VALUES

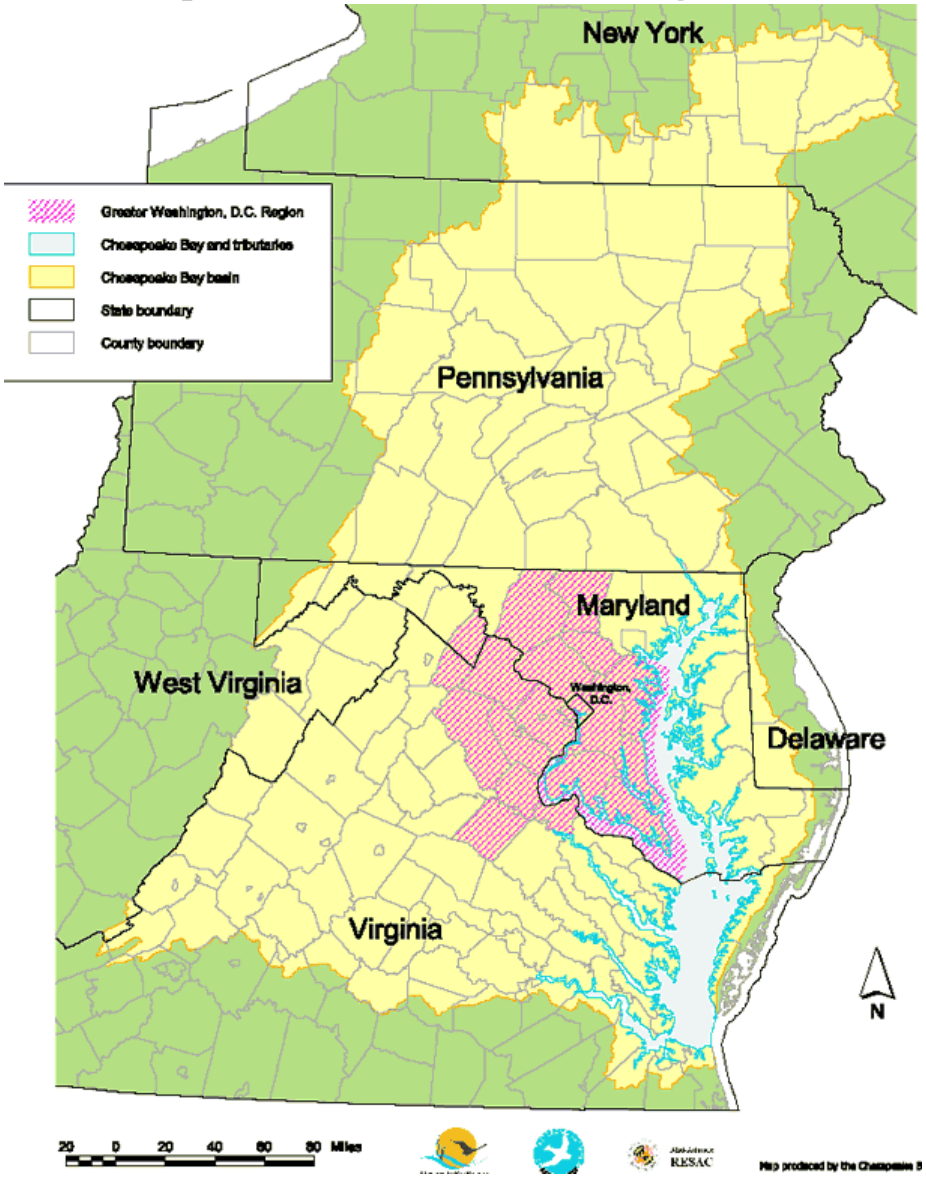
Virginia Agronomic Land Use Evaluation System

Steven Hodges

Background

- Water Quality Issues
- Nitrogen and Phosphorus
- Excessive N and P cause Eutrophication in Surface Waters
- High cost of fertilizers

Chesapeake Bay Region



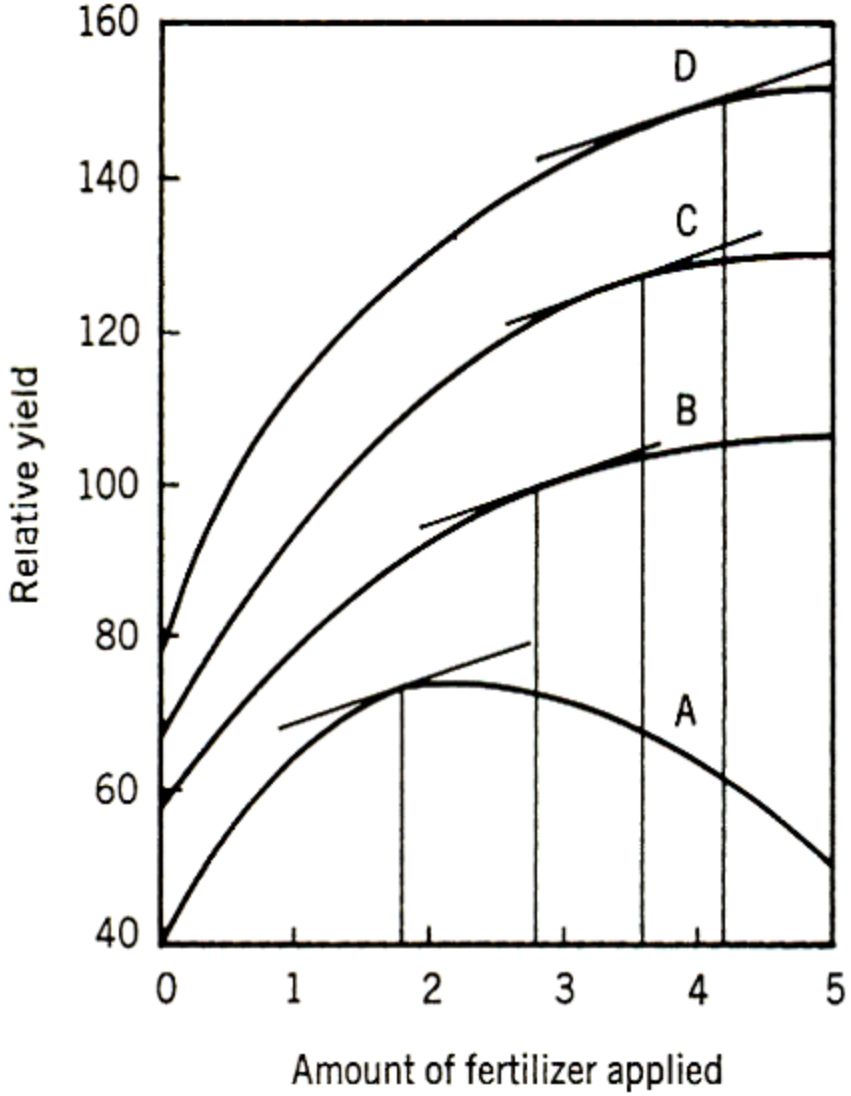
Background

- Fertilizer N rates based on “yield goal’.
  - (N is not measured in standard soil testing procedures).
- No limits on yield goals based on realistic estimates of soil capacity to produce.
- Yield goals often exceeded maximum observed yields.
  - 250 bushels of corn on a Bojac sand, non-irrigated

Soil Fertility vs Soil Productivity

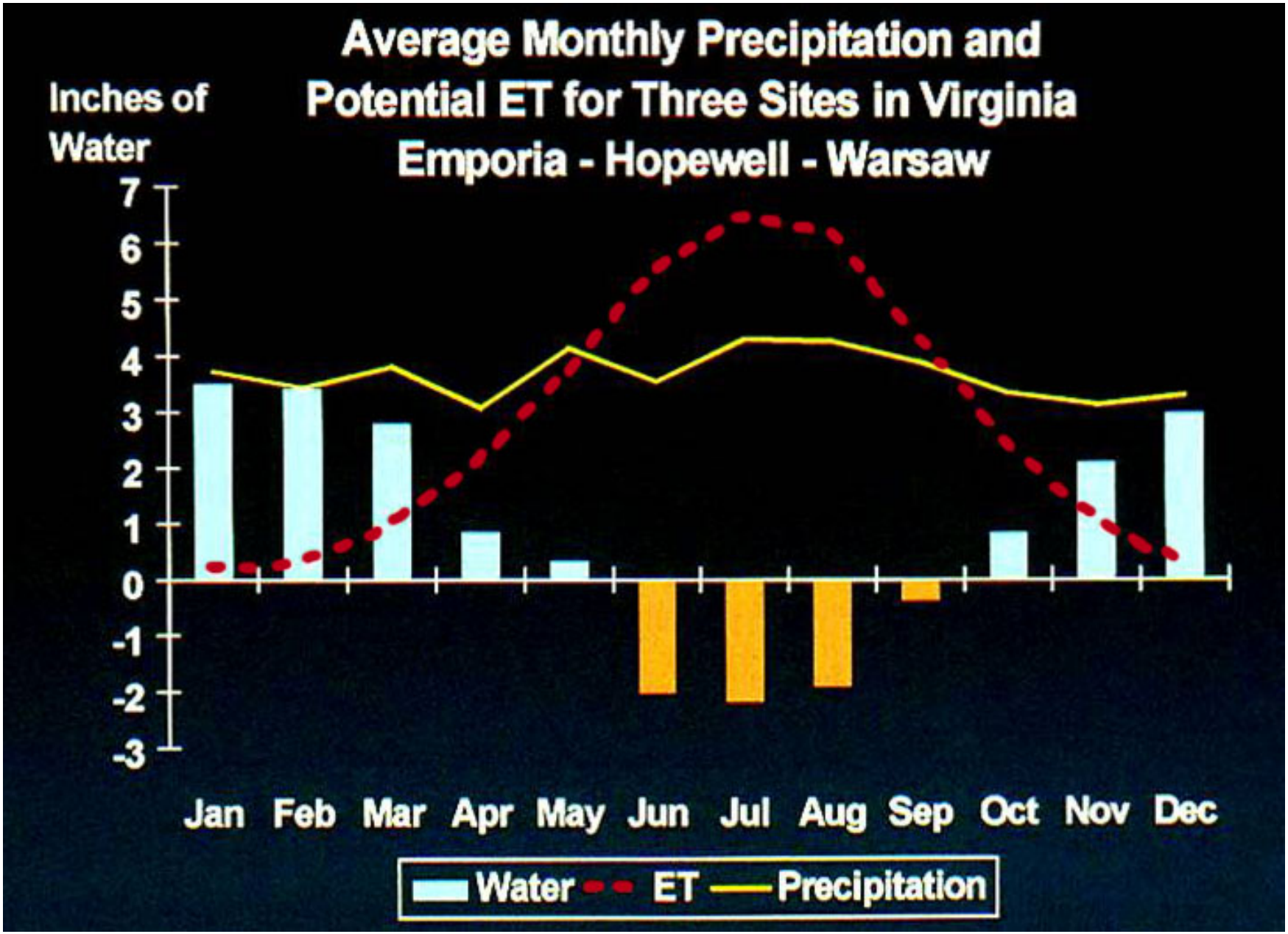
- A fertile soil is not necessarily a productive soil.
- Soil Fertility – nutrient status
- Soil Productivity – yield potential of the “soil”.
- Takes into account:
  - Fertility, water supply, drainage, soil depth, pH, restrictive layers, others.

Relative Yield vs N applied for Soils of Different Productivity

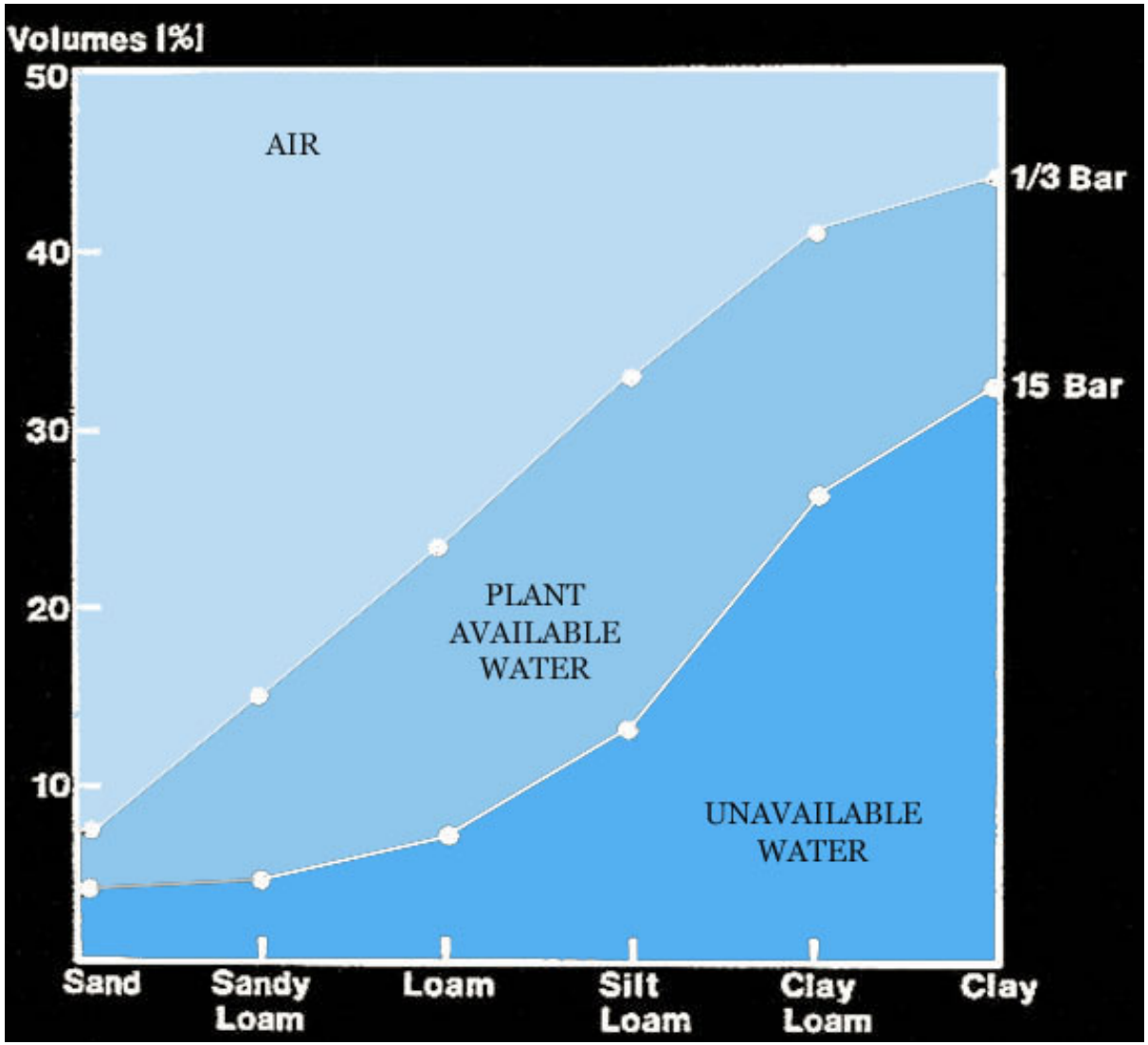


Soil Features that Limit Plant Growth

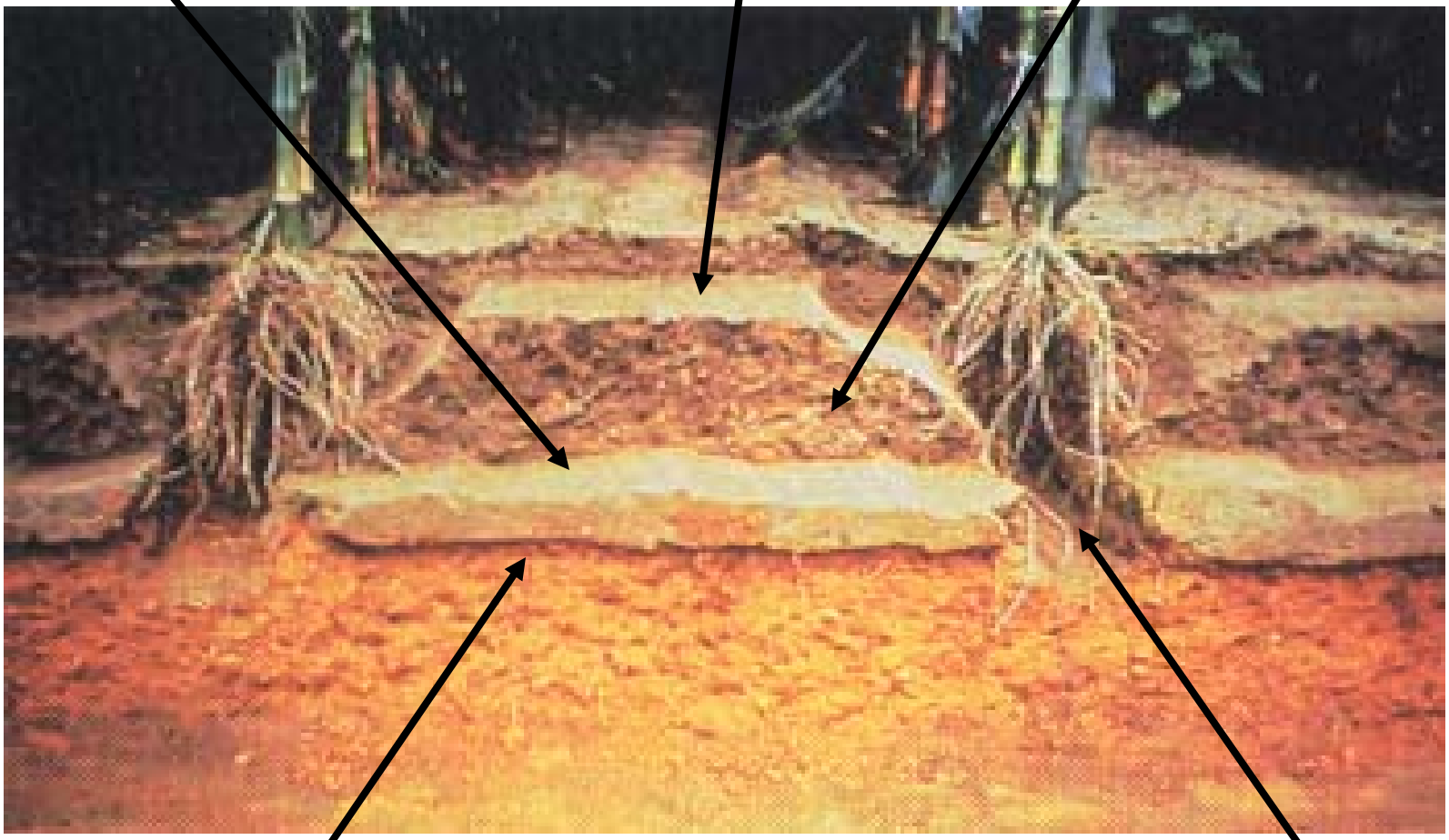
- Low Water Supplying Capacity
- Limited Rooting Zones
- Restrictive Layers
- Poor Drainage (surface and internal)
- Steep Slopes
- Low Soil Fertility (pH and nutrients)


Average Monthly Precipitation and
Potential ET for Three Sites in Virginia
Emporia - Hopewell - Warsaw
Inches of
Water
7
6
5
4
3
2
1
0
-1
-2
-3
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Water
ET
Precipitation

Textural Class & Water Retention in Soils



Compaction


Plow Pan
Disk Pan
Non-Compacted Ap
Non-Compacted Sub-Surface
Zone where traffic pan has been disrupted by “ripping”

Low Fertility

- Low pH
- High Aluminum
- Low nutrient levels
- Acid subsoils
- P or K depletion due to “nutrient mining”
- Failure to correct plow layer nutrients before adopting no-till.

The Challenge

- Develop a Nutrient Management System that Would:
  - Be based on recent yield potential data for each soil series in Virginia
  - Provide for best N application rate to reduce pollution potential, reduce cost of excessive fertilization
  - Recognize/address differences in soils in the same field

VALUES

Developing the System

- **1. Creation of Soil Management Groups**
  - Grouped soils with similar properties:
    - Regional occurrence; parent material; landscape position or influence; solum thickness; dominant profile feature (i.e., texture); plant available water supplying capacity; internal drainage
  - Created 43 different groups
- 2. Develop Crop Yield Data Base specific for each Soil Management Group

Soil Management Group “B” Characteristics

- Formed from alluvium within the Coastal Plain region.
- Associated with landscapes along streams and river terraces.
- Deep soils with loamy textures
- High available water storage capacity
- Well drained
- Examples: Pamunkey, Altavista, Wickham

Pamunkey Series

Collection of Yield Data

- Geographical Region Covered
  - Virginia
  - Other States with similar soils, temperature regimes and cropping systems
- Types of Data Obtained
  - University Variety Trials
  - Research Plots
  - Test Demonstrations
  - Maximum Yield Clubs
  - Seed Companies
  - Farmers with Accurate Records

Data Included

- Data That……
  - Could be associated with a specific soil series
  - Were obtained under use of high management practices
  - Were non-irrigated

VALUES

Developing the System

- **2. Selection of a "Realistic Yield" for each Soil Management Group**
  - **Evaluated standard statistical parameters**
  - **Developed a mathematical "model" to determine most optimum economic yield**
  - **GOAL: Minimize the Risk associated with applying the wrong amount of N over time.**

Corn Yields: Soil Management Group T

Year	Yields, bushels per acre	Average*
1969	86, 86	86
1970	130, 130, 57, 86	101
1971	83, 83, 88, 120	94
1972	108, 132	120
1973	27, 45	36
1974	84, 116, 148	116
1975	119, 136	128
1976	86, 120	103
1977	28, 46	37
1978	92, 126	109
1979	150, 126	138
1980	45, 45	45
1981	119, 129	124
1988	103,102, 101, 131	109
1989	151, 122, 168, 137, 143, 125, 173, 145, 172, 168, 163, 157, 154, 152	152
Overall Average		100

* Median Yield = 109 bu/A

Nitrogen Requirements: Corn

- Assumed average yield of 100 bu/ac
- Assumed a N requirement of 1.0 lb N/bushel corn
- Assumed that any soil would supply sufficient residual soil N to produce 20 bu corn grain/acre

Calculating Net Returns - Corn

Assumptions used in calculations

- Price of N fertilizer = $0.25/lb N
- Price of Corn = $2.50/bushel

Net Return Over Time to Nitrogen When Fertilizing for an Average Yield of 100 bu/Acre

Yield Bu/Acre	Cost of Excessive N Application, $/Acre	Income Forfeiture due to Insufficient N, $/Acre
36	16.00	0.00
37	15.75	0.00
45	13.75	0.00
86	3.50	0.00
94	1.50	0.00
101	0.00	0.00
103	0.00	0.00
109	0.00	0.00
109	0.00	0.00
116	0.00	0.00
120	0.00	0.00
124	0.00	10.00
128	0.00	20.00
138	0.00	45.00
152	0.00	80.00
TOTAL	$50.50	$155.00

Median Yield = 109 bushels

Optimum Realistic Yield

1) Cost of excessive N applied during low production years
2) Yield lost (value forfeited) due to insufficient N during years of good growing conditions

- Optimum yield is obtained when the **difference** between **1 & 2** is at a minimum!!

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TOTAL	$50.50	$155.00

Median Yield = 109 bushels

Summary of Calculations to Determine Optimum Realistic Yield

Target Yield bu/Acre	(Column 2) Total Cost of Excessive N Application, $/Acre	(Column 3) Total Income Forfeiture due to Insufficient N, $/Acre	Difference Between Col. 2 & Col. 3
100	50.50	155	104.50
109	65.75	80	14.25
110	68.00	75	7.00
111†	70.25	70	-0.25
112	72.50	65	-7.50
113	75.00	60	-15.00

† Realistic Yield

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Soil Management Groups vs. Soil Productivity Groups for Corn Grain

Soil Management Groups	Soil Productivity Groups	Realistic Yield, bu/acre
A, B	Ia	180
C, D	Ib	170
E, F, G, H, I	IIa	160
J, K, L, M, N, O, P	IIb	150
Q, R, S	IIIa	140
T, U	IIIb	130
V, W, X, Y, Z, AA	IVa	120
BB, CC, DD, EE, FF, GG, HH	IVb	100
II, JJ, KK, LL, MM, NN, OO, PP, QQ	V	80

VALUES SOIL DATA BASE

- 1992 version of VALUES utilized soil specific crop yield data from 1969 to 1992, representing 591 soils. Over 400 soil/corn yield data plots were used in the set.
- 2006 VALUES (’06 Update), utilized soil specific crop yield data from 1992 to 2004, representing 888 soil series mapped in Va.

  Over 4,000 soil/corn yield plots were used.

Corn yield trends in VA.

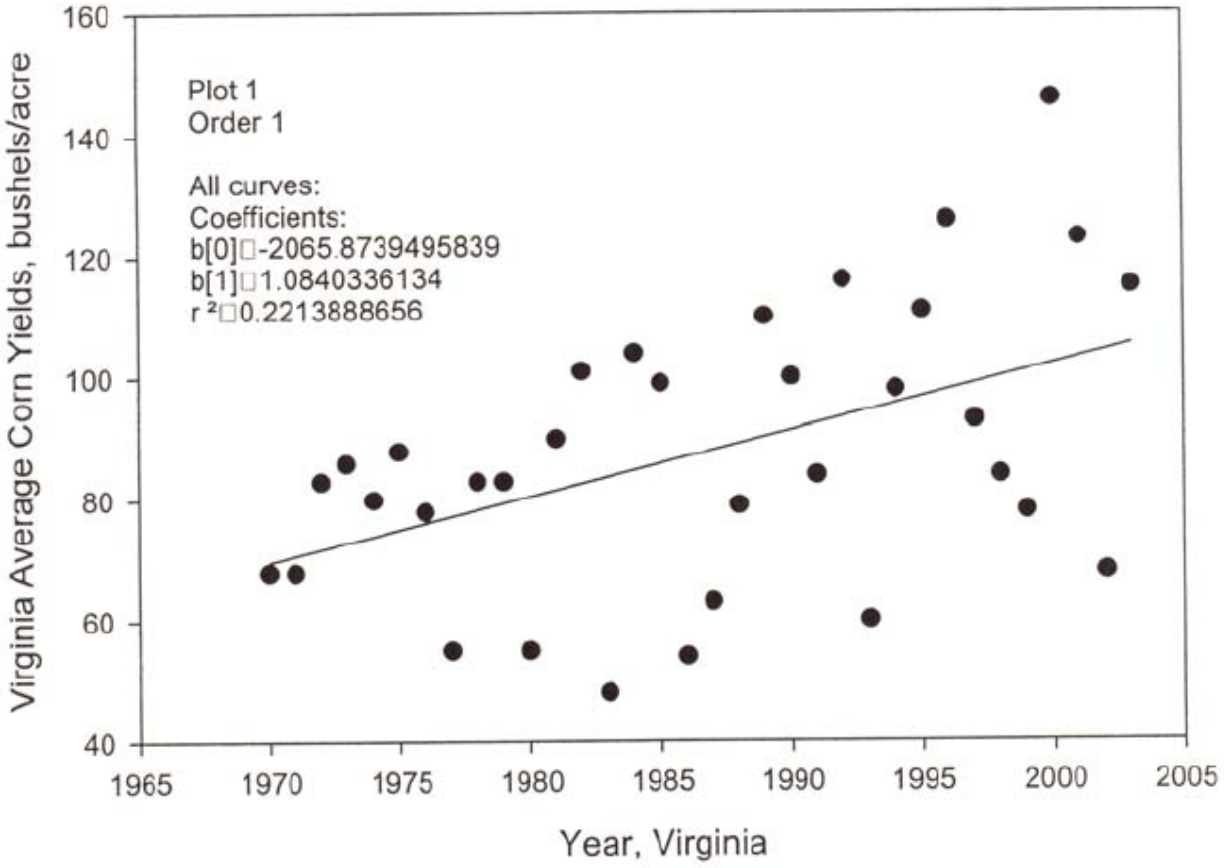


Figure 1. Average corn yields, bu/A, 1970-2004.

Wheat yield trends in Va.

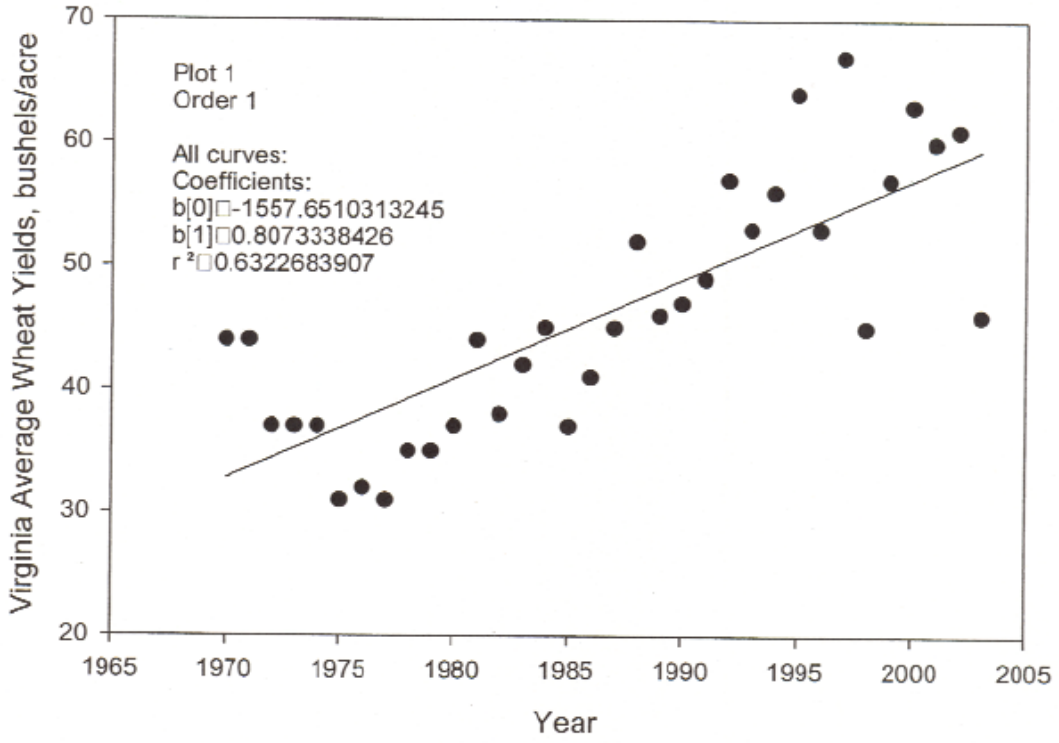


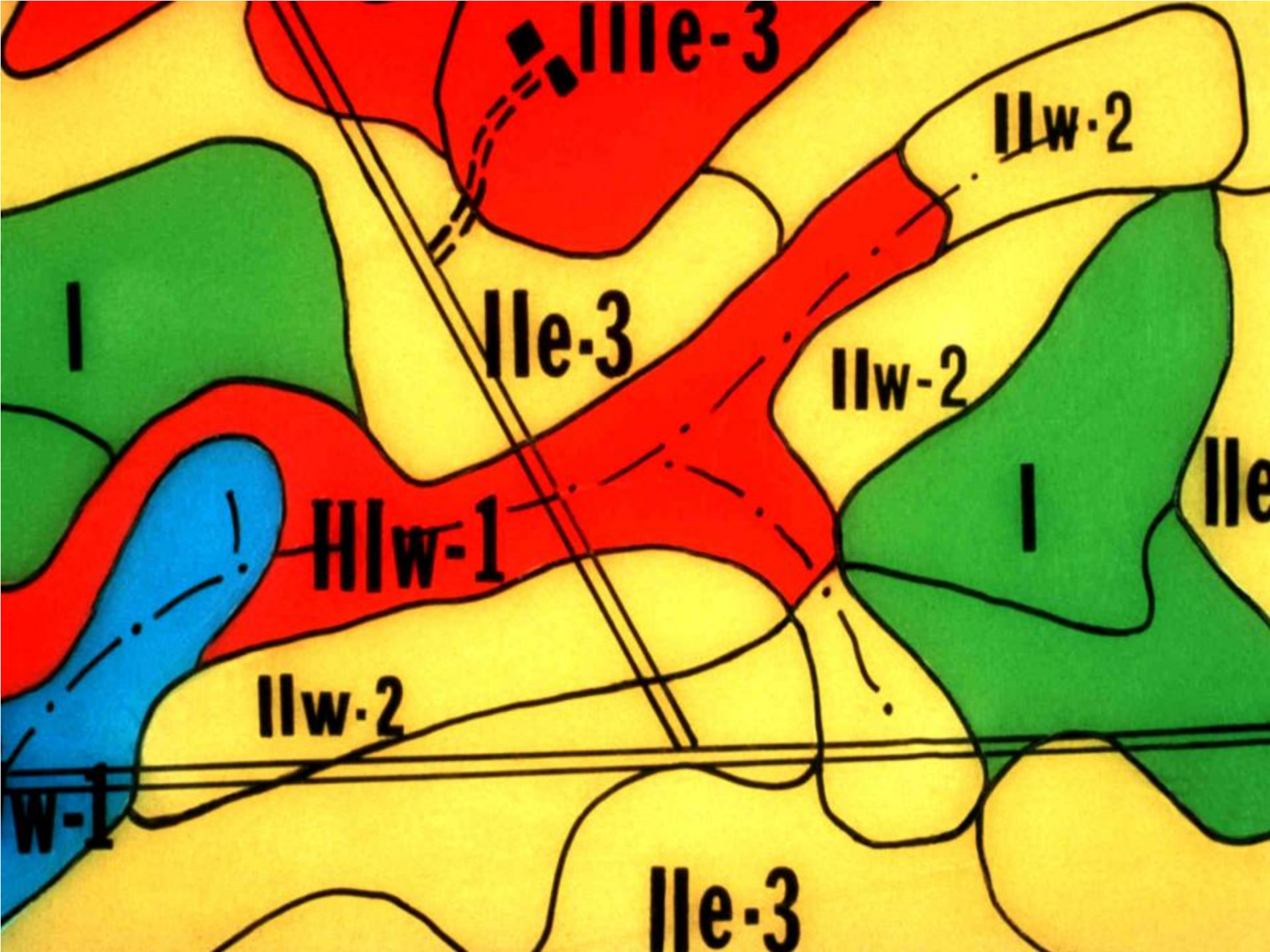
Figure 3. Average wheat yield, bu/A in Virginia, 1970-2004.

Soil productivity groups for various crops in Virginia, VALUES ‘O6

Table 1. Estimated Yields in Bushels (Bu) or Tons (T) per Acre of Various Non-Irrigated Crops for Identified Soil Productivity Groups.

	I		II		III		IV		V
Crop	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**	
Corn (Bu/A)	180	170	160	150	140	130	120	100	80
Silage (T/A)	25	24	23	22	21	20	19	18	16
Grain Sorghum (Bu/A)	140	130	120	110	100	100	90	90	80
Soybeans (Bu/A)									
Early Season	50	45	40		35		25		20
Late Season	40	34	34	30	25		18		15
Wheat (Bu/A)									
Standard	64		56		48		40		24
Intensive	80		70		60		50		30
Barley (Bu/A)									
Standard	100		70		60		50		30
Intensive	115		88		75		63		38
Oats (Bu/A)	80		80		80		60		60
Cereal Silage (T/A)									
Barley/Oats/Rye	>10		8-10		6-8		3-6		<3
Wheat/Triticale	>12		10-12		8-10		4-8		<4
Tallgrass Hay (T/A)	>4.0		3.5-4		3-3.5		<3		<3
Bermudagrass Hay (T/A)	>6		5-6		4-5		3-4		<3
Prairie Grass Hay (T/A)	>5		4.25-5		3.5-4.25		3-3.5		<3
Alfalfa (T/A)	>6		4-6		<4		<4		<4
Pasture (Ac/Au)	1.0		1.1-1.5		1.6-3.0		3.1-6.5		3.1-6.5

Soil Variability in Landscapes


IIIe-3
IIw-2
I
IIe-3
IIw-2
IIIw-1
I
IIe
IIw-2
w-1
IIe-3

VALUES:

Calculation of Average Yield-Corn

Soil Mapping Unit	Expected Yield	% of Field	Fraction of Total Yield*
1	130	50	65
2	125	30	38
3	120	20	+ 24
Weighted Mean = 127 bu/A			

*** 130 X 0.50 = 65, etc.**