

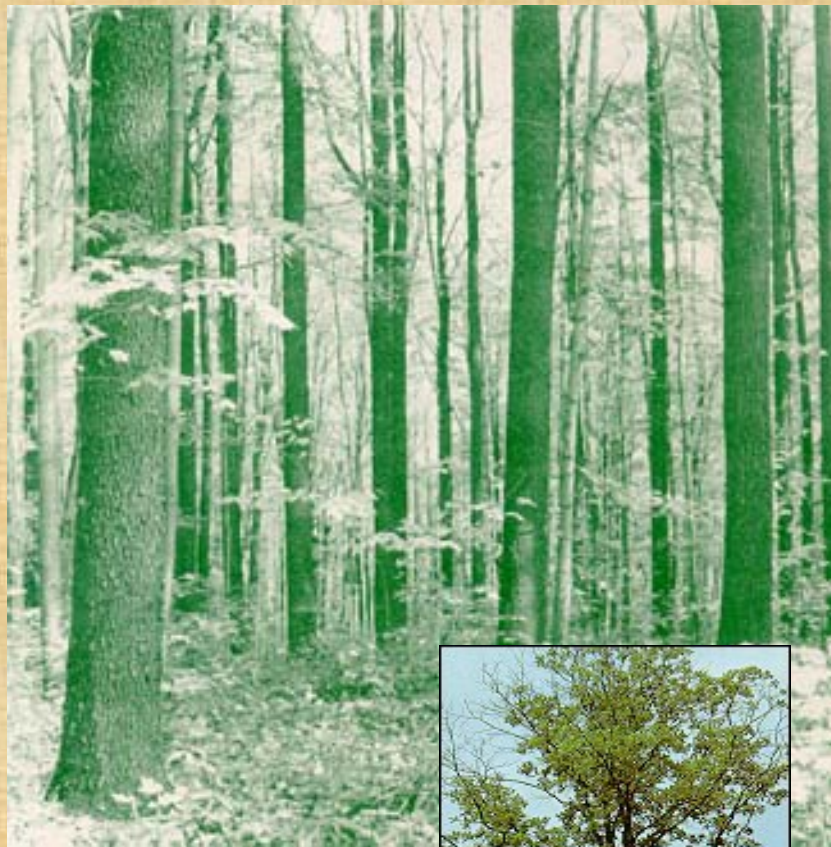
SOIL PROPERTIES ASSOCIATED WITH LOBLOLLY PINE DECLINE IN ALABAMA

Emily Carter
U.S. Forest Service
Auburn, AL





INTRODUCTION



RED MAPLE - 2006

SUGAR MAPLE - 2006

RED PINE - 2002

RED SPRUCE - 2006

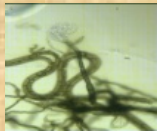
RADIATA PINE - 2007

EUCALYPTUS - 2005





INTRODUCTION



LITTLELEAF DISEASE - 1930'S

LOBLOLLY DIE OFF - 1959

**OAKMULGEE RD ASSESSMENT
- 60'S AND 70'S**

**OAKMULGEE RD
REASSESSMENT - 1998**

**ADDITIONAL ASSESSMENT
OF LDO IN ALABAMA - 2000**



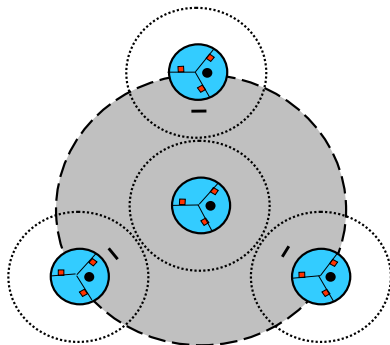
STUDY ELEMENTS



STAND AGE (YRS)
 DBH (INCHES)
 BASAL AREA (FT² / AC)
 LIVE CROWN RATIO
 FOLIAGE TRANSPARENCY (%)
 CROWN DIEBACK (%)
 CROWN DENSITY (%)



Phase 2/Phase 3 Plot Design

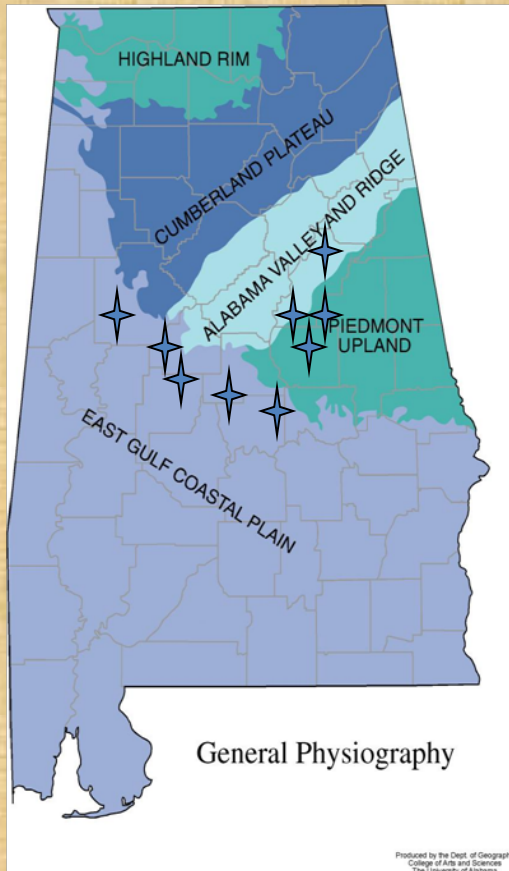


- | | |
|---------------------|---------------------------|
| ● Subplot | 24.0 ft (7.32 m) radius |
| ● Microplot | 6.8 ft (2.07 m) radius |
| ○ Annular plot | 58.9 ft (17.95 m) radius |
| ● Lichens plot | 120.0 ft (36.60 m) radius |
| ■ Vegetation plot | 1.0 m ² area |
| — Soil Sampling | (point sample) |
| — Down Woody Debris | 24 ft (7.32 m) transects |

DBH (INCHES)
 LAST 5 YR GROWTH INCREMENT (mm)
 LAST 10 YEAR GROWTH INCREMENT (mm)
 LIVE CROWN RATIO
 FOLIAGE TRANSPARENCY (%)
 CROWN DIEBACK (%)
 CROWN DENSITY (%)



STUDY ELEMENTS



NUMBER OF PLOTS	PHYSIOGRAPHIC REGIONS	COUNTY	MANAGEMENT
9	PIEDMONT	CLAY CLEBURNE TALLADEGA	TALLADEGA NF
5	VALLEY & RIDGE	CALHOUN	CHOCOLOCCO SP
16	COASTAL PLAIN	BIBB, HALE CHILTON, PERRY	TALLADEGA NF
9	TRANSITION	TUSCALOOSA	WESTERVELT



PHYSIOGRAPHIC LOCATIONS

PIEDMONT

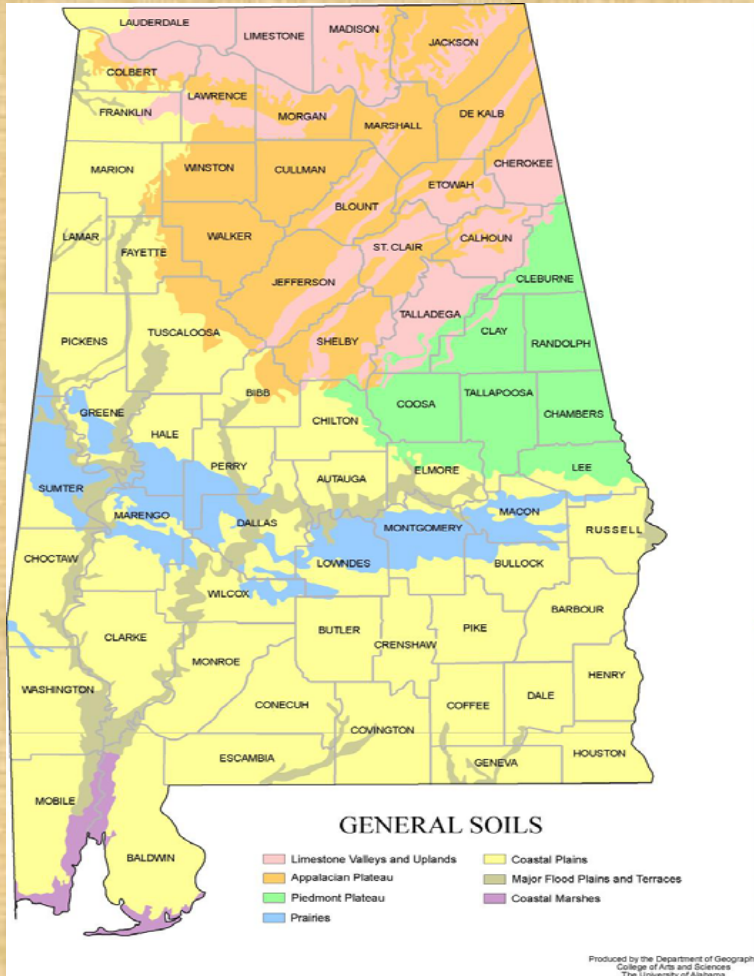
A DISSECTED GEOLOGIC SURFACE DEVELOPED FROM IGNEOUS AND METAMORPHIC ROCKS. SOILS POSSESS LOAMY OR CLAYEY SUBSOILS, UDIC SOIL MOISTURE, AND KAOLINITIC, MIXED, OR OXIDIC MINERALOGY.

VALLEY & RIDGE

A SERIES OF PARALLEL RIDGES AND VALLEYS UNDERLAIN BY FAULTED AND FOLDED ROCKS. SOILS ARE FORMED ON SHALE OR SANDSTONE RIDGES, DEEP VALLEYS, OR LIMESTONE RIDGES. SOILS ARE WELL-DRAINED, ACIDIC, AND CLAY ENRICHED SUBSOILS.

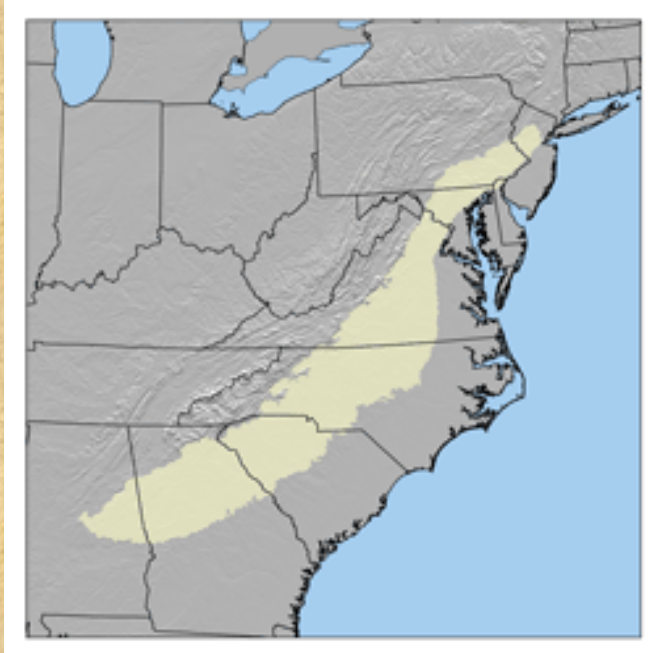
COASTAL PLAIN

A GEOLOGIC SURFACE UNDERLAIN BY SEDIMENTARY DEPOSITS. SOILS ARE DEEP WITH A LOAMY OR SANDY SOIL SURFACE UNDERLAIN BY LOAMY OR CLAYEY SUBSOIL.





PIEDMONT DESCRIPTION



TREE CHARACTERISTICS

AGE: 26 - 55
DBH: 5.8 - 14.3
5 YR GI: 2 - 23
10 YR GI: 4 - 53
BAP: 11.5 - 18.4
BAAT: 11.5 - 23.0

SOIL CHARACTERISTICS

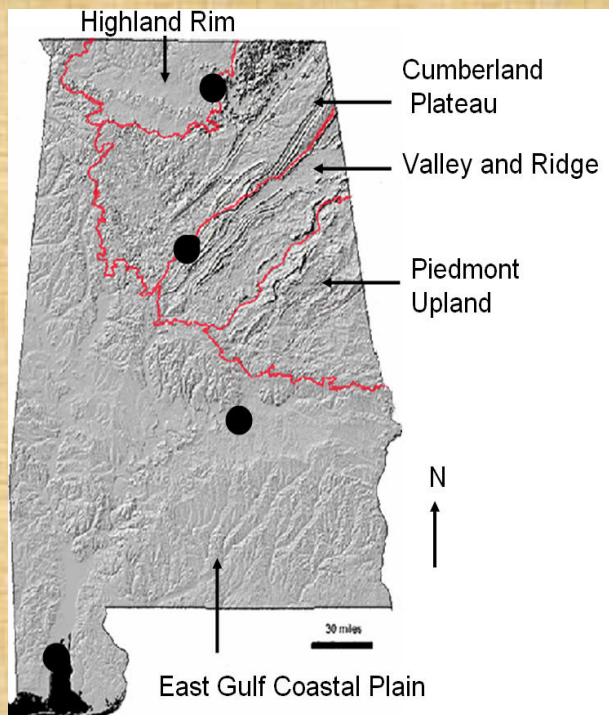
SOILS

TYPIC KANHAPLUDULT
RUPTIC-ULTIC DYSTRUDEPT
TYPIC HAPLUDULT

DPTH	TN	P	pH	EB	ECEC	BD
(cm)	(%)	(mg/kg)		(meq/100g)		(Mg/m ³)
10	0.12	6.79	4.2	0.94	3.03	0.82
20	0.05	4.06	4.5	0.45	2.01	1.20
30	0.04	1.76	4.4	0.46	2.06	1.31



VALLEY & RIDGE DESCRIPTION



TREE CHARACTERISTICS

Age: 41-53
 DBH: 9.5-21.3
 5 YR GI: 5 - 14
 10 YR GI: 14 - 31
 BAP: 13.8 - 18.4
 BAAT: 13.8 - 29.8



SOIL CHARACTERISTICS

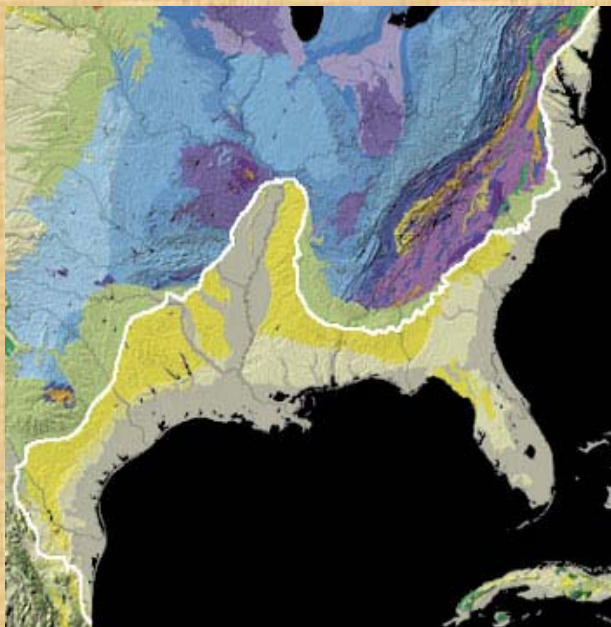
DPTH	TN	P	pH	EB	ECEC	BD
(cm)	(%)	(mg/kg)		(meq/100g)		(Mg/m ³)
10	0.15	12.7	4.9	4.74	5.38	1.01
20	0.08	5.1	4.8	1.78	2.89	1.22
30	0.07	3.2	4.8	1.75	2.99	1.24

SOILS

RHODIC PALEUDULT
 AQUIC HAPLUDULT
 TYPIC HAPLUDULT



COASTAL PLAIN DESCRIPTION



TREE CHARACTERISTICS

Age: 30 - 70
DBH: 5.8 - 19.4
5 YR GI: 1 - 14
10 YR GI: 5 - 39
BAP: 13.8 - 25.2
BAAT: 6.1 - 29.8

SOIL CHARACTERISTICS

SOILS

AQUIC HAPLUDULT
GROSSARENIC PALEUDULT
FLUVENTIC DYSTRUDEPT
TYPIC HAPLUDULT

DPTH (cm)	TN (%)	P (mg/kg)	pH	EB	ECEC meq/100g	BD Mg/m ³
10	0.06	7.90	4.6	1.79	2.54	0.98
20	0.04	4.42	4.7	0.69	1.42	1.33
30	0.03	3.75	4.6	0.64	1.60	1.41



SAMPLING AND ANALYSIS



SOIL SAMPLING



SOIL ANALYSIS

PHYSICAL - BD, GMC, TEXTURE
CHEMICAL - N, P, S, Ca, Mg, K
Na, Mn, S



CROWN RATING



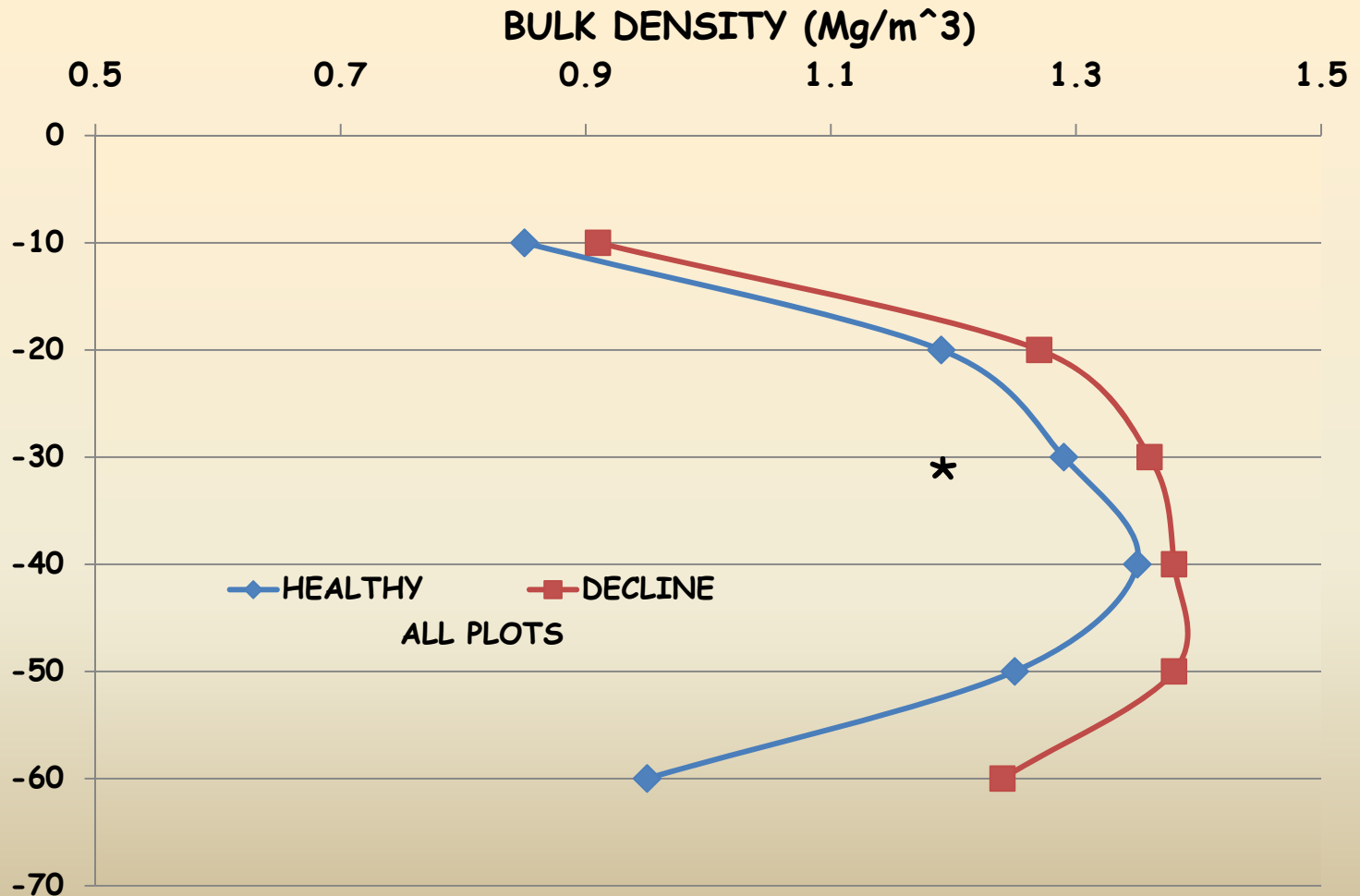
FUNGAL STATUS



TREE
PARAMETERS

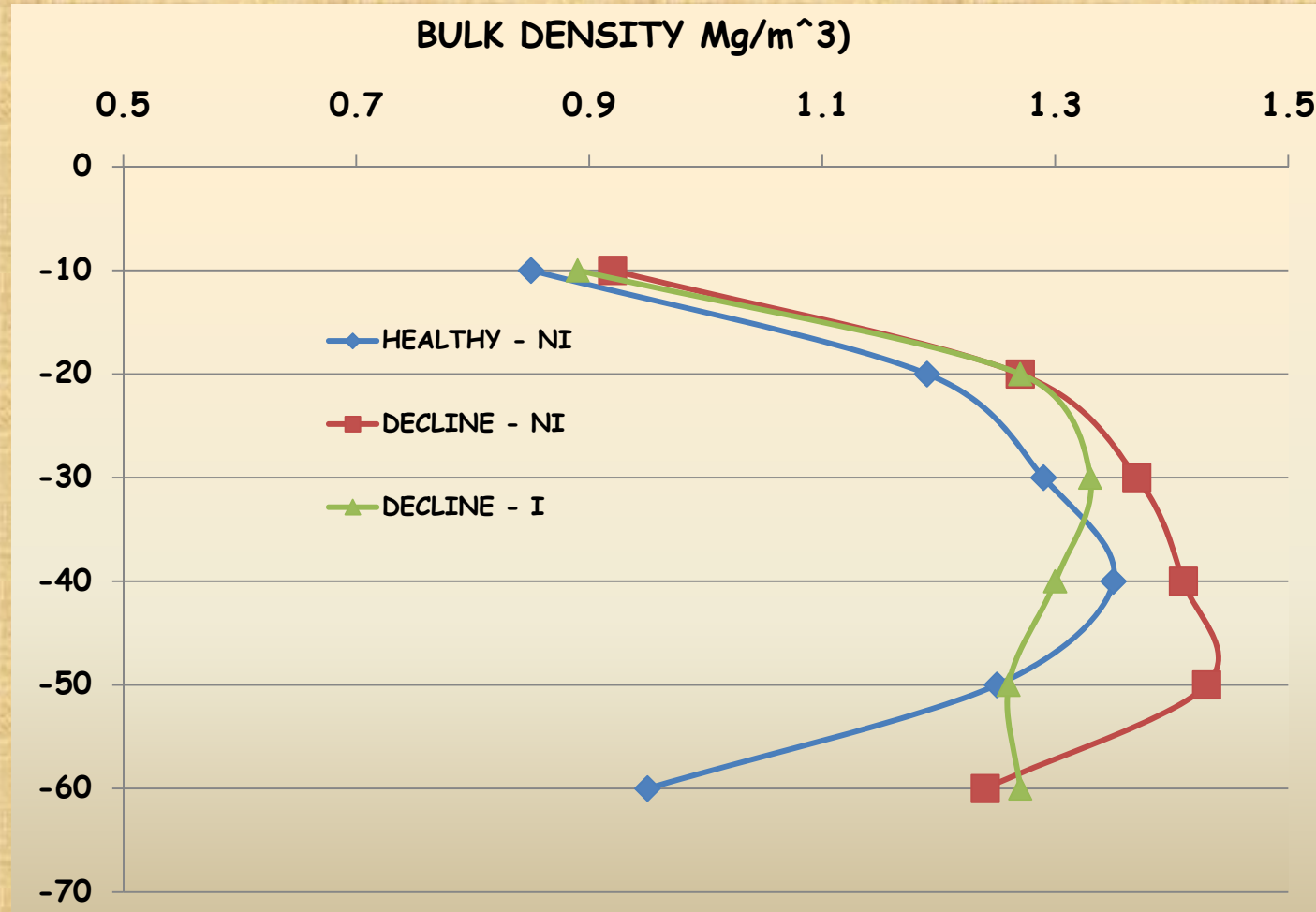


BULK DENSITY & INITIAL CROWN RATING



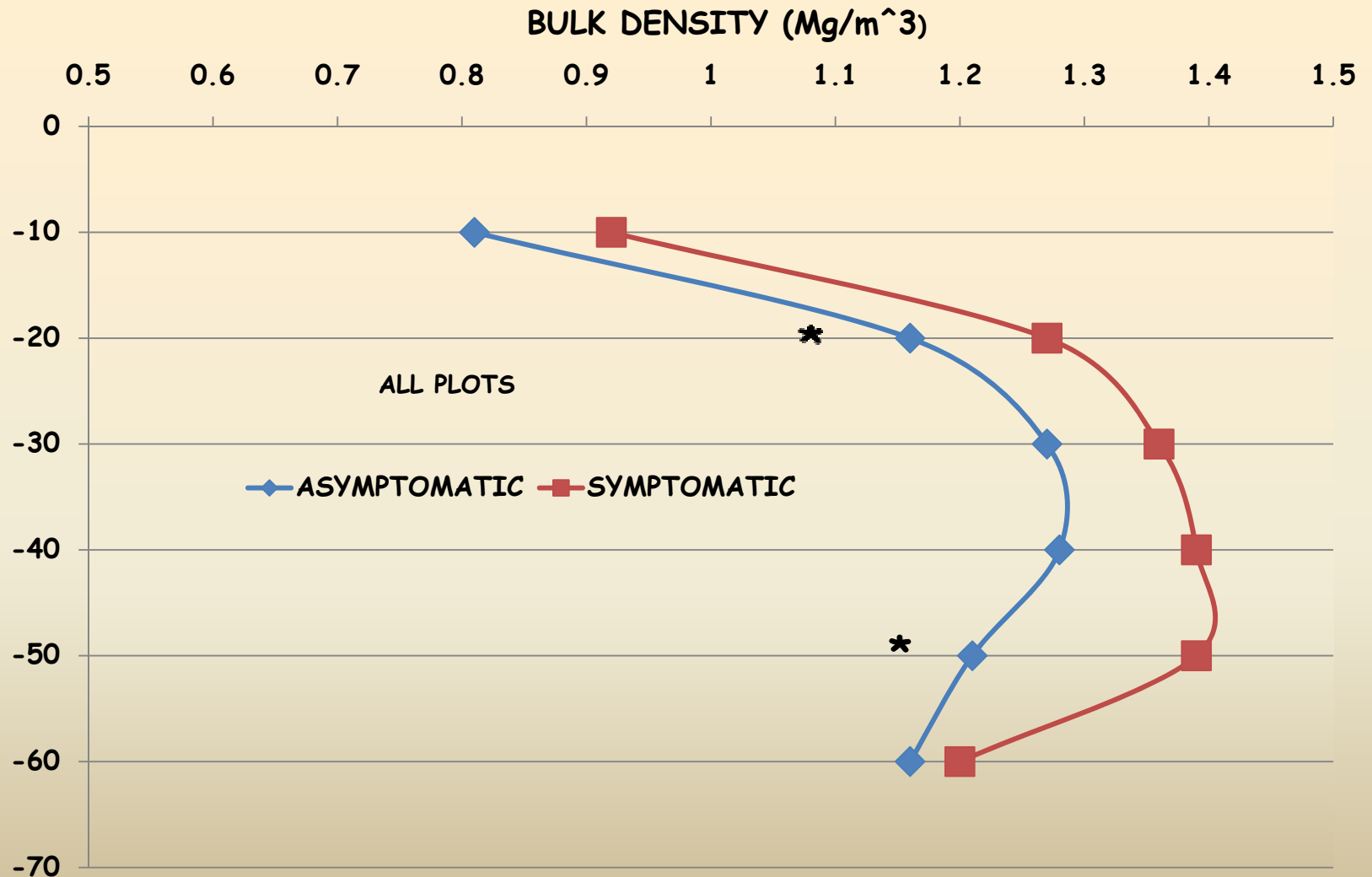


BULK DENSITY & INITIAL CROWN RATING



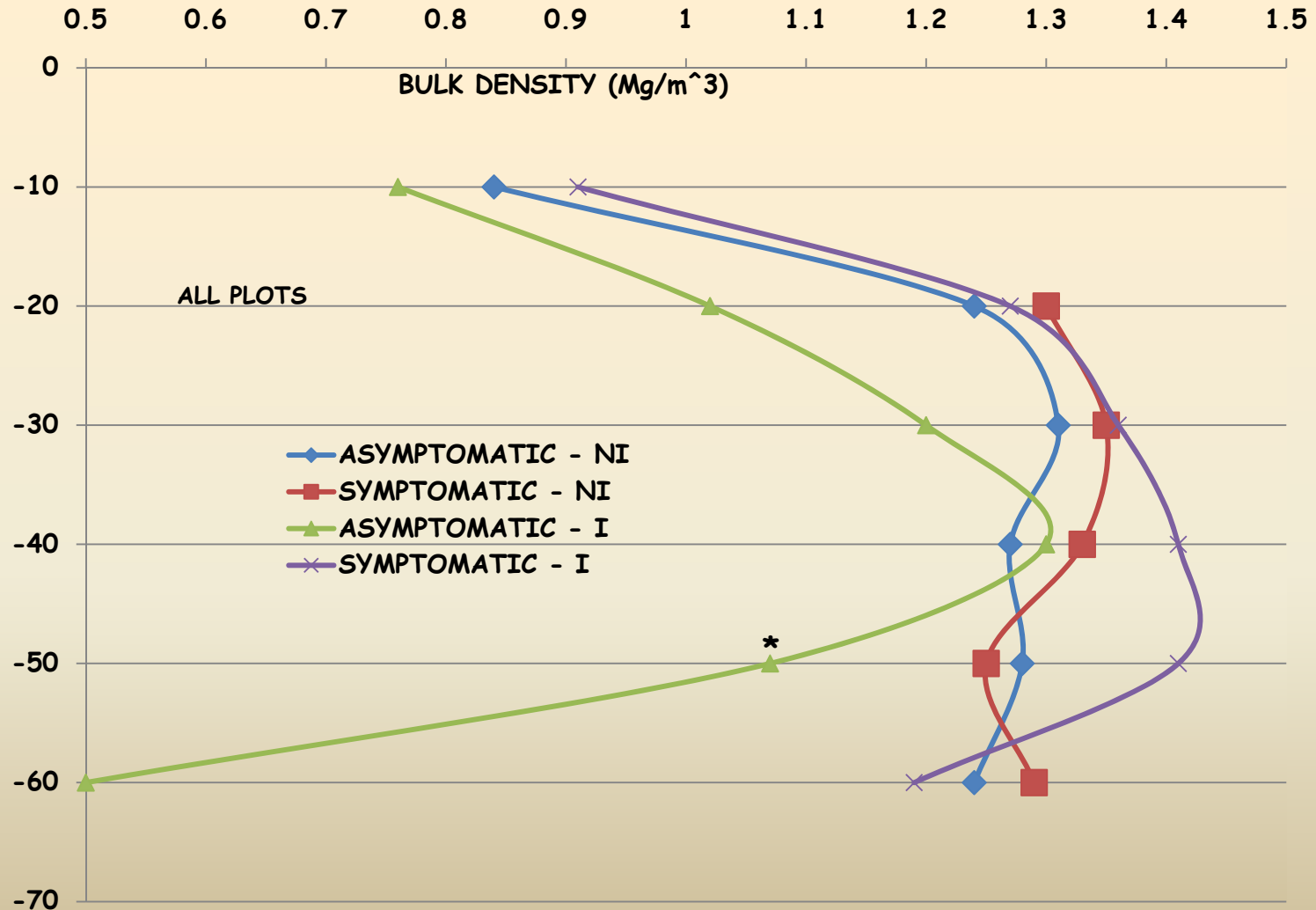


BULK DENSITY AND FUNGAL STATUS



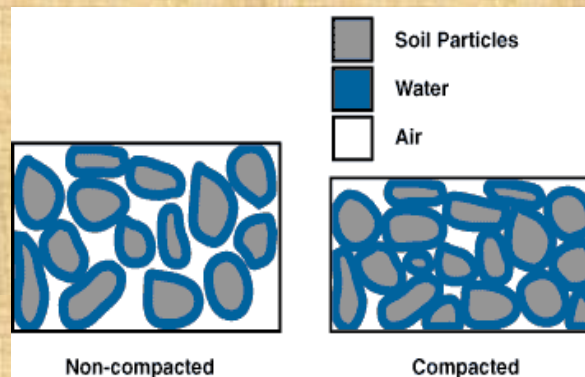
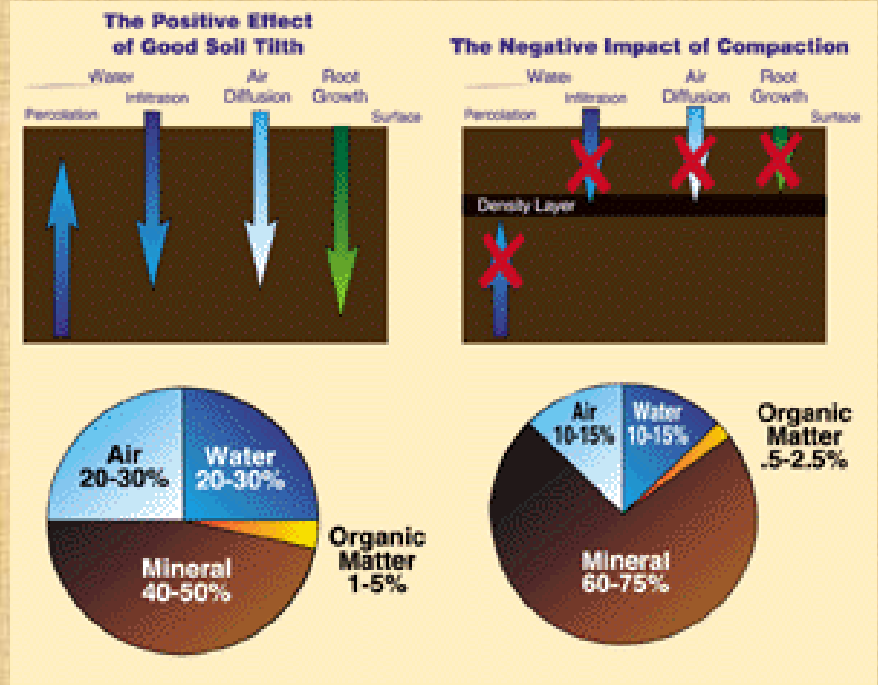
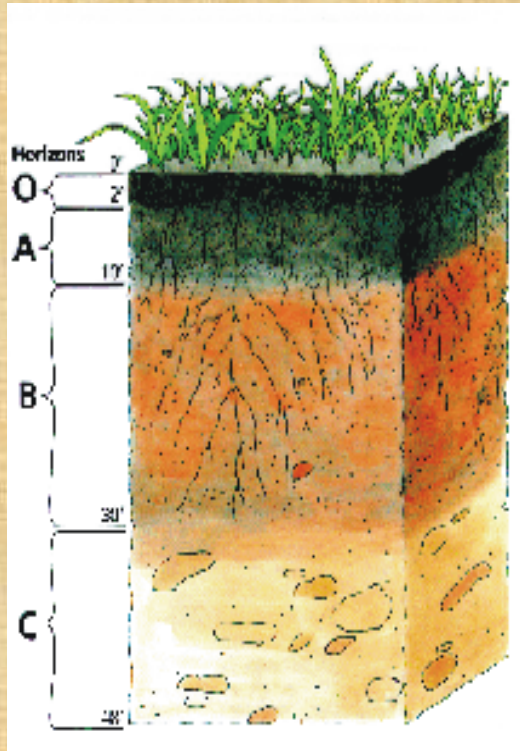


BULK DENSITY AND FUNGAL STATUS



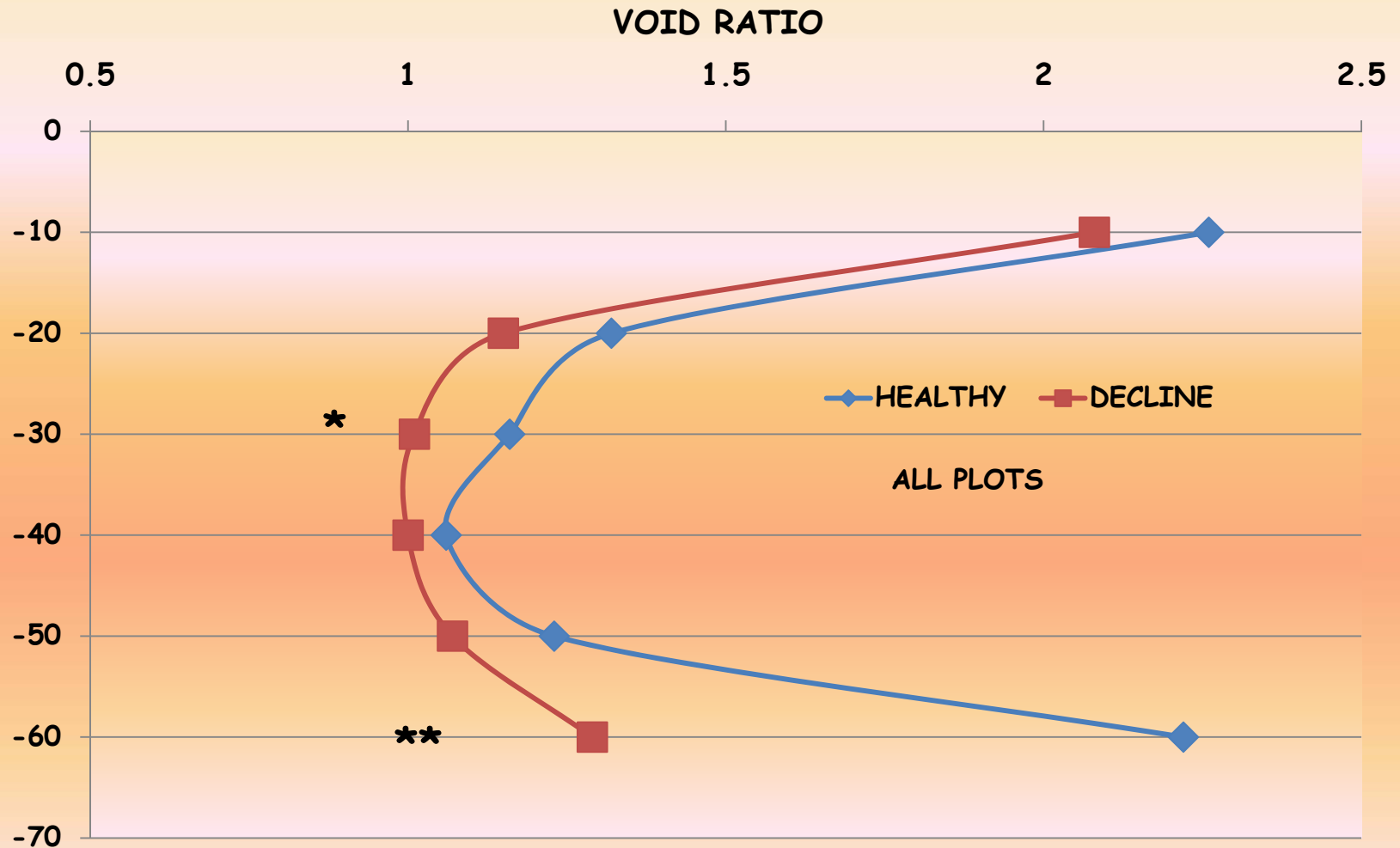


IMPACT OF SOIL STRUCTURE



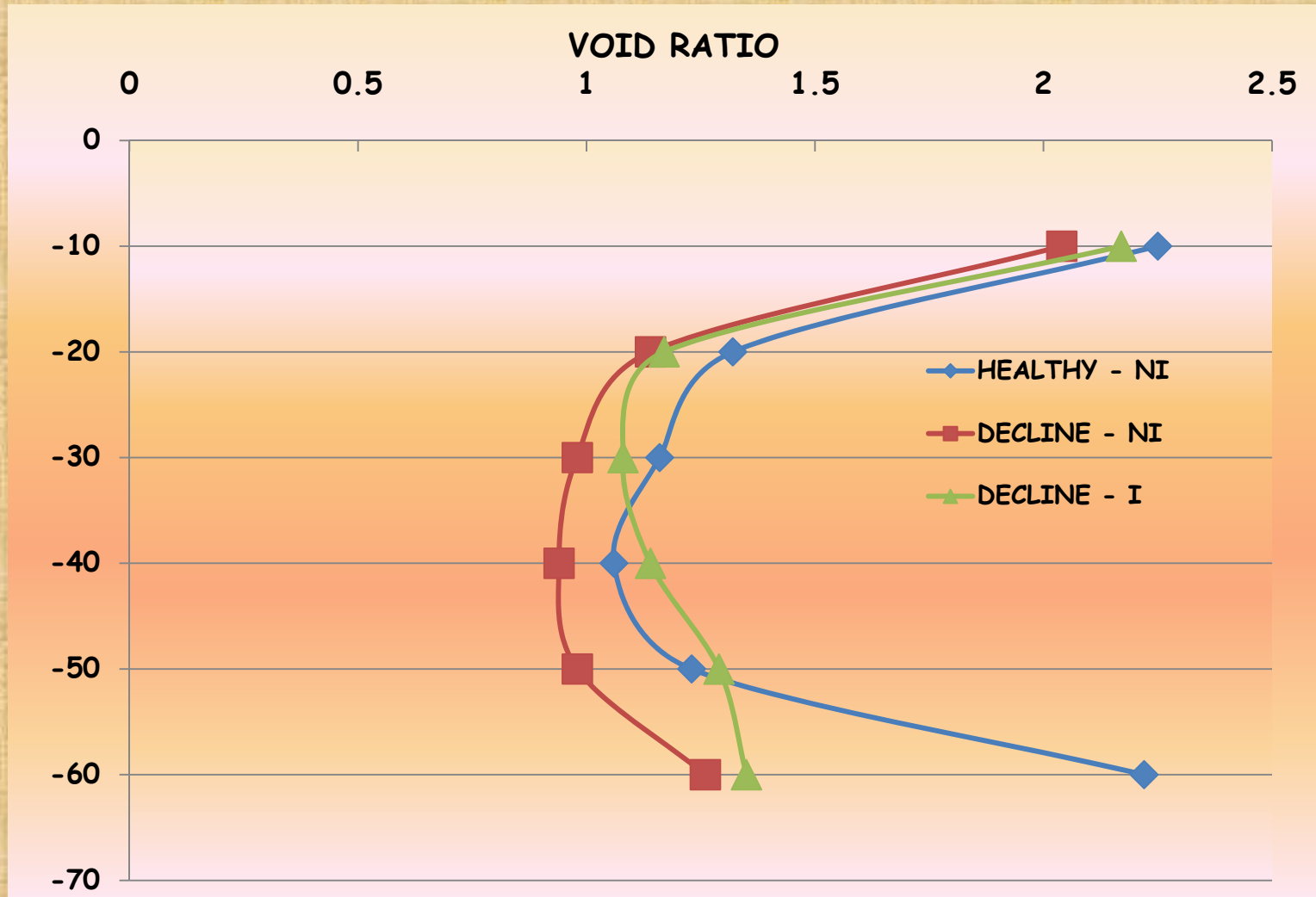


VOID RATIO & CROWN RATING



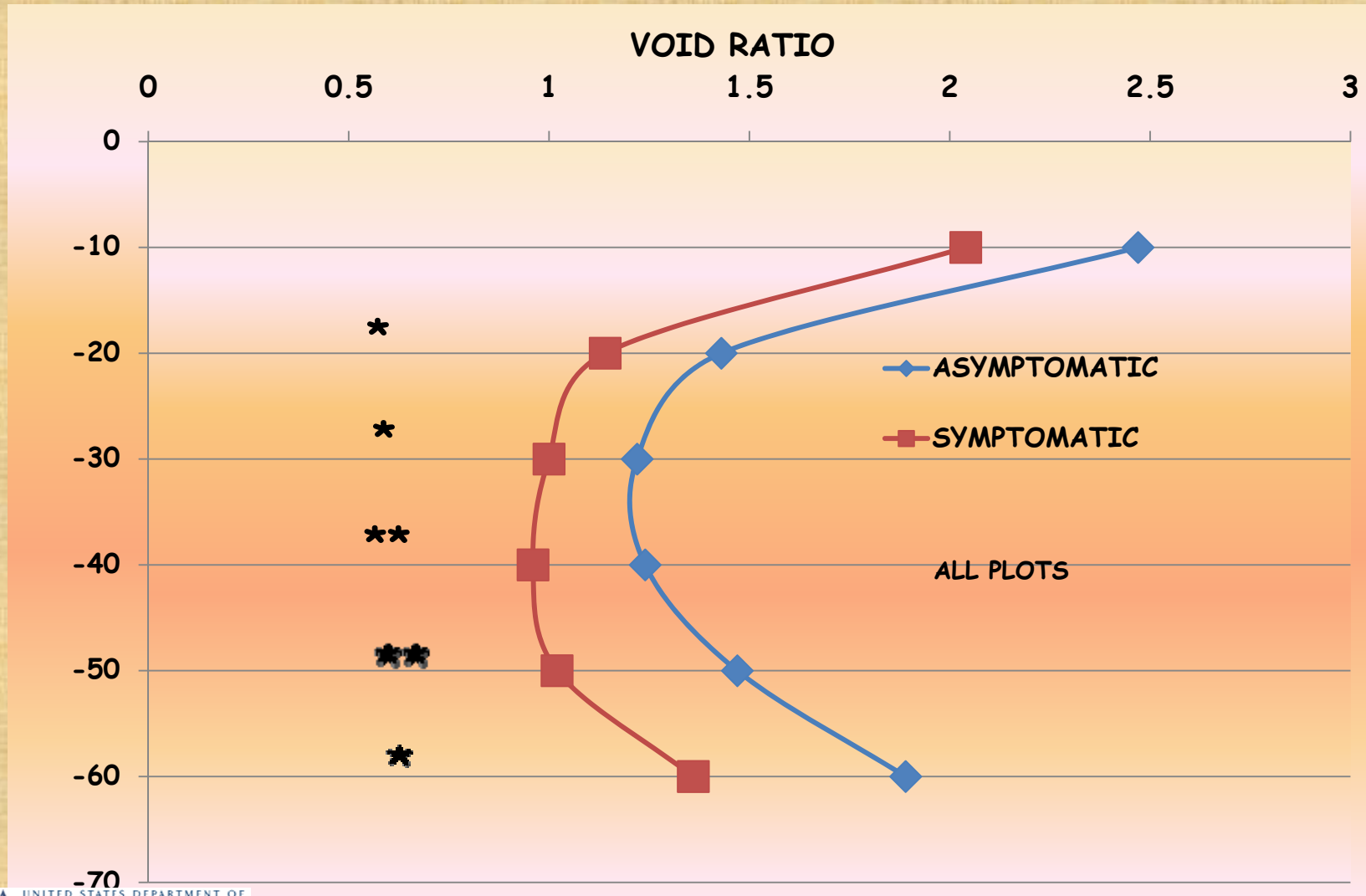


VOID RATIO & CROWN RATING



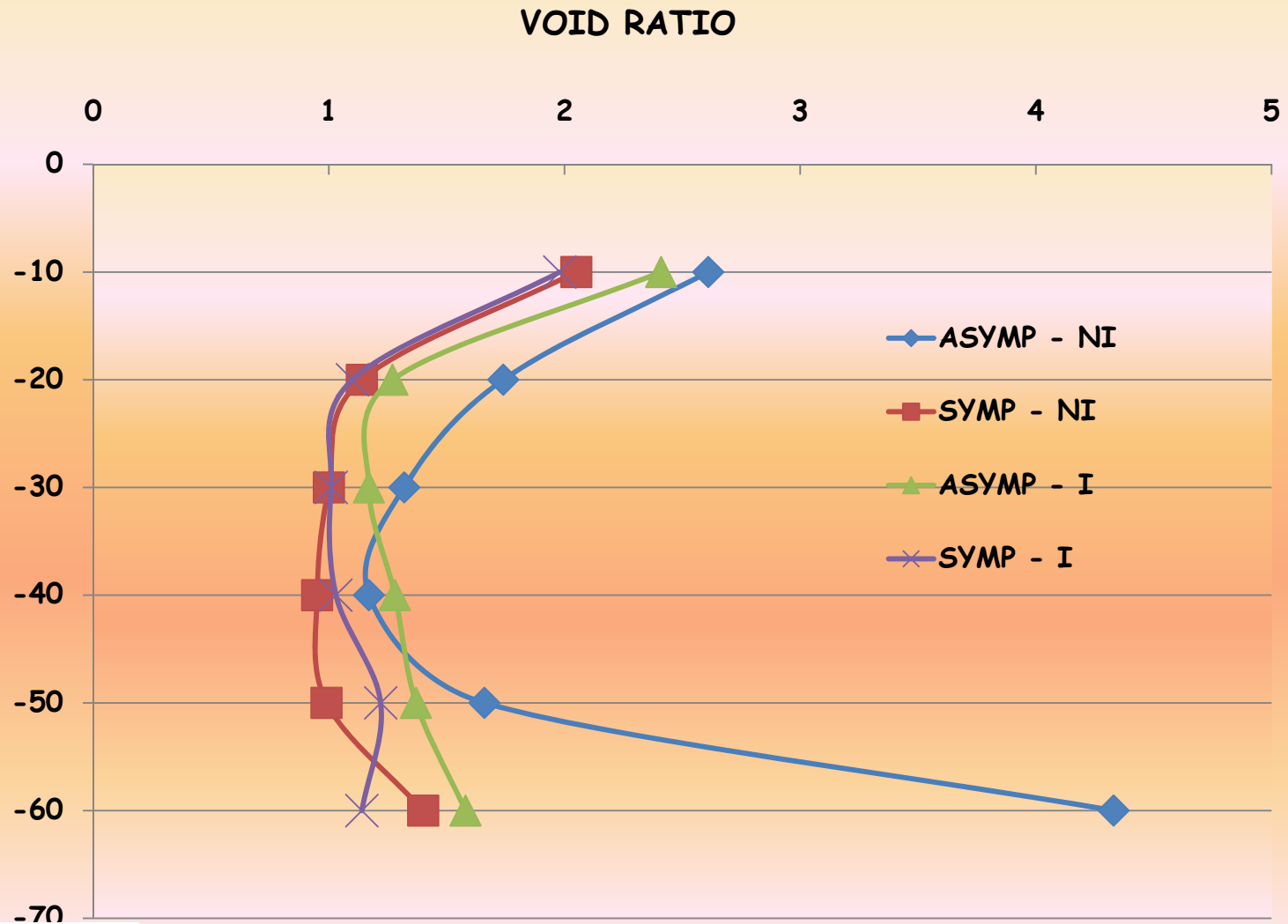


VOID RATIO & FUNGAL STATUS





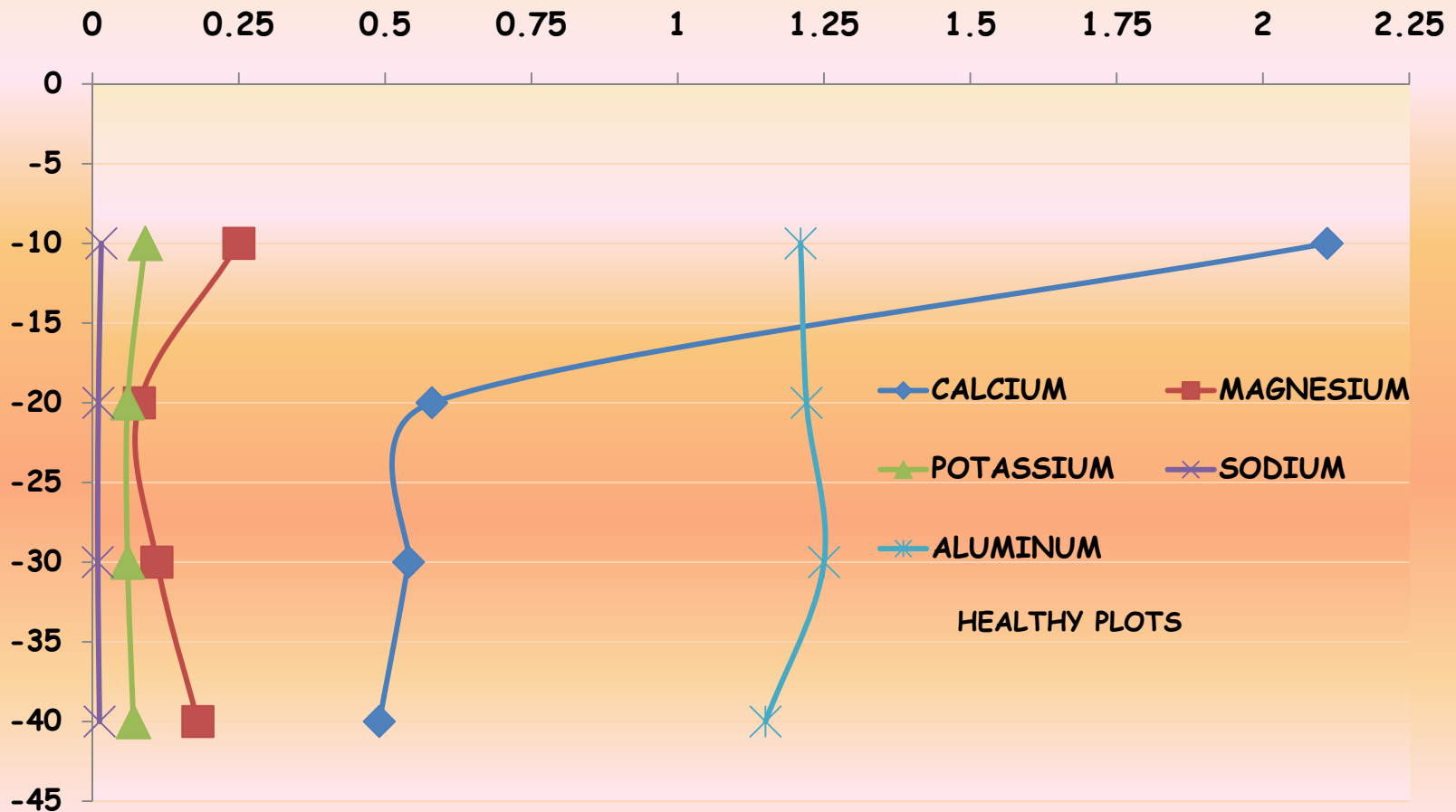
VOID RATIO & FUNGAL STATUS





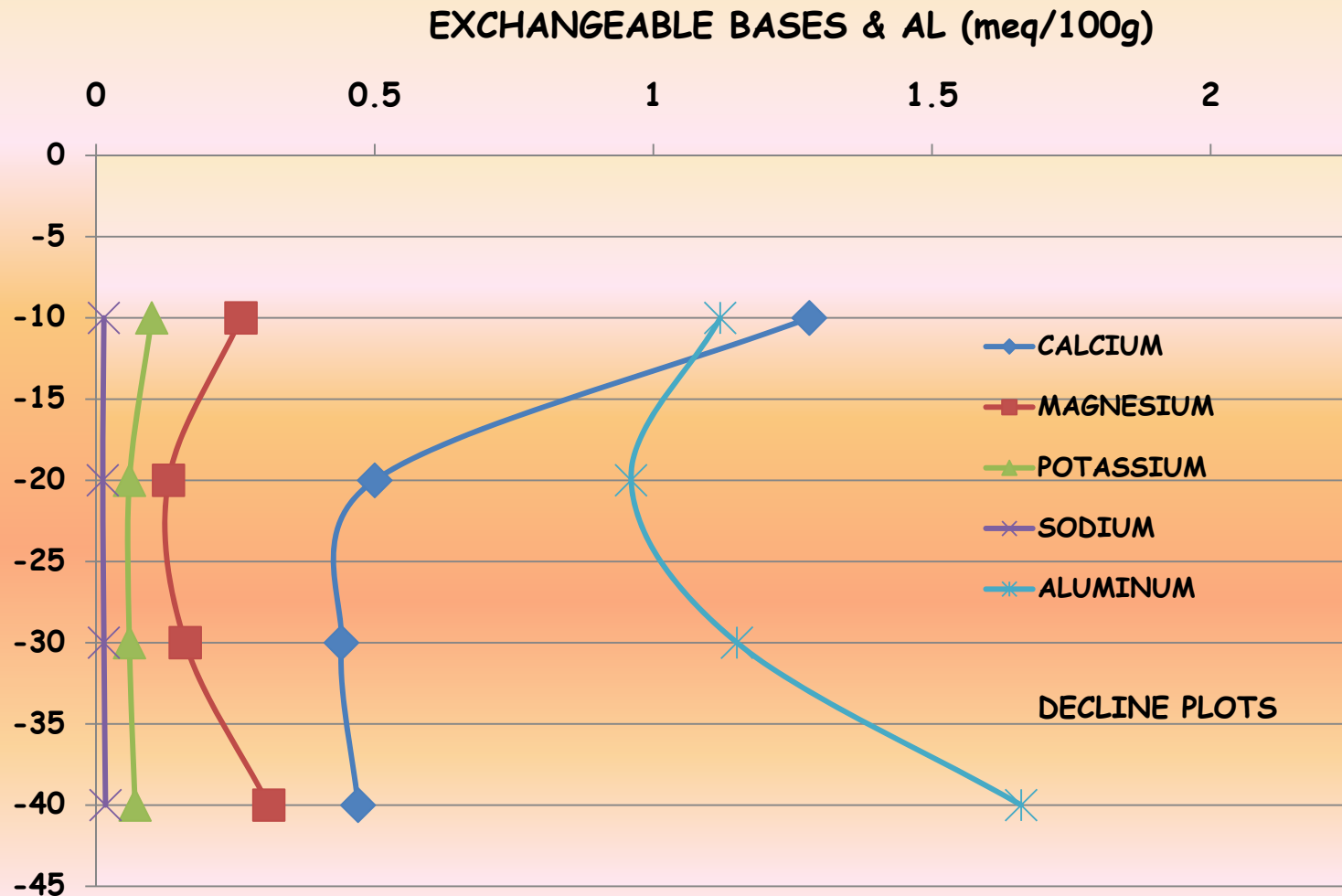
SOIL NUTRIENTS & CROWN RATING

EXCHANGEABLE BASES & ALUMINUM (meq/100g)



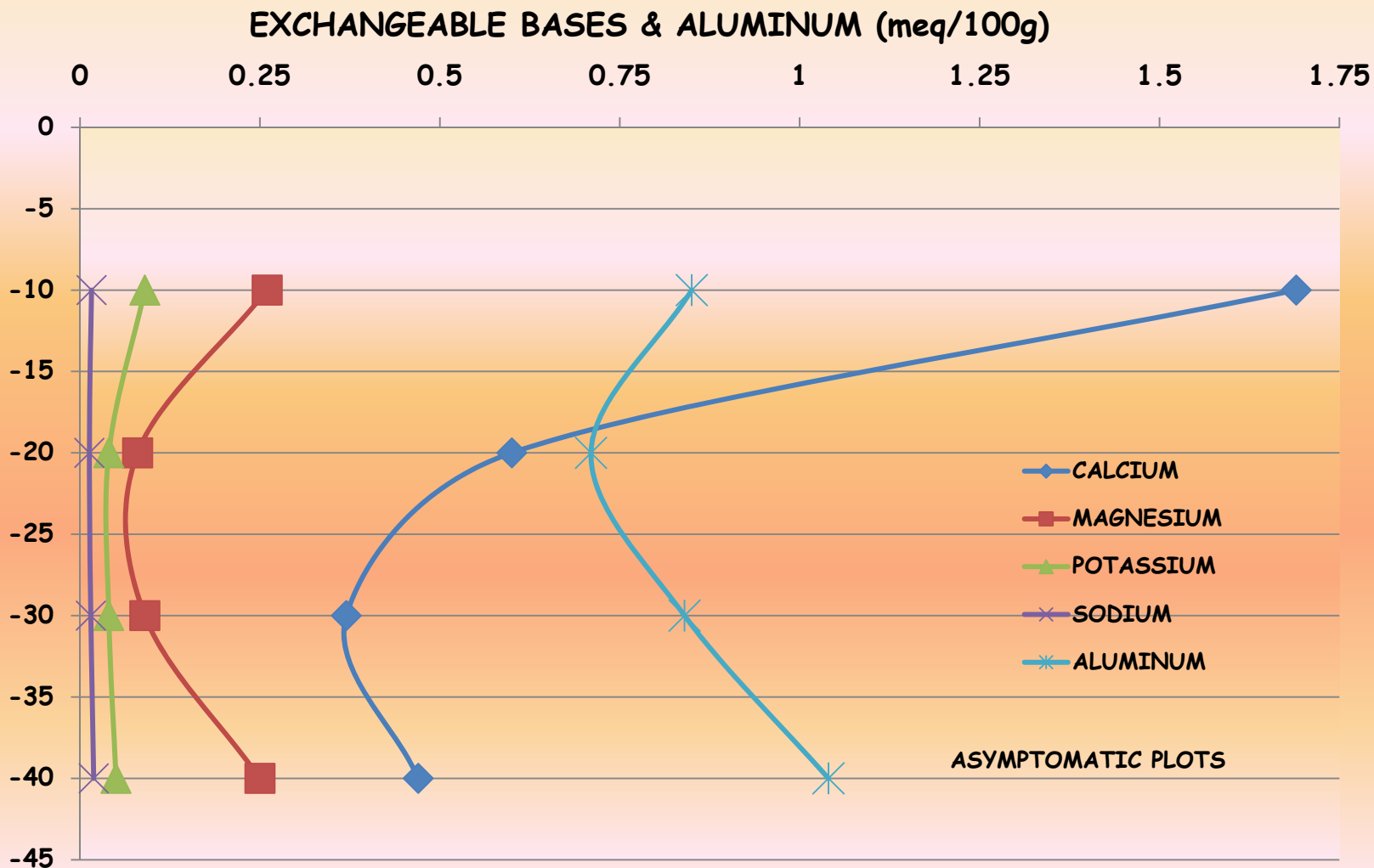


SOIL NUTRIENTS & CROWN RATING



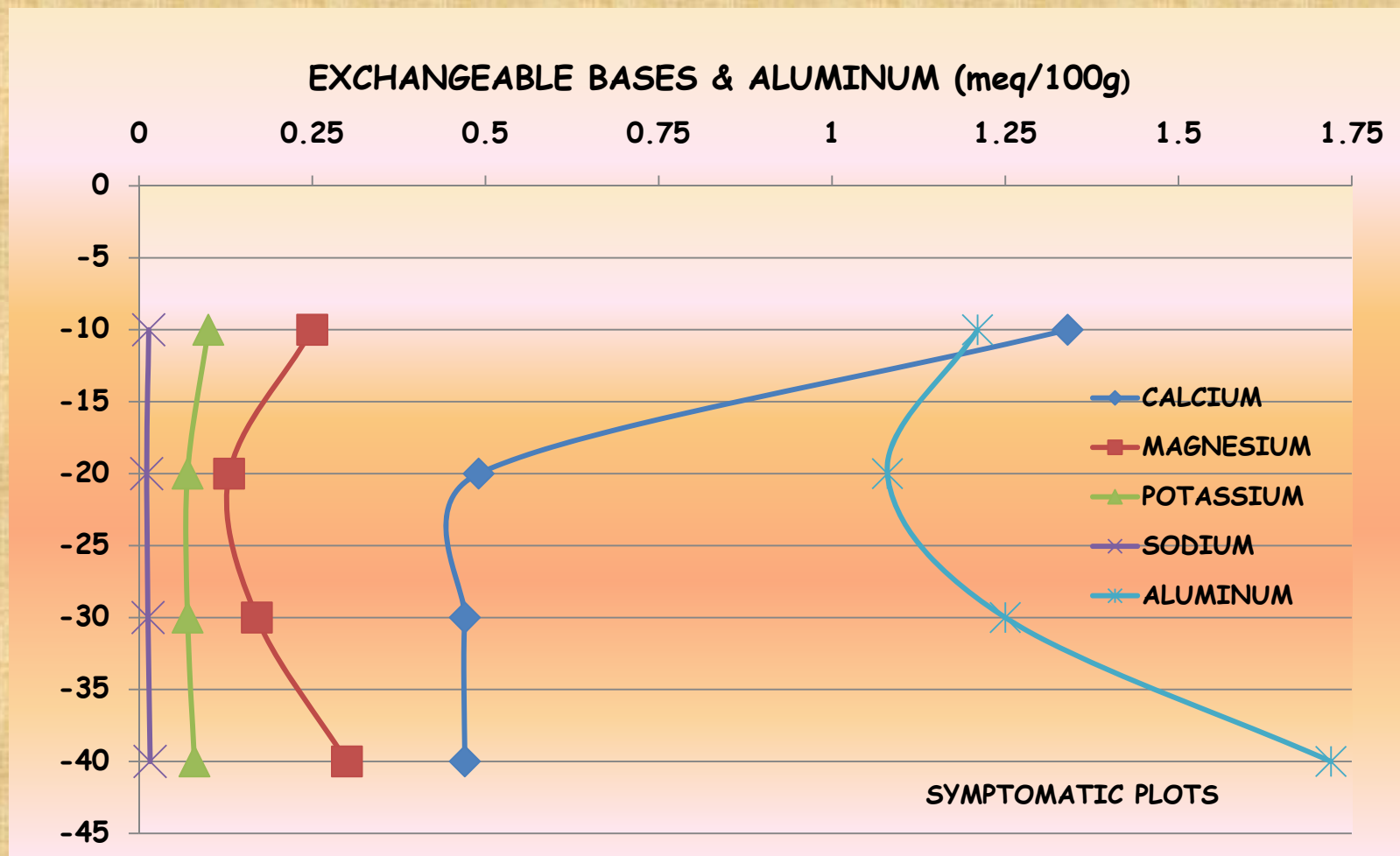


SOIL NUTRIENTS & FUNGAL STATUS





SOIL NUTRIENTS & FUNGAL STATUS



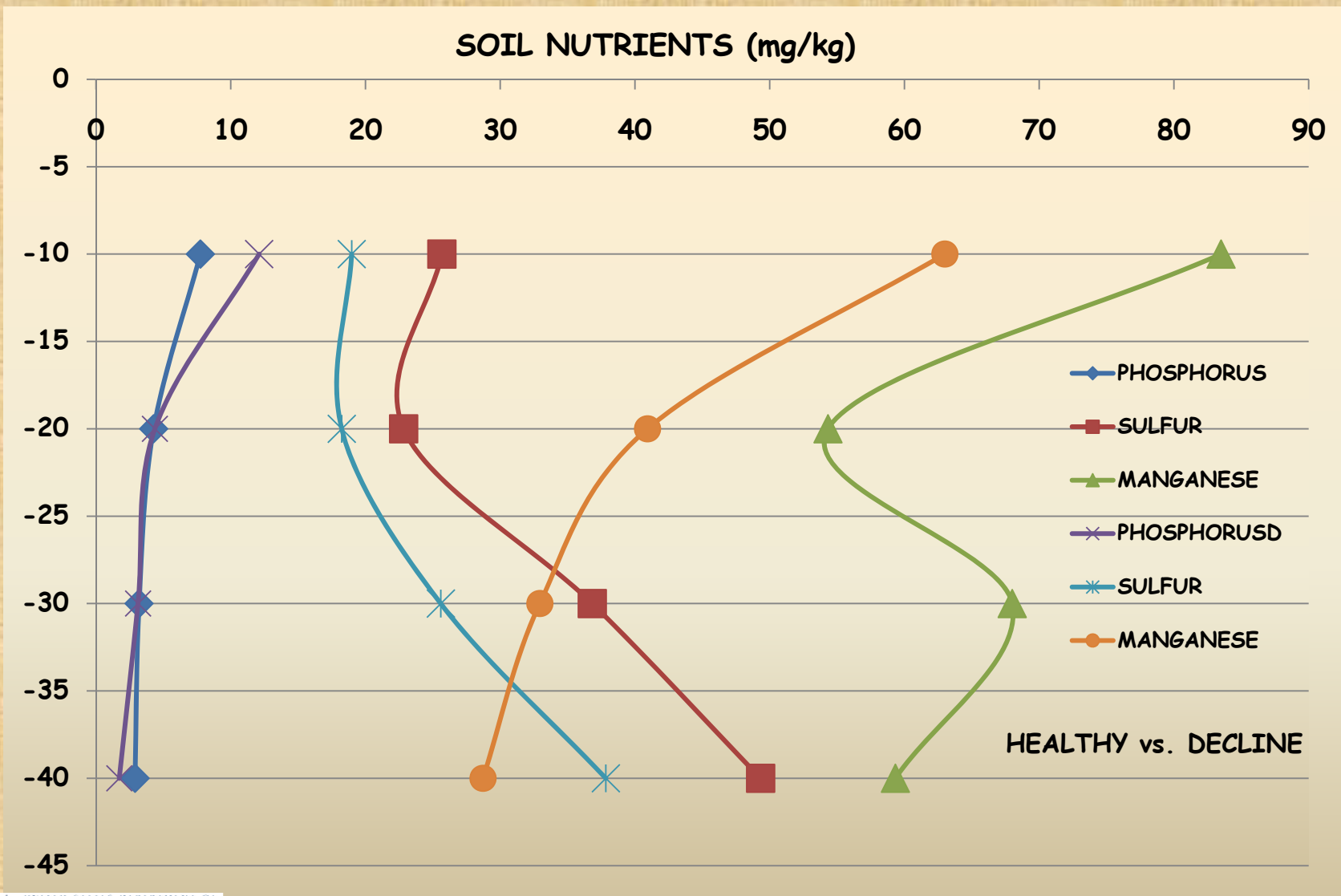


TOTAL SOIL NITROGEN

DEPTH (cm)	TOTAL NITROGEN (%) HEALTHY	TOTAL NITROGEN (%) DECLINE	TOTAL NITROGEN (%) ASYMPTOMATIC	TOTAL NITROGEN (%) SYMPTOMATIC
10	0.09	1.28	1.35	1.026
20	0.05	0.04	0.04	0.042
30	0.035	0.03	0.029	0.034
40	0.03	0.025	0.024	0.026

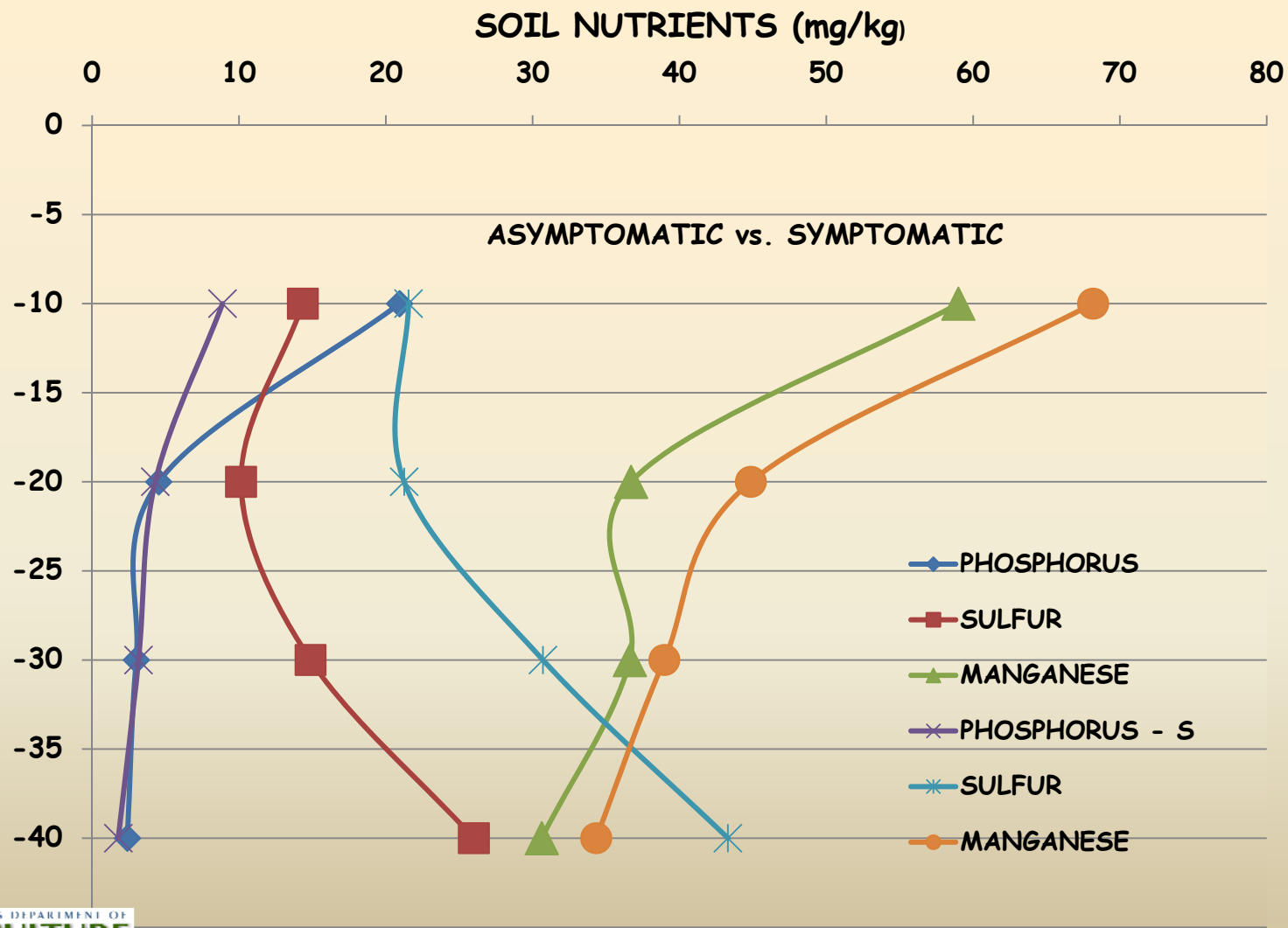


SOIL NUTRIENTS & CROWN RATING



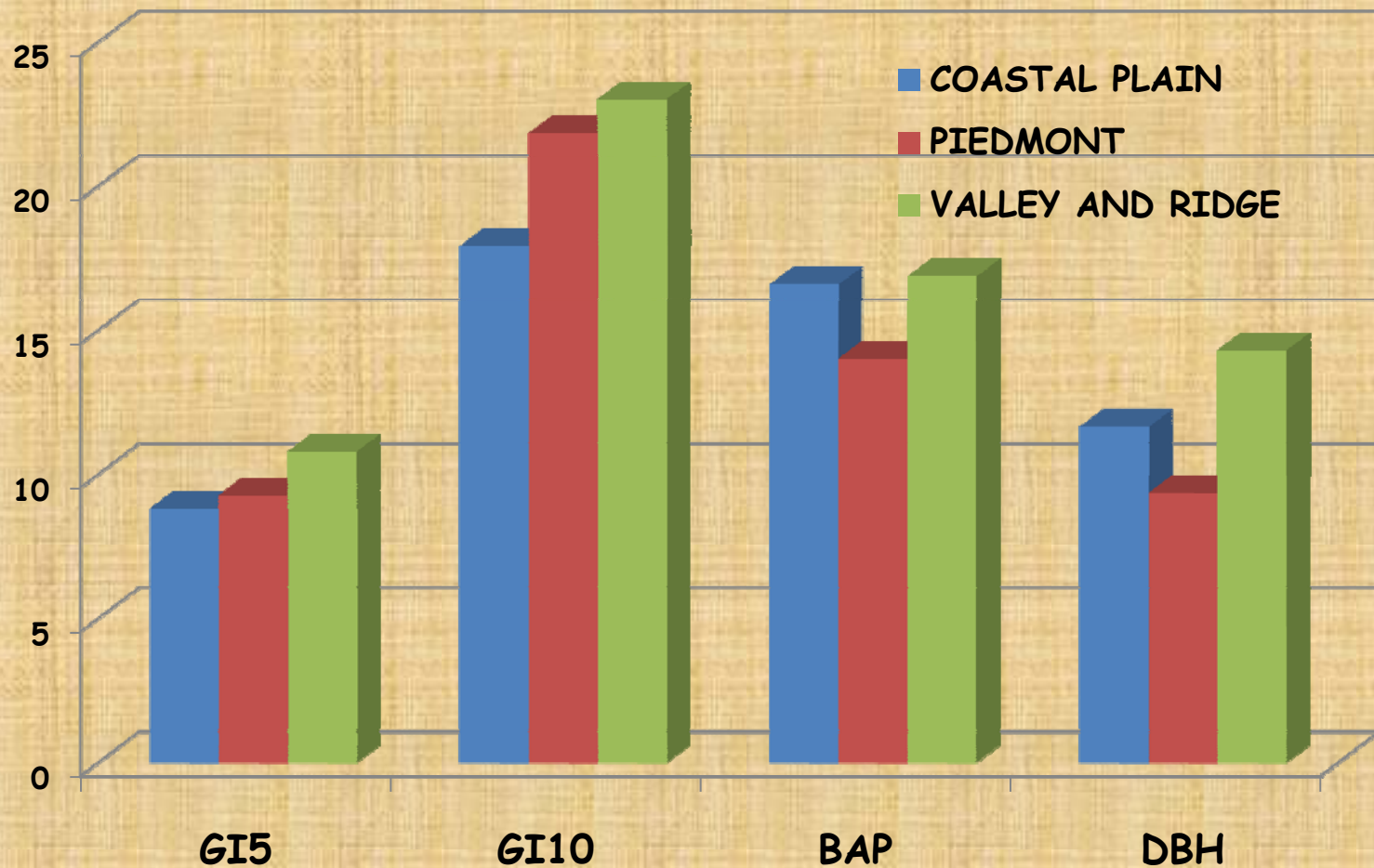


SOIL NUTRIENTS & FUNGAL STATUS





TREE CHARACTERISTICS BY REGION





PRINCIPLE COMPONENTS ANALYSIS

EIGENVALUE	PROPORTION	CUMULATIVE
PC 1	0.397	0.397
PC 2	0.203	0.600
PC 3	0.098	0.698
PC 4	0.050	0.748
PC 5	0.038	0.786
PC 6	0.034	0.820
PC 7	0.027	0.847
PC 8	0.022	0.869
PC 9	0.020	0.889
PC 10	0.016	0.905



PCA MODEL EVALUATION

BIOLOGICAL CHARACTERISTIC	p = 0.001	p = 0.01	p = 0.05	p = 0.10
5 YR GI R ² = 0.63	PC9		PC3 PC5 PC8	
10 YR GI R ² = 0.57		PC5 PC9		PC2
BAP R ² = 0.37			PC4	PC9
The USDA logo, featuring the word "USDA" in blue and "UNITED STATES DEPARTMENT OF AGRICULTURE" in green, with a green leaf icon.				

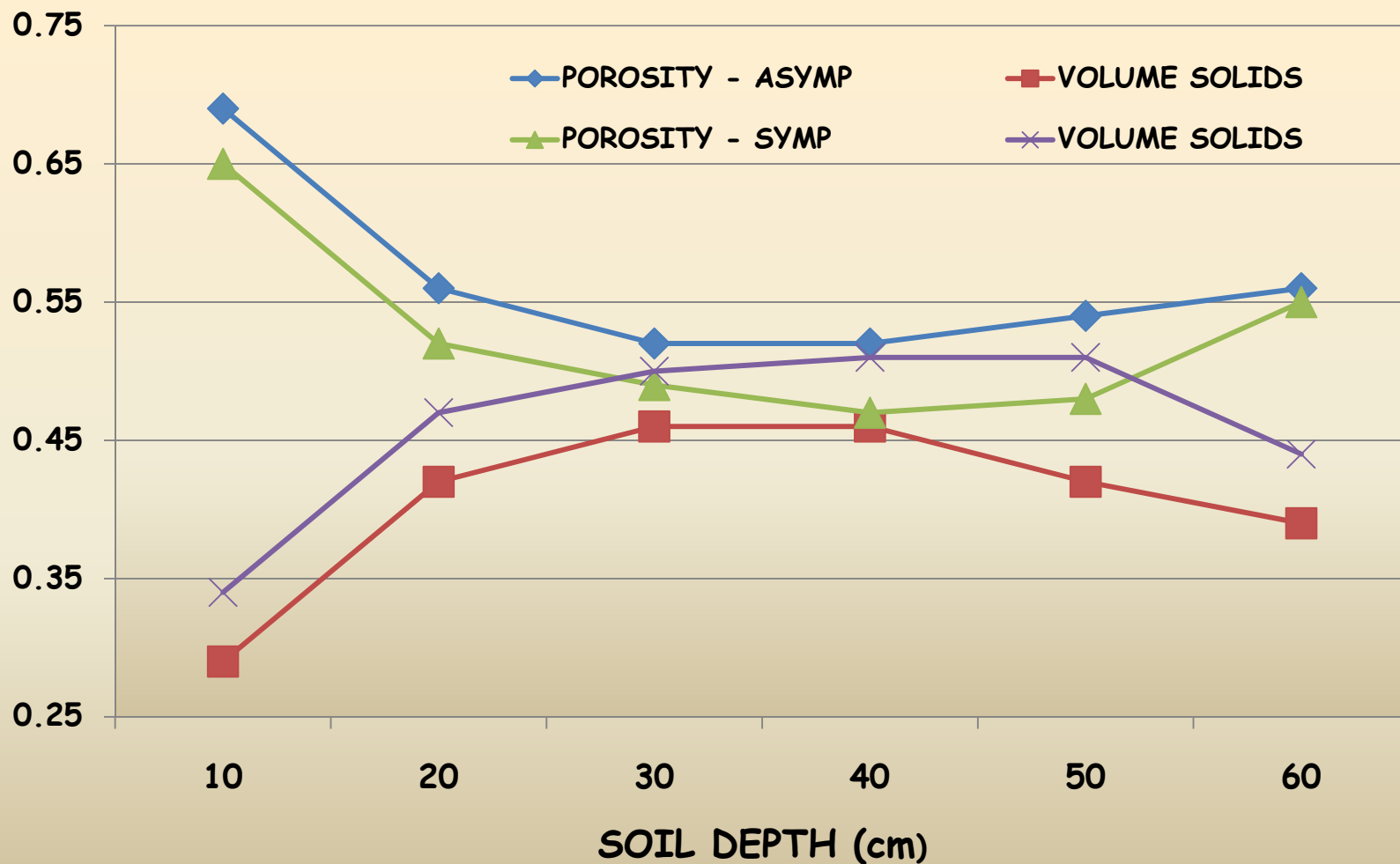


PCA COMPONENTS

5 YR GI	10 YR GI		BAP
P30	CAAL30	P30	P30
CLAY 10	CAAL20	CLAY10	BD10
SILT 30	P20	SILT30	P10
CLAY 30	CAAL10	CLAY 30	P20
SILT 20	S10	SILT20	BD20
BD 30	MN20	BD30	TOTAL C30
	SILT30		ORGANIC C30
	PH10		SILT10

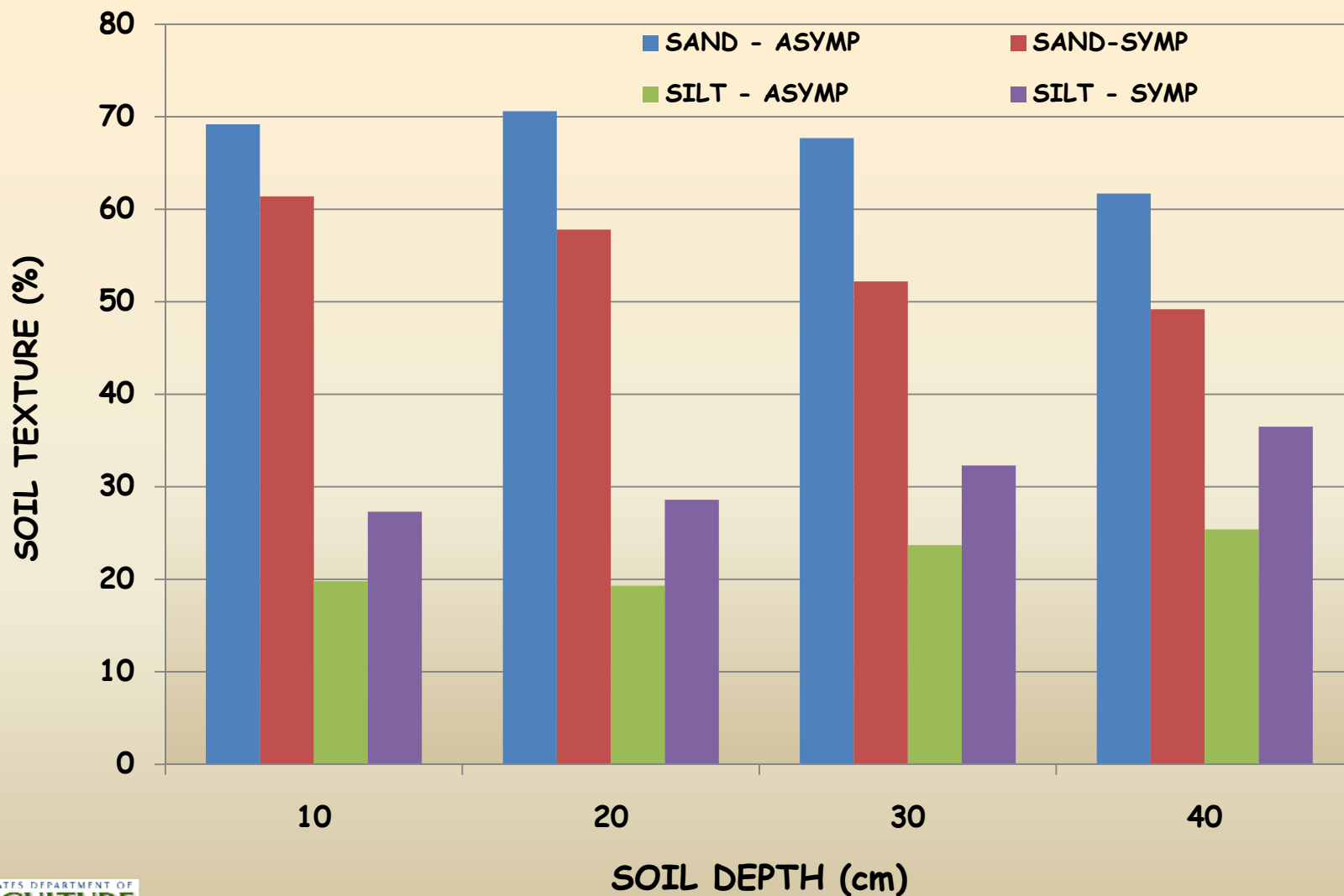


VOID RATIO & FUNGAL STATUS





TEXTURE & FUNGAL STATUS



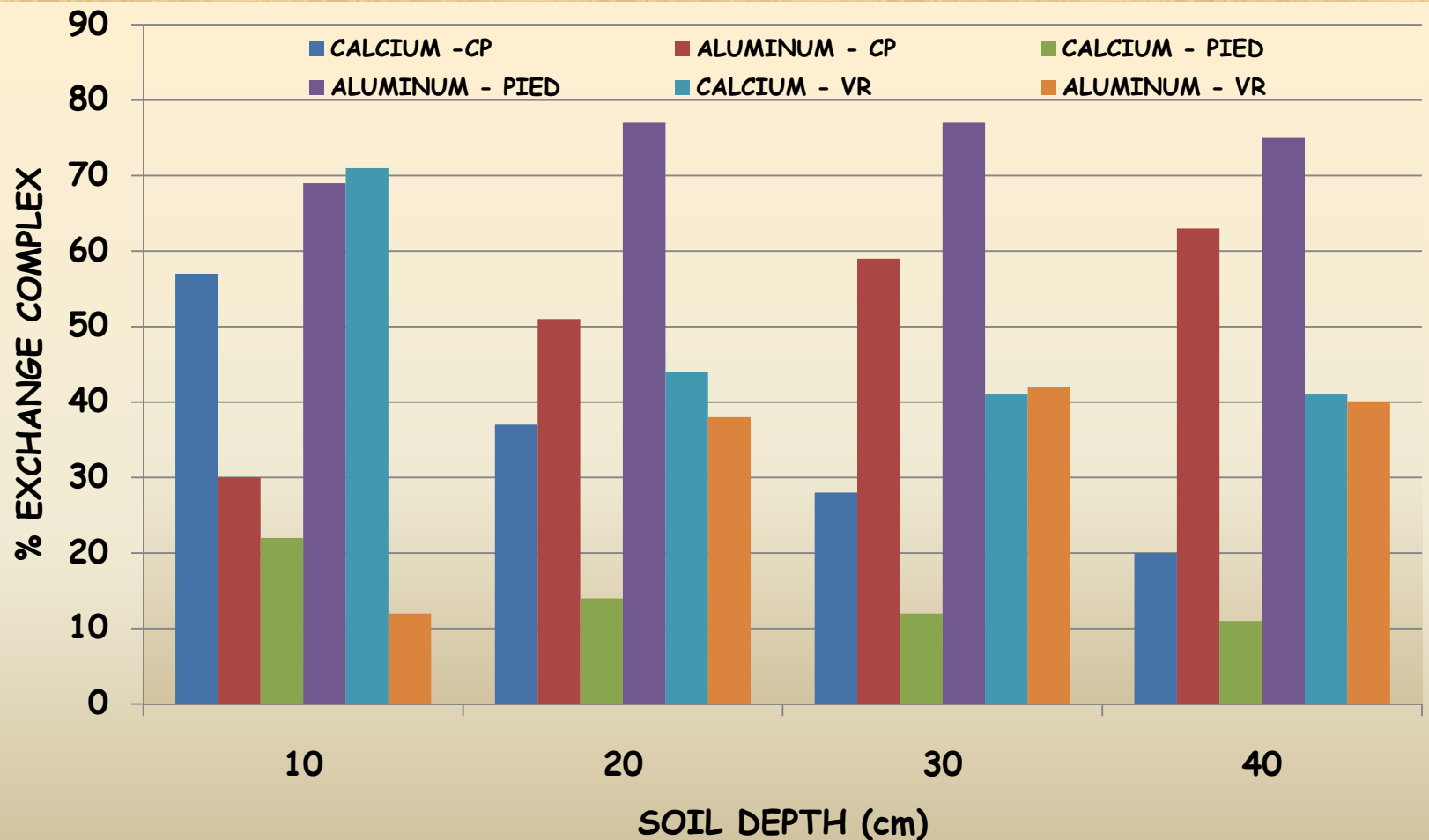


BULK DENSITY & GROWTH IMPACTS

DEPTH (cm)	PIEDMONT		VALLEY & RIDGE		COASTAL PLAIN	
10	0.72	SL	1.10	L	1.09	LS
20	1.13	SL	1.36	CL	1.57	SL
30	1.31	SCL	1.35	SiL	1.49	SL
40	1.54	L	1.29	SiL	1.78	SL

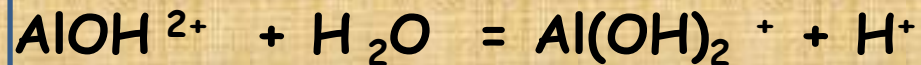
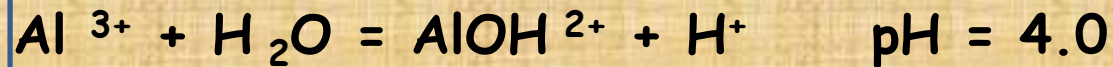


CALCIUM & ALUMINUM CONTENTS BY REGION





ALUMINUM HYDROLYSIS



PRECIPITATION



DISSOLUTION





SOIL NUTRIENTS & PHYSIOGRAPHIC REGION

DEPTH (cm)	PHOSPHORUS (mg/kg)			SULFUR (mg/kg)			MANGANESE (mg/kg)		
	CP	PIED	VR	CP	PIED	VR	CP	PIED	VR
10	7.9	6.8	12.7	14.7	28.6	44.3	127.1	56.4	743.7
20	4.4	4.1	5.1	11.0	25.8	49.0	83.7	15.1	464.4
30	3.8	1.8	3.2	15.4	43.6	63.7	78.8	6.9	436.1
40	2.2	1.0	2.8	26.5	62.4	61.3	70.3	6.9	364.4

A photograph of a pine forest with a path leading into the distance. The trees are tall and thin, with a dense canopy of green needles. The ground is covered in brown pine needles and some small green plants. The path is a narrow, straight line that leads from the foreground into the distance, flanked by rows of trees.

THANK YOU FOR YOUR ATTENTION

QUESTIONS ?

08/26/2006

UGA5000030