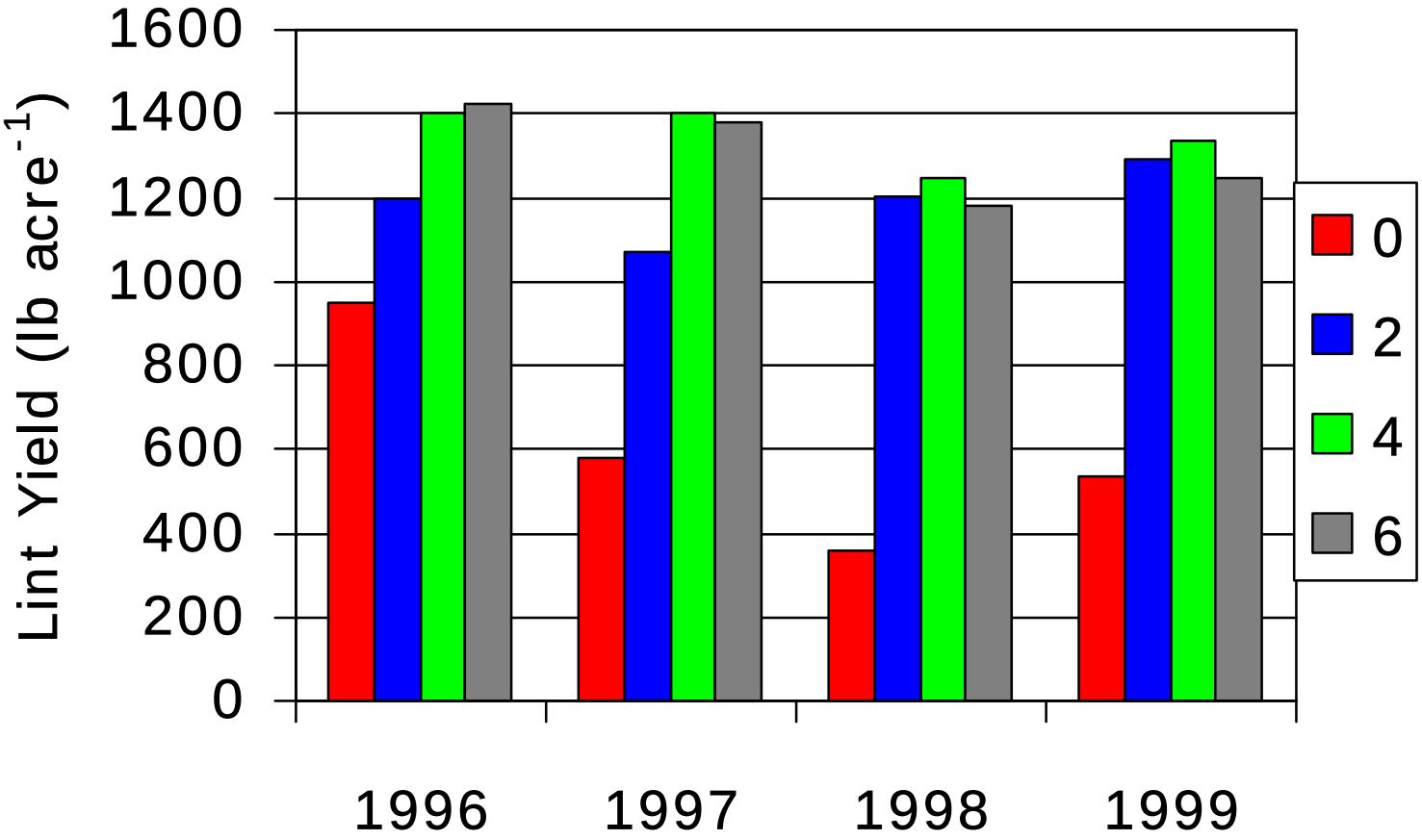
Will The “P Issue” Bog Us Down ?

Chicken Litter Makes Pretty Good Cotton Fertilizer

Cotton Response to Poultry Litter



Cotton Response to Broiler Litter - Tifton, Georgia



Data from Gascho et al.

The Value of a Ton of Broiler Litter

Assumptions:

Analysis = 3-3-2

2011 Fertilizer Prices = .60-.45-.50

Availability of N-P-K = 60–80-80 %

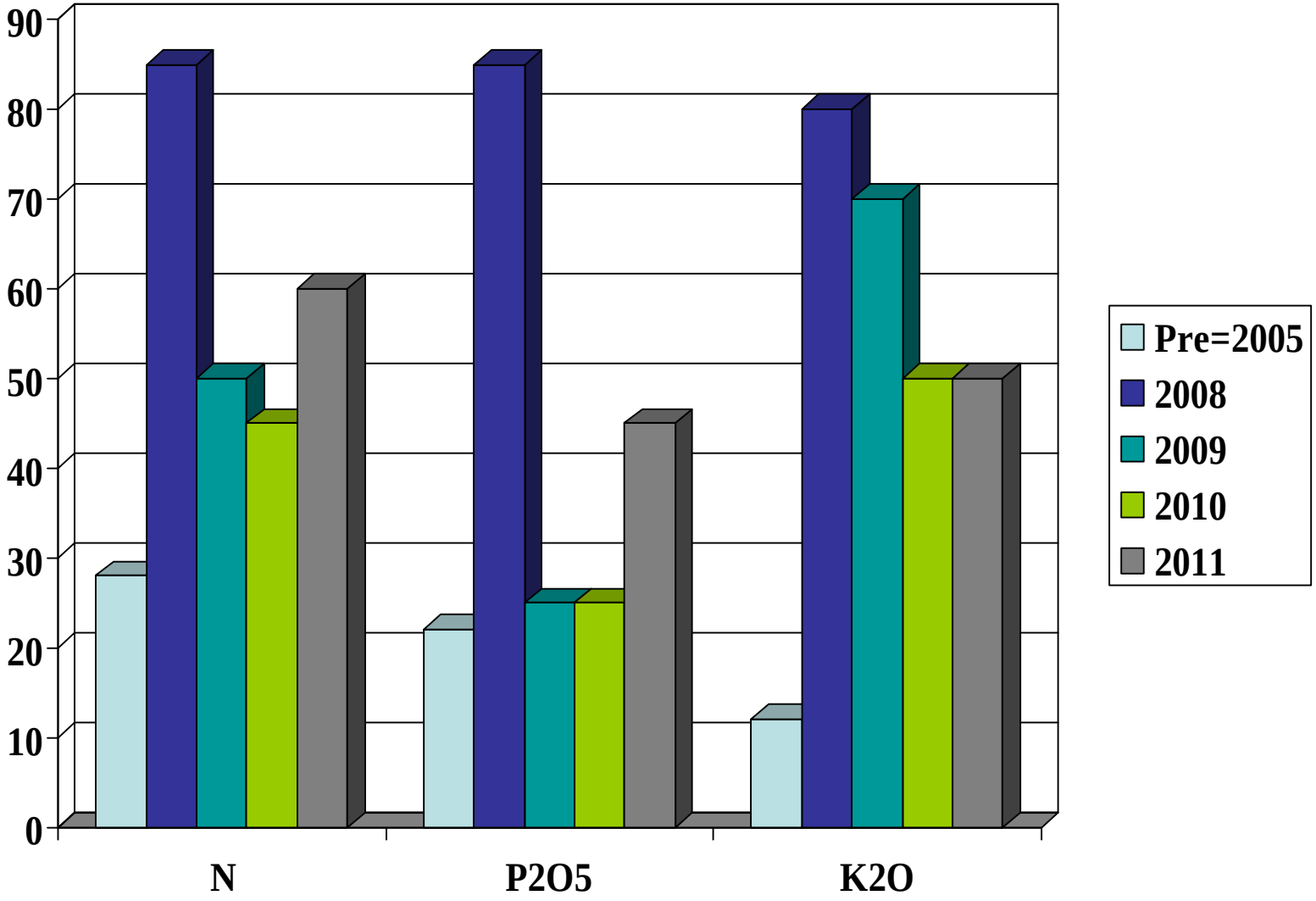
Calculation:

- 60#N x .60 x .6 = 21.60
- 60#P2O5 x .45 x .8 = 21.60
- 40#K2O x .50 x .8 = 16.00

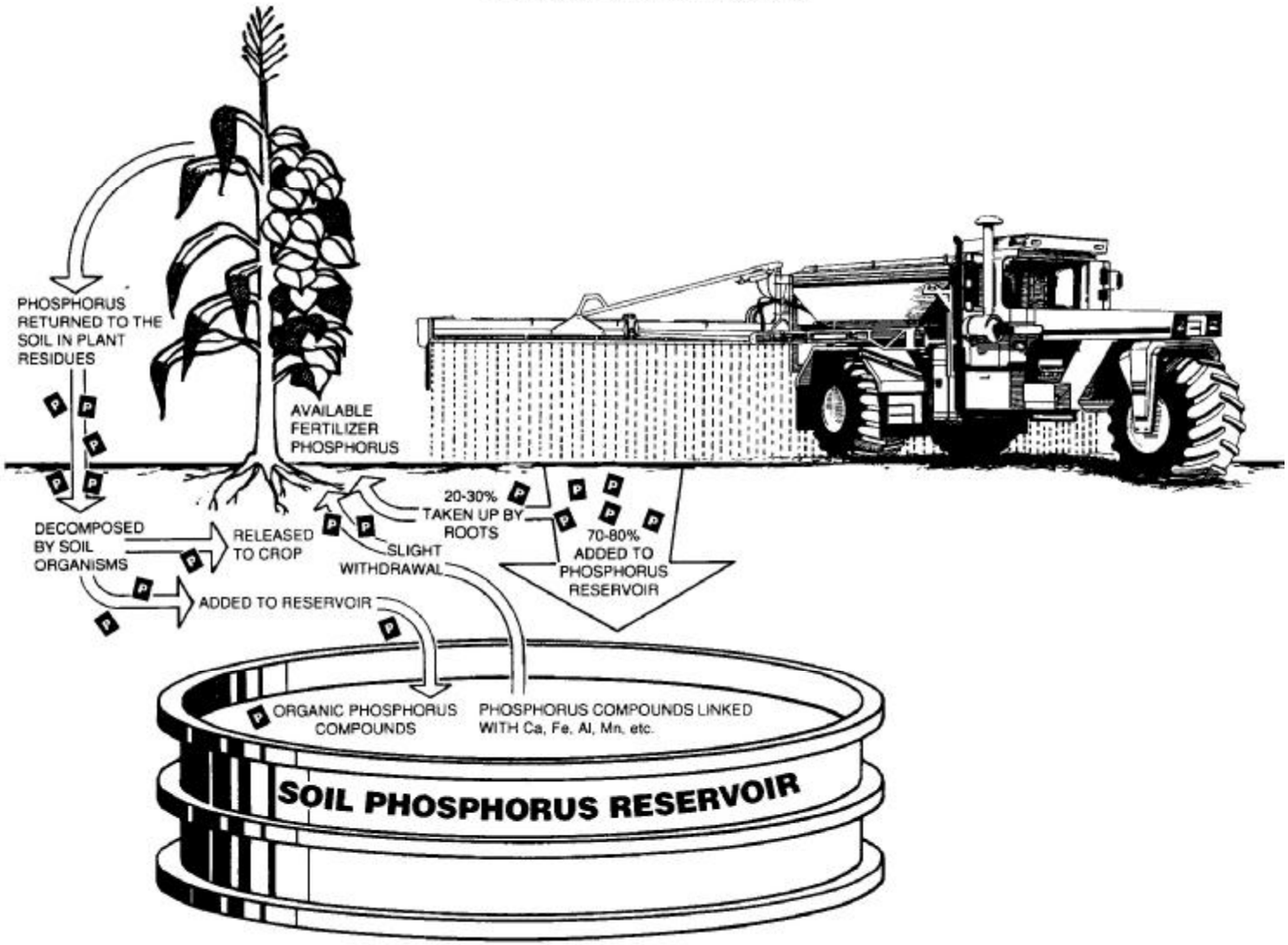
»Total = $59.20

Other Nutrients ?
Organic Matter ?
Liming ?
Nematode Suppresion ?
Weeds?

Fertilizer Prices (cents/lb)



Simplified P Cycle



Phosphorous Cycle

- No atmospheric component
- Little Mobility in Soil
- Minimal Leaching
- Mineralization/Immobilization vs. Fixation

- Inputs = Fertilizer + Manure
- Outputs = Harvested Crops + Runoff + Erosion

Forms of P in Soil

- Organic
  - More important in highly weathered soils?
- Inorganic
  - Ca-bound (alkaline soils)
  - Al-bound (acid soils)

  - Low concentrations in soil solution
  - Plant takes up HPO_4^{-2} and HPO_4^{-1}
  - Availability best at pH 6.0 – 7.0
  - Mycorrhizal fungi help uptake at low soil P levels

P Fixation or Retention

- Ex.
- Acid soils: $Al^{+3} + H_2PO_4^- + 2H_2O$

  $2H^+ + Al(OH)_2H_2PO_4$

Alkaline soils – Ca

Amount and type of clay = key

Al and Fe Oxides fix more than 2:1

Ultisols/Oxisols vs. Mollisols/Vertisols

Organic matter “masks” P fixing sites

Sulfur – Similarities to N

- Similar “Cycle”
- Component of Protein
- Atmospheric Component
- Mineralization from SOM
- Leaching
- Environmental Problems

Sulfur – Differences From N

- Secondary vs. Primary Nutrient
- Less Deficiency
- Less Emphasis on Fertilization
- N:S Ratio in plants approx. 10:1

No Biological S Fixation

Different Environmental Problems

-- Acid Rain, Acid Drainage, Acid Sulfate Soils

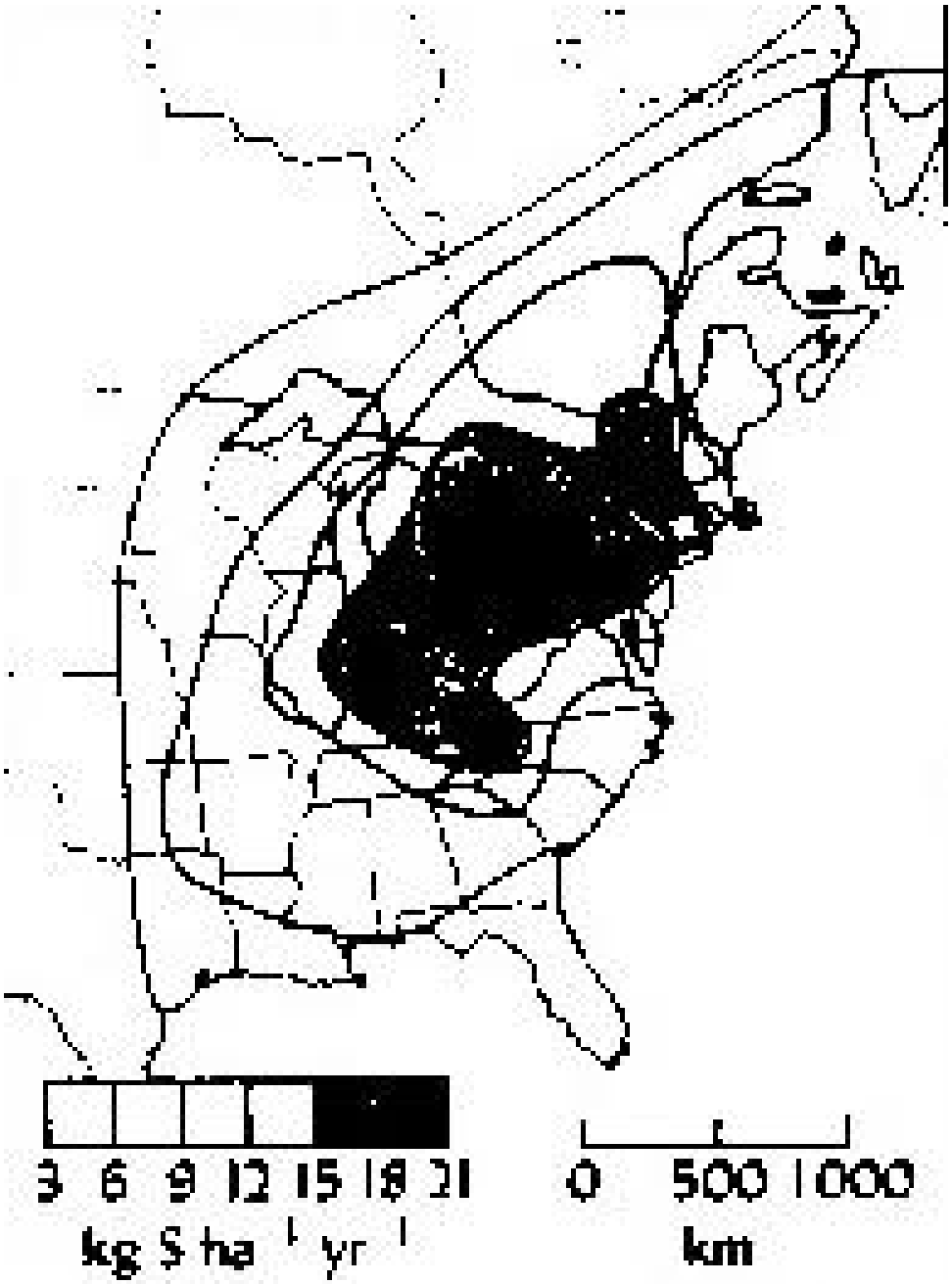
Less Mobile in Plant

S Deficiencies Increasing

- Higher Crop Yields
- High Analysis (Low S) Fertilizers
- Less Atmospheric Input
  - Low S Fuels
  - Scrubbing Smokestacks (FGD)

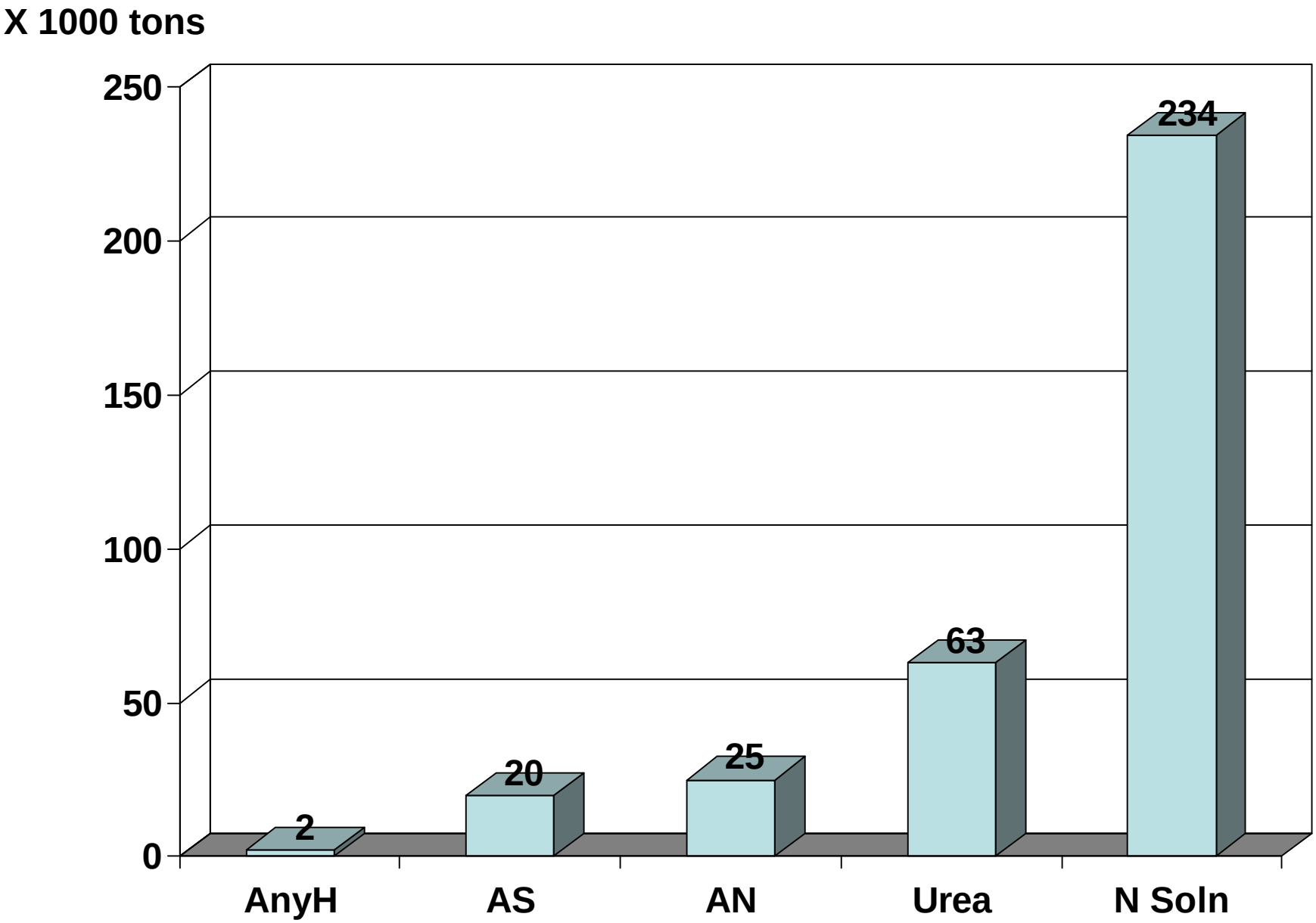
  Less S in Pesticides

  Immobilization of S in SOM from Con-till


3 6 9 12 15 18 21
kg S ha⁻¹ yr⁻¹
0 500 1000
km


HUTCHINSON
SELF STORAGE

Nitrogen Fertilizers Sold in Georgia - 2010



Nitrogen Management
Split Applications

¼ to 1/3 Preplant

Remainder at Sidedress

Nitrogen Management

Most Efficient = “3-Way Split”

Preplant

Sidedress

Foliar

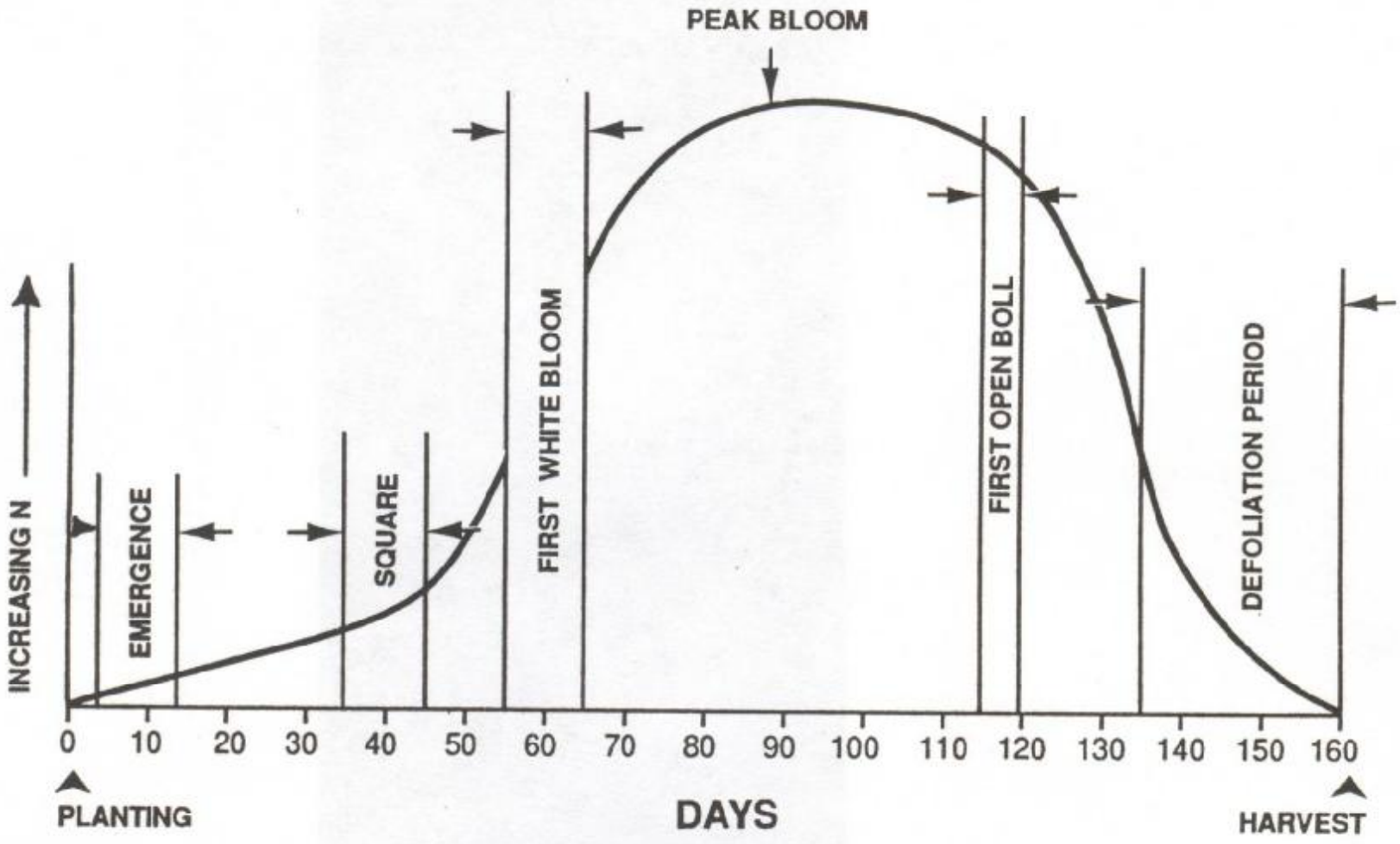
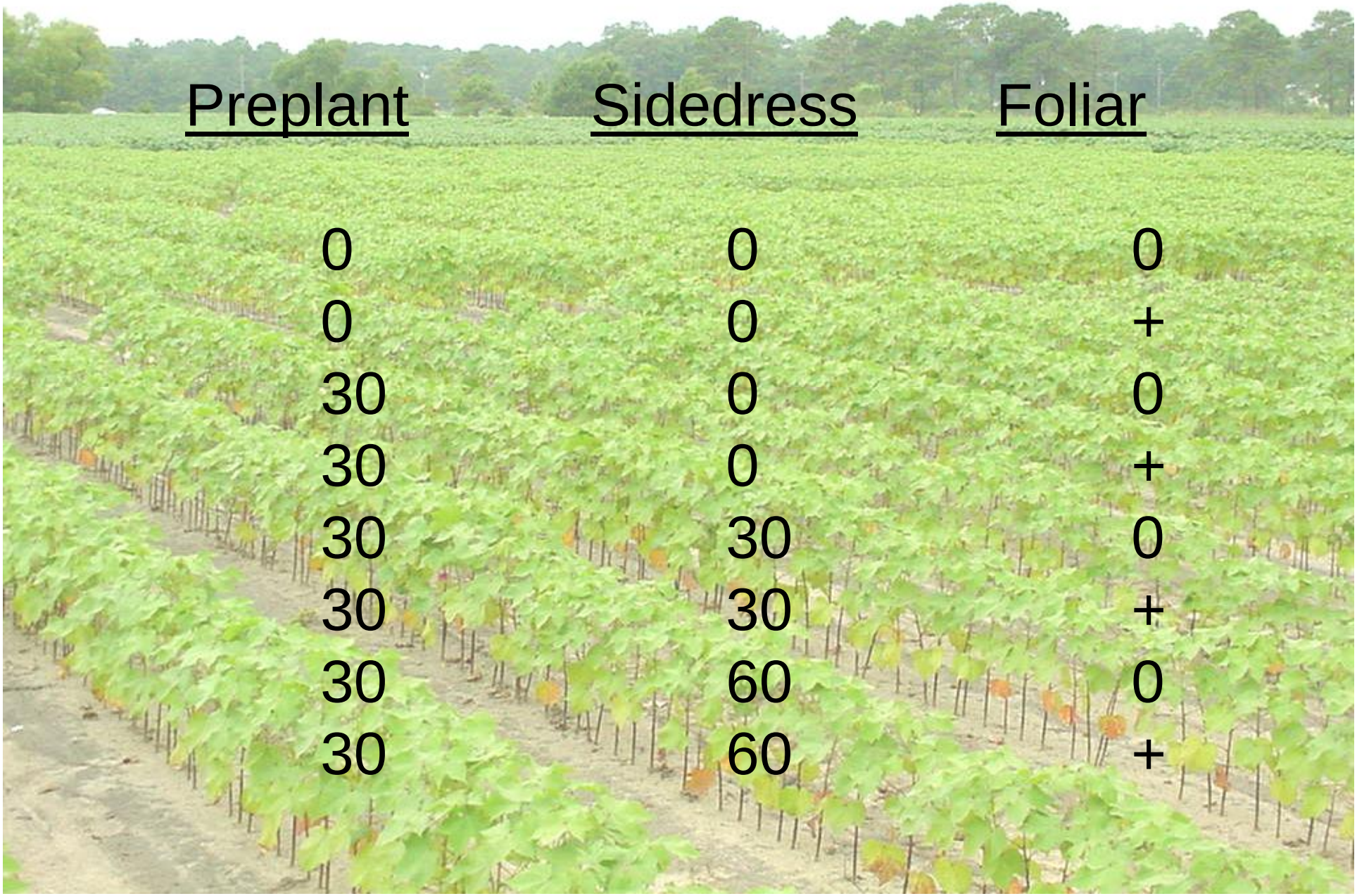


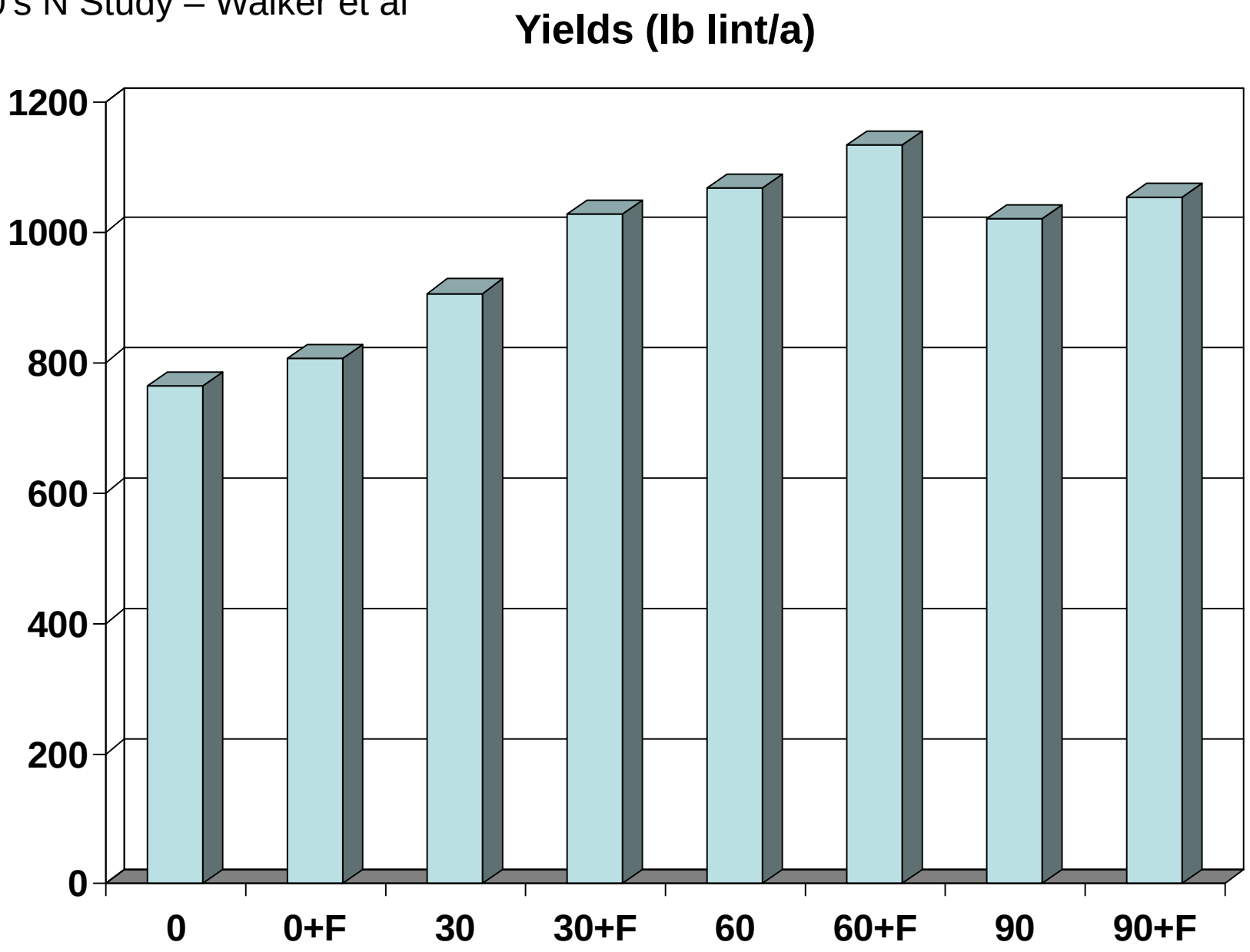
Figure 1. Relative nitrogen requirements of cotton.

1980's N Study – Walker et al

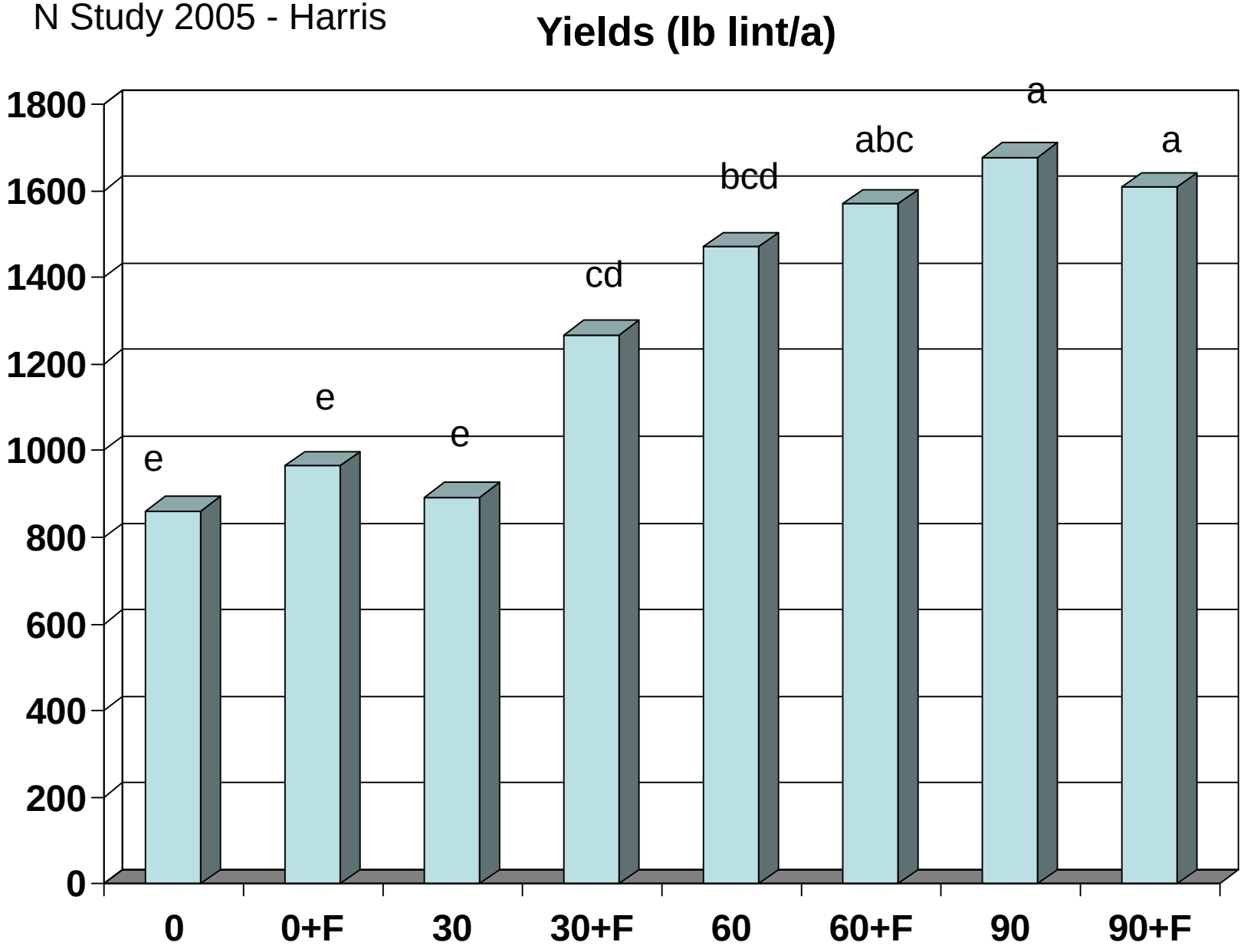


Preplant	Sidedress	Foliar
0	0	0
0	0	+
30	0	0
30	0	+
30	30	0
30	30	+
30	60	0
30	60	+

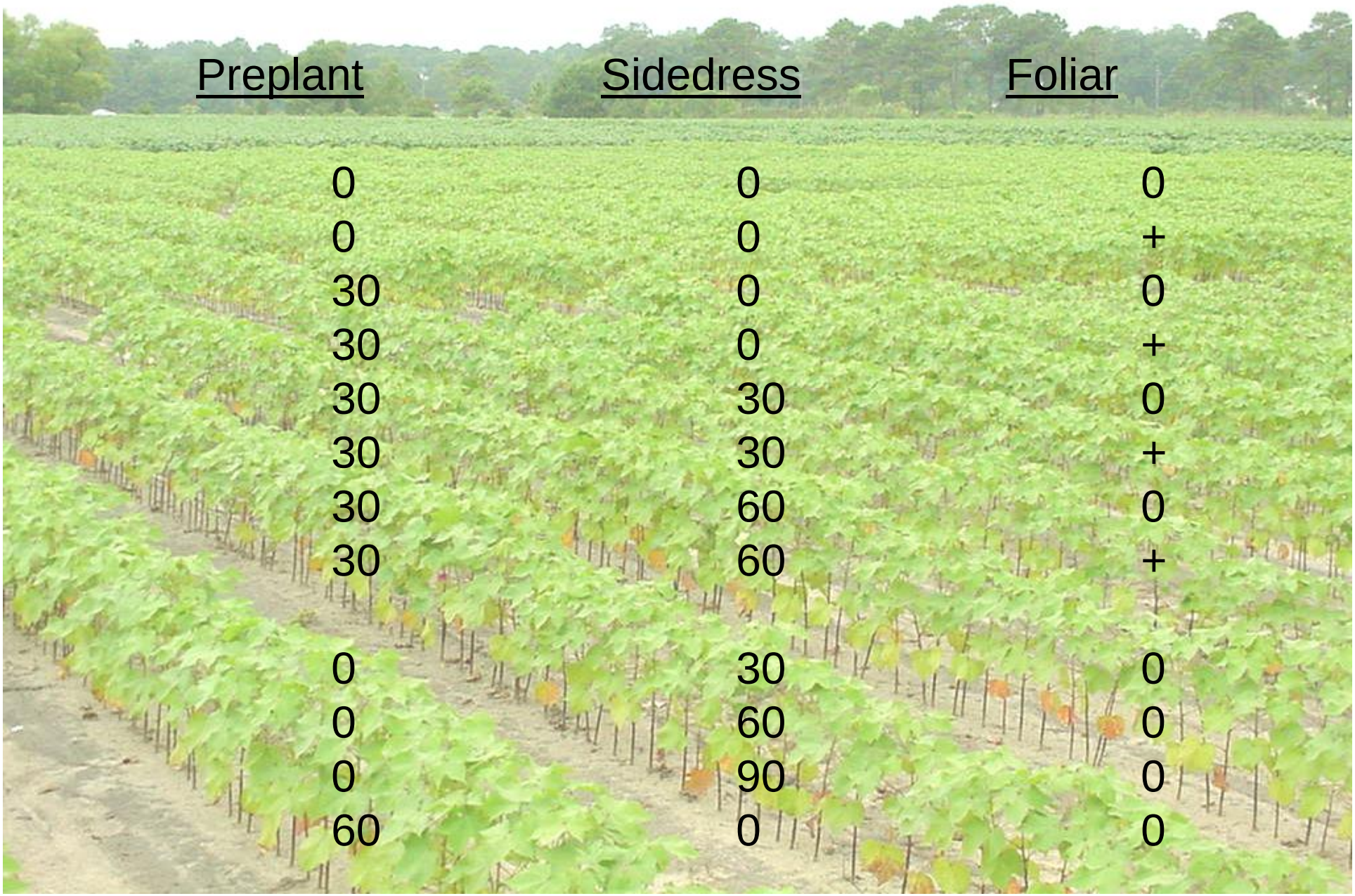
1980’s N Study – Walker et al



N Study 2005 - Harris

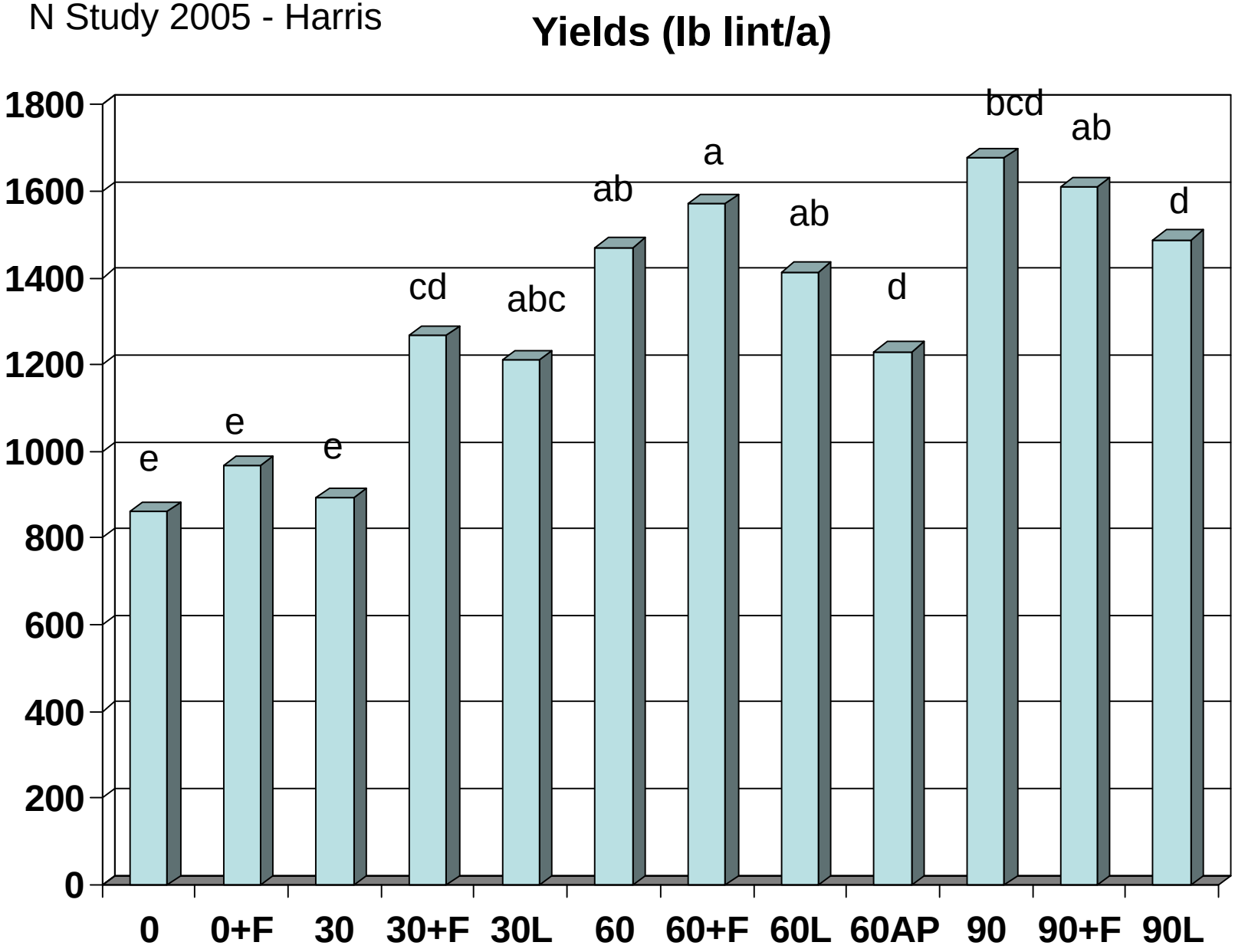


1980's N Study – Walker et al



Preplant	Sidedress	Foliar
0	0	0
0	0	+
30	0	0
30	0	+
30	30	0
30	30	+
30	60	0
30	60	+
0	30	0
0	60	0
0	90	0
60	0	0

N Study 2005 - Harris



Enhanced Efficiency Nitrogen Fertilizers for Cotton In the Southeast – Where Do They Fit ?

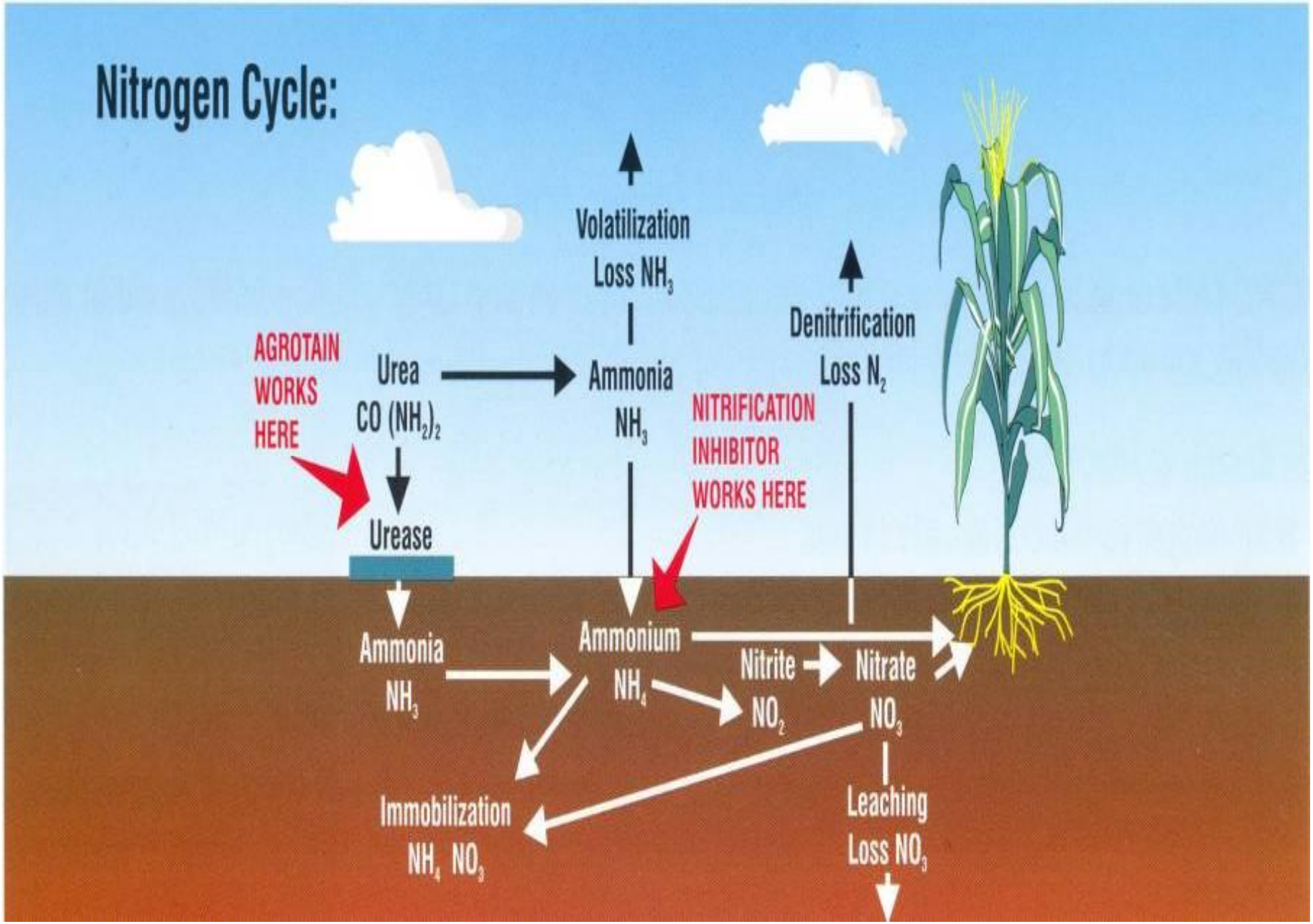
Glen Harris
University of Georgia - Tifton

NEE's Tested, since 2006….

ESN
Nitamin
CoRoN

Agrotain
Nutrisphere
Excelis
Nzone
Nstay/StayN
Humates
Arborite

CaCl
Agrinos

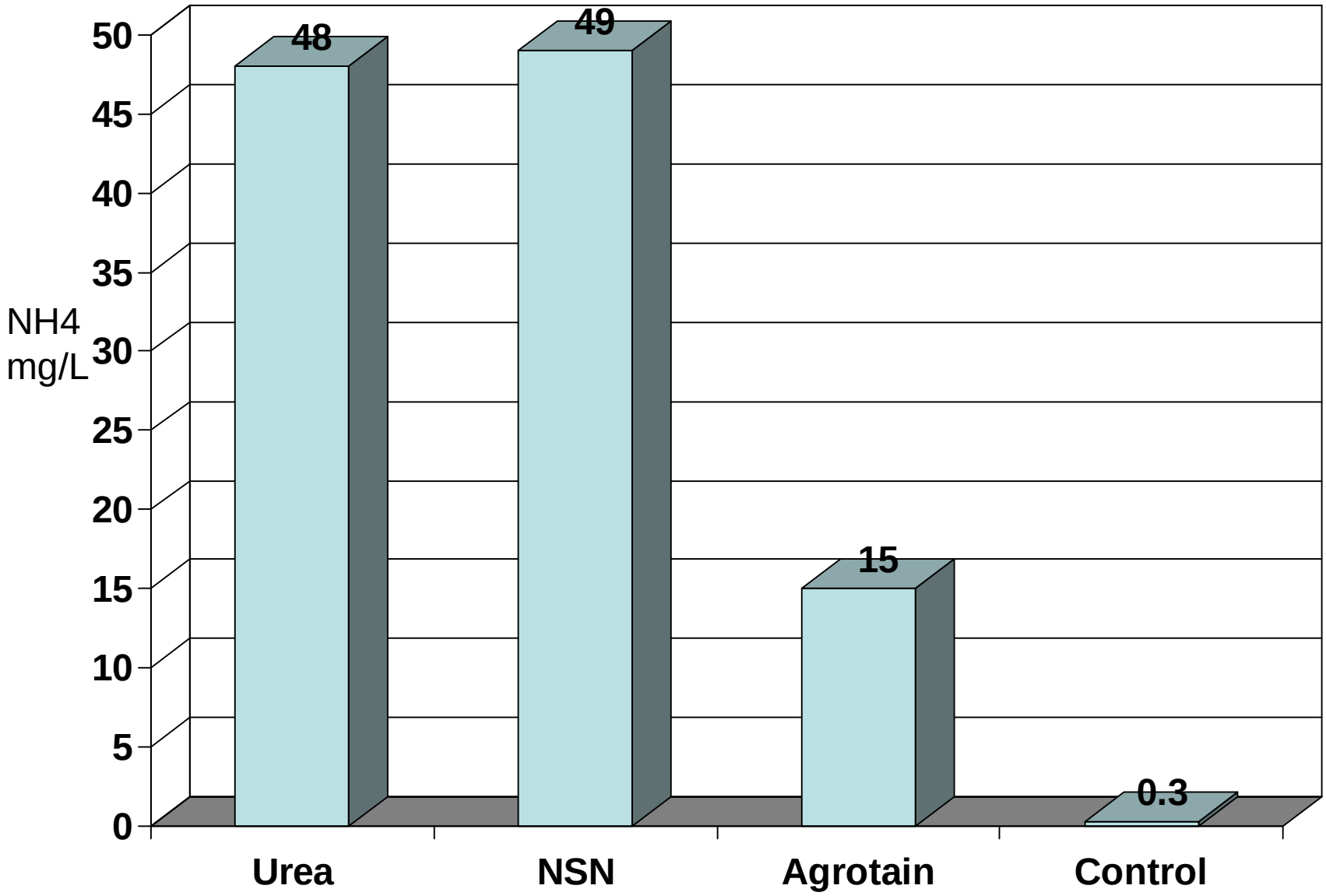

Nitrogen Cycle:
Volatilization
Loss NH_3
Denitrification
Loss N_2
AGROTAIN
WORKS
HERE
Urea
$CO(NH_2)_2$
Ammonia
NH_3
NITRIFICATION
INHIBITOR
WORKS HERE
Urease
Ammonia
NH_3
Ammonium
NH_4
Nitrite
NO_2
Nitrate
NO_3
Immobilization
NH_4 NO_3
Leaching
Loss NO_3


BD
1-19

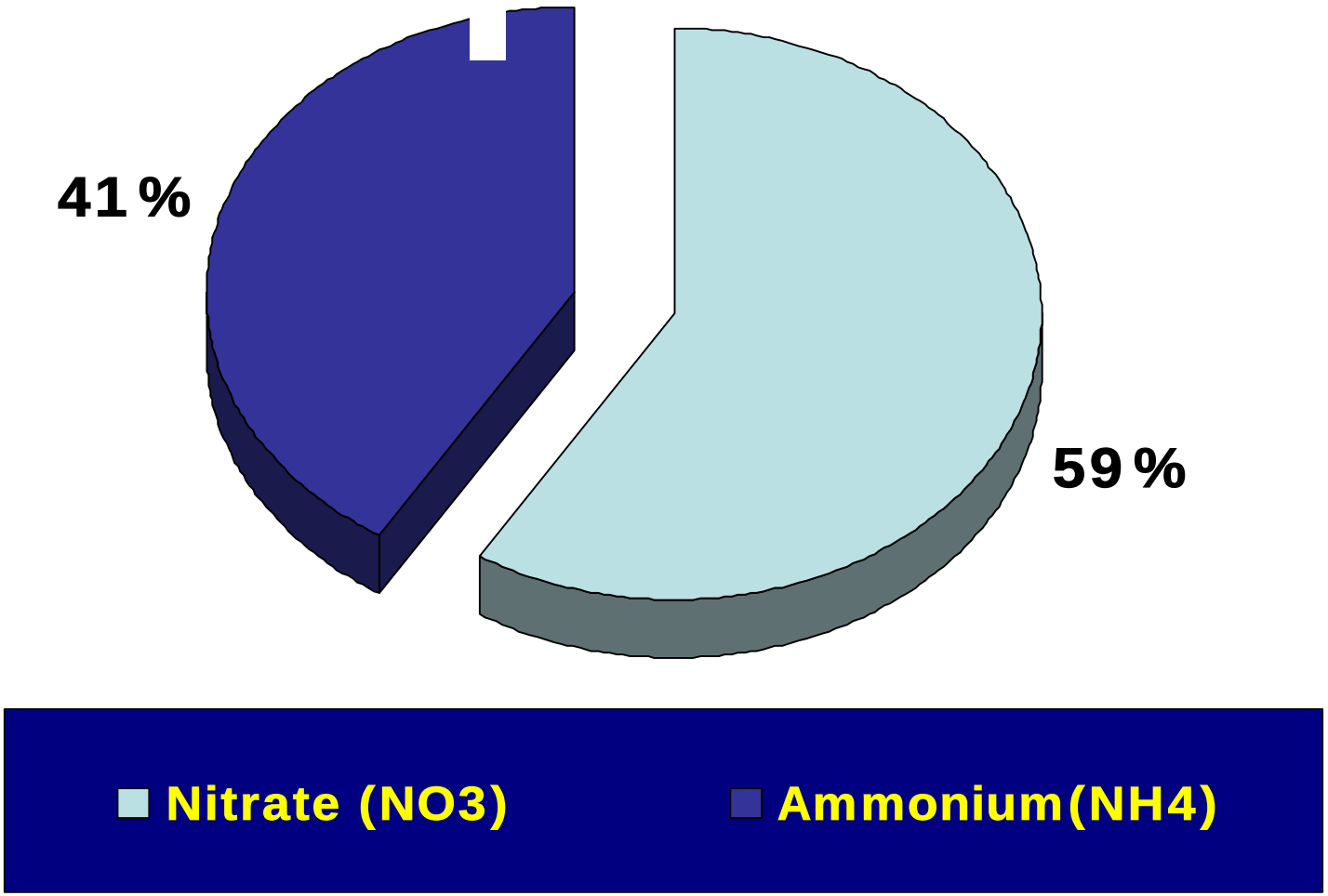

2-1


SCH 40 SER

N Volatilization – Cotton, 3 Location Average

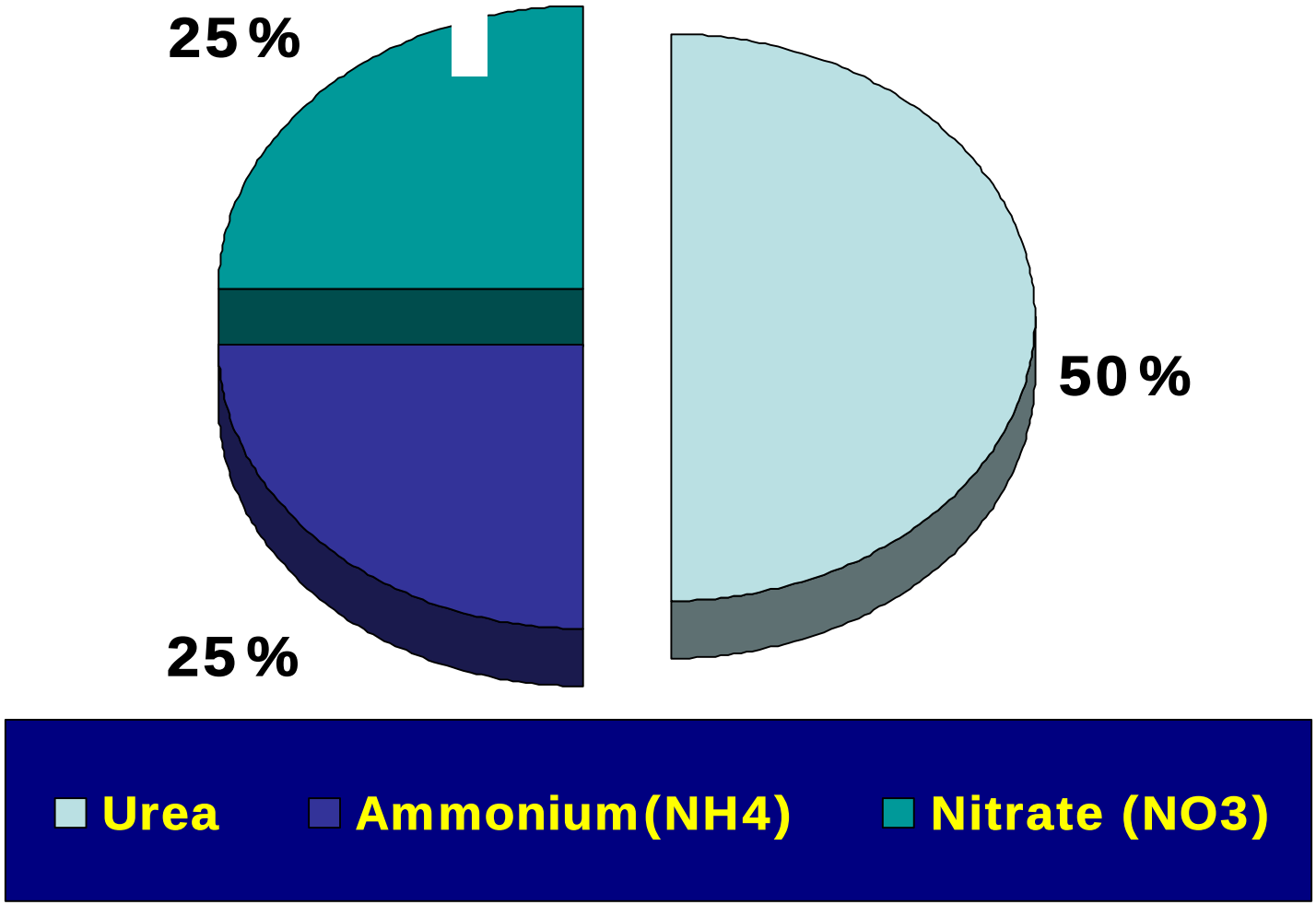


Composition of “19-E” (19%N)



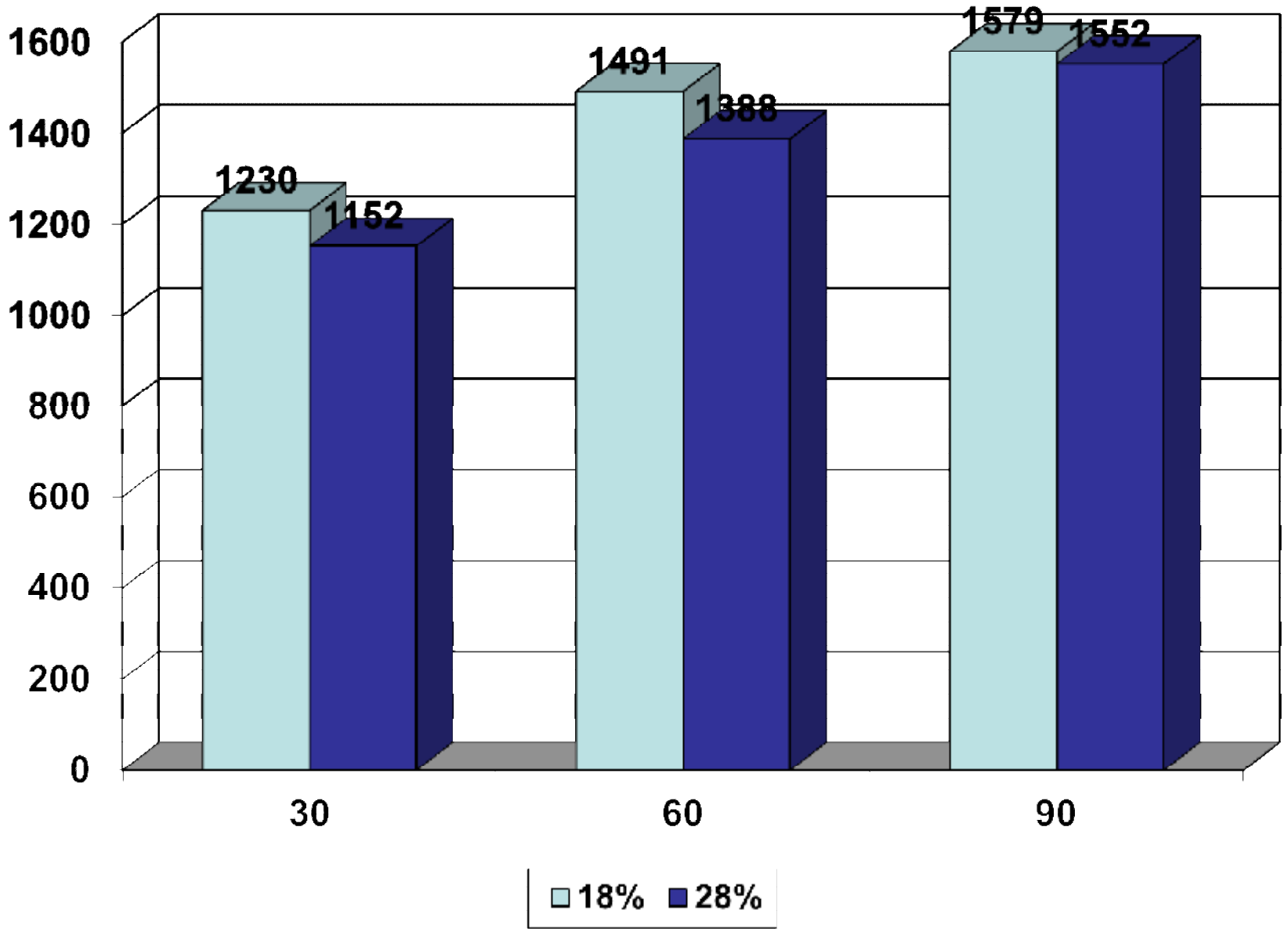
*** Add ATS to make 18-0-0-3(S)**

Composition of UAN (32% N)

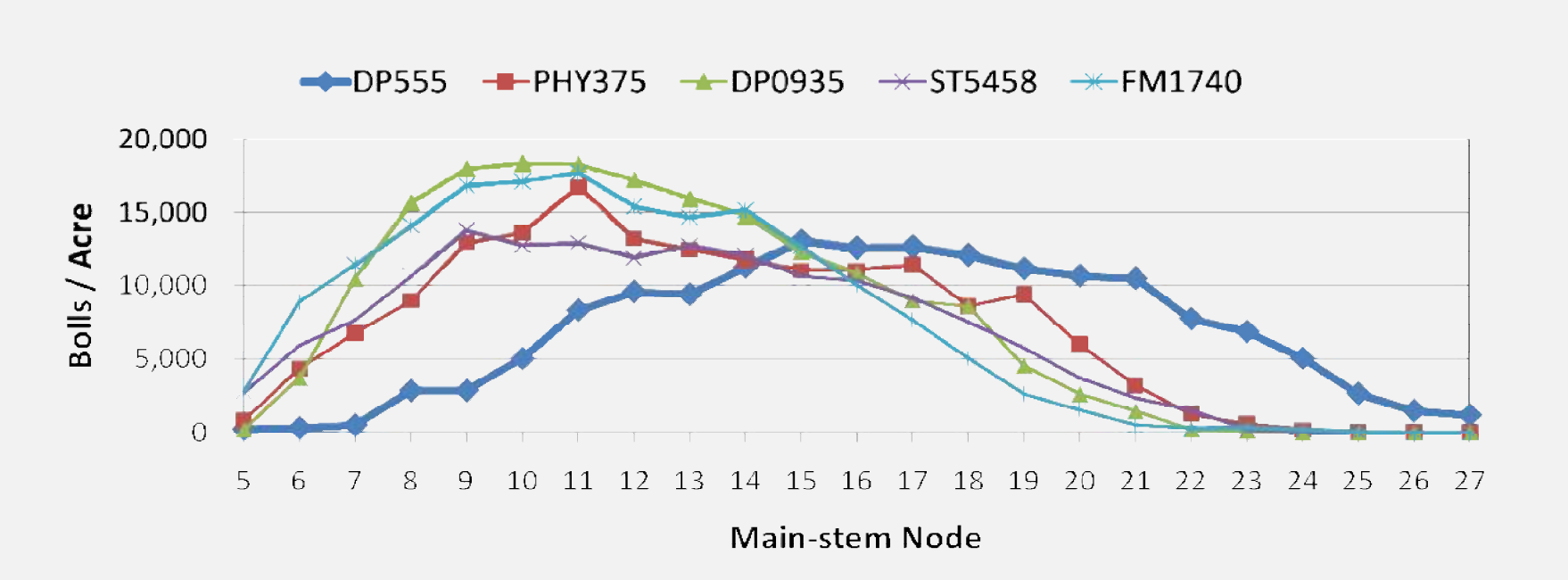


* Add ATS to make 28-0-0-5(S)

Sidedress N
2010 and 2011 – Average of 5 Locations



Boll Production Compared to DP 555 BG/RR (1st Position)



Guy Collins, Jared Whittaker and Glen Ritchie – University of Georgia- Tifton
2009 Unpublished data

Cotton Fertilization “Strategy”

1. Soil Test
2. Lime to pH of 6.0-6.5
3. Apply P, K (Mn and Zn) at Planting
4. Apply 10 lb S/a at planting or sidedress
5. Apply N in Split Applications
6. Apply ½ lb/a Boron before Bloom
7. Tissue and Petiole Sample
8. Foliar Feed if Needed

Thanks to:

Georgia Cotton Commission
Georgia Plant Food Ed Soc
UGA Cotton Team
Sunbelt Expo
Waters Lab
UGA Microgin

The University of Georgia

Cotton Team

“My Crew”

(L to R)

Ryan Meeks – Student Worker
Benjie Baldree – Rehired Technician
Lindsay McDonald – Utility Worker