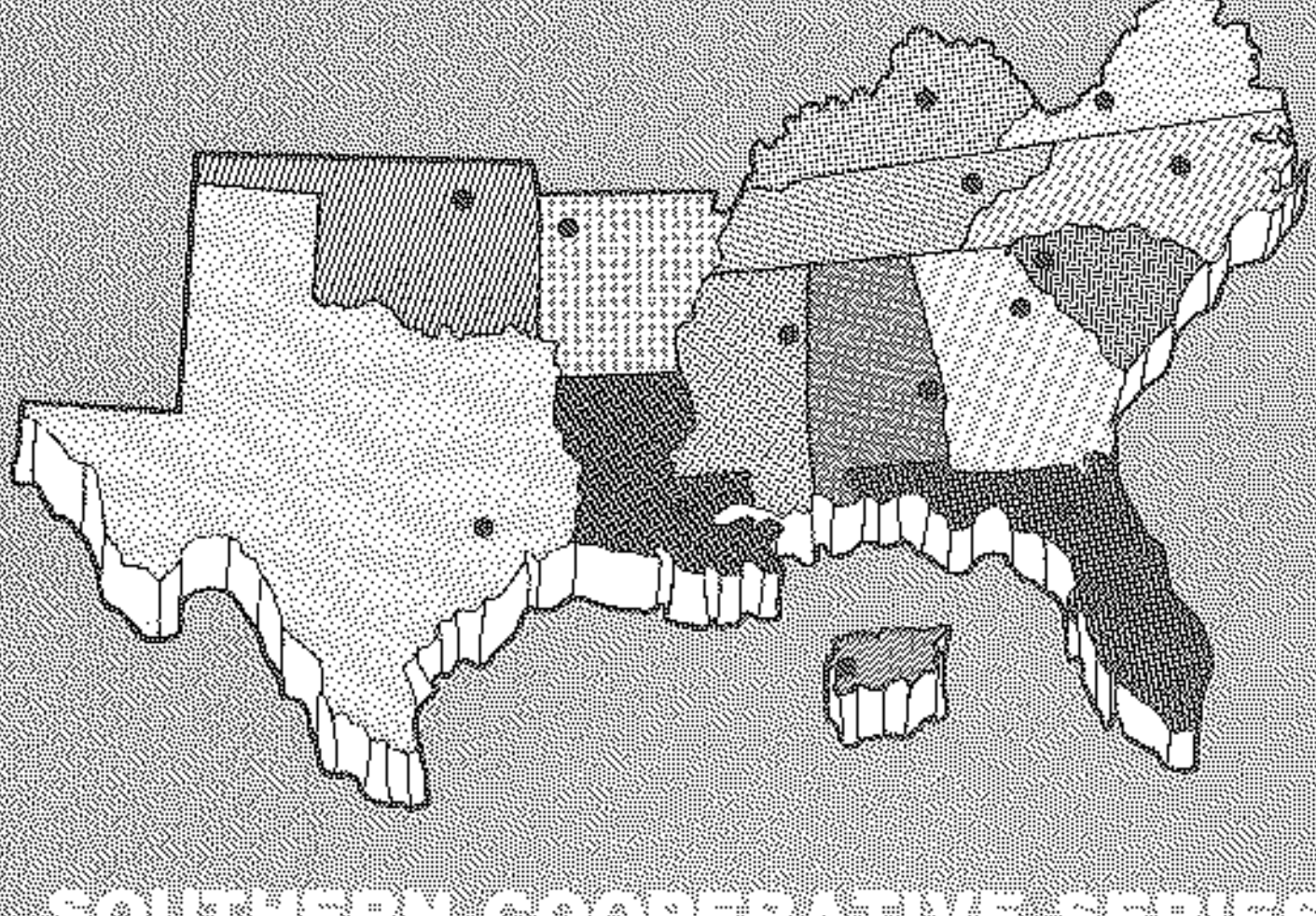
February 1988

Procedures and Practices Followed by Southern State Soil Testing Laboratories for Making Liming Recommendations



SOUTHERN COOPERATIVE SERIES

Bulletin No. 332

Bulletin 332 is a publication in the Southern Cooperative Series and as such, is in effect a separate publication by each of the cooperating Agricultural Experiment Stations listed below. Thus, it may be mailed under the frank and indicia of each. Requests for copies from outside the cooperating states may be addressed to IFAS Publications, Bldg. 664, University of Florida, Gainesville, FL 32611.
Published by the Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611.

Stations and agencies directly participating are:

Alabama Agricultural Experiment Station
Auburn University
Auburn, AL 36830
L.T. Frobish, Director

Arkansas Agricultural Experiment Station
University of Arkansas
Fayetteville, AR 72701
G.J. Musick, Director

Florida Institute of Food and Agricultural Sciences
University of Florida
Gainesville, FL 32611
K.R. Tefertiller, Director

Georgia Agricultural Experiment Station
University of Georgia
Athens, GA 30602
C.W. Donoho, Jr., Director

Kentucky Agricultural Experiment Station
University of Kentucky
Lexington, KY 40506
C.E. Barnhart, Director

Louisiana Agricultural Experiment Station
Louisiana State University
Baton Rouge, LA 70893
C.O. Little, Director

Mississippi Agricultural and Forestry Experiment Station
Mississippi State University
Mississippi State, MS 39762
V. Hurt, Director

North Carolina Agricultural Research Service
North Carolina State University
Raleigh, NC 27650
R.J. Kuhr, Interim Director

Oklahoma Agricultural Experiment Station
Oklahoma State University
Stillwater, OK 74074
C.B. Browning, Director

Puerto Rico Agricultural Experiment Station
University of Puerto Rico
Mayaguez, PR 00708
J. Roman, Dean

South Carolina Agricultural Experimental Station
Clemson University
Clemson, SC 29631
J.R. Fischer, Director

Tennessee Agricultural Experiment Station
University of Tennessee
Knoxville, TN 37901
J.I. Sewell, Acting Dean

Texas Agricultural Experiment Station
Texas A&M University System
College Station, TX 77843
N.P. Clarke, Director

Virginia Agricultural Experiment Station
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061
J.R. Nichols, Director

Virgin Islands Agricultural Experiment Station
College of the Virgin Islands
Kingshill St. Croix, VI 00850
D.S. Padda, Director

Liming of acid soils is a widely-used agricultural practice in the Southern region of the United States and is the subject of many studies and publications. Members of SRIEG-18 are involved in the ongoing process of developing recommendations which clients of soil testing use in making lime managment decisions. Members are also involved in evaluating soil testing methods which influence liming recommendations. This bulletin documents the procedures and practices being used in the various states of the region. It should aid in the continuing process of evaluating liming recommendations.

ACKNOWLEDGEMENTS

We wish to express our appreciation to all SRIEG-18 members and others who contributed to this bulletin by providing information during the survey phase and suggestions during the manuscript preparation and review. The editing of Ms. S.M. Knox and the efforts of Ms. T.V. Thomas in producing the camera-ready manuscript are also gratefully acknowledged.

Lime Committee

Gerald Kidder, Chair
W.E. Sabbe
C.L. Parks

Members
of the Southern Research Information Exchange Group
on Soil Testing and Plant Analysis
1987

Administrative Advisor - G.J. Kriz, Associate Director, Agricultural Experiment Station, North Carolina State University

Alabama	C.C. Mitchell (Rep), C.E. Evans
Arkansas	W.E. Sabbe (Rep), R.L. Maples
Florida	G. Kidder (Rep), E.A. Hanlon, Jr.
Georgia	C.O. Plank (Rep), R.A. Isaac, M.E. Sumner
Kentucky	W.O. Thom (Rep), D. Kirkland
Louisiana	O.D. Curtis (Rep), J.E. Sedberry, Jr.
Mississippi	E. R. Funderburg (Rep)
North Carolina	M.R. Tucker (Rep), F.R. Cox, G.S. Miner
Oklahoma	G.V. Johnson (Rep)
Puerto Rico	N. Cavallero (Rep)
South Carolina	C.L. Parks (Rep), R. Lippert
Tennessee	J.R. Jared (Rep)
Texas	H.D. Pennington (Rep)
Virgin Islands	E.M. Craft (Rep)
Virginia	S.J. Donohue (Rep)

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION AND PURPOSE

Liming of acid soils is an old and well-established agricultural practice. Much of the credit for the widespread use of lime on agricultural land in the United States goes to the land grant universities. Years of experiments and demonstrations, teaching and extension, and hundreds of publications have made the general public aware of liming as an important practice in plant production.

Sound experimental data should always be the basis for recommendations. However, as with any widely-used practice, it is sometimes difficult to trace the origin of specific liming recommendations and the cultural practices that result from their use. In recent years, liming practices and some of the technical folklore that have grown up around them have attracted the attention of soil and plant scientists.

The purpose of this publication is to present the current status of liming recommendations from land grant universities in the Southern region of the United States. It should aid the ongoing process of reevaluation of recommendations.

Data for this report were obtained through a questionnaire sent in 1985 to members of the Southern Research Information Exchange Group on Soil Testing and Plant Analysis (SRIEG-18). The group functions under the auspices of the Southern Region Experiment Station Directors. All respondents work closely with the lime recommendation-generating process of their respective land grant universities.

SOURCE OF LIMING RECOMMENDATIONS

The different administrative structures operating within Southern region states make it somewhat difficult to describe where the responsibility lies for making liming recommendations. While most states listed the Cooperative Extension Service as a source of liming recommendations, more than half also listed the Agricultural Experiment Station as a source (Table 1). Frequently, the promulgation of the recommendations is by the Extension Service after consultation with researchers from the Experiment Station (either based at the land grant university campus or at branch experiment stations).

In some states formal committees meet on a regular (usually annual) basis and review recommendations; in others the procedure and committees are much less formal. Typically, groups of 10 to 30 people representing research and extension functions of agronomy, horticulture, and soil science departments of land grant universities are responsible for developing new and updating existing liming recommendations. The state department of agriculture is another public agency which is involved in the process in two states. The administrative structure and number of crops within a state are factors which most influence those involved in the recommendation process.

DOCUMENTATION OF RECOMMENDATIONS

In Alabama, Georgia, Oklahoma, and Puerto Rico, liming recommendations are summarized in a single publication. In the other ten states of the Southern region, the recommendations are addressed in an assortment of bulletins, circulars, research reports, fact sheets, and other publications.

It is frequently difficult to find a published link between the recommendations and the data upon which they are based. The diversity of sources of recommendations undoubtedly contributes to this situation.

PHILOSOPHY OF LIMING RECOMMENDATIONS

Across most of the region, the underlying philosophy towards liming soil is one which calls for liming to reach a certain pH value or the upper limits of an optimum or "ideal" pH range. The ideal pH almost always depends on the crop to be grown as well as soil characteristics such as cation exchange capacity (CEC), texture, or organic matter content.

In some states the economics of liming is considered when making recommendations. Several respondents noted that the philosophy included "liming for economical returns" from individual crops. In other cases it was obvious that the "ideal pH" was a prevalent concern, even when it was not chosen as the best means of describing the philosophy in use. The following sample comments illustrate these points:

> "The lime must pay for itself in increased yield over a three-year period."
> "Growers are encouraged to lower recommendations if conditions warrant, e.g., rented land, limited cash flow, etc."
> "The recommended rate of liming is usually somewhere between what the farmer can afford and the ideal for the crop."

CHANGES IN RECOMMENDATIONS MADE DURING THE PREVIOUS FIVE YEARS

Nine states reported having made significant changes in their liming recommendations within the previous five years. The changes and some comments are presented below. Threshold pH is the highest soil pH which would trigger a lime recommendation. Target pH is the soil pH anticipated within a year or so after lime application.

Alabama - County agents and growers are advised to modify standard liming recommendations in the following ways:
- on leased land, reduce recommended lime rate with little or no loss in yield
- decrease recommended lime rate proportionally if plow depth is less than 8 inches
- change recommendation depending on quality of lime used
- use lower lime rates and more frequent lime applications.

Arkansas - The threshold pH for recommending lime for field crops was lowered from 5.9 to 5.7. Economic returns did not justify liming of soils with pH above 5.7.

Florida - Target pH's for forage crops were modified following a review of the literature on responses to liming in Florida and neighboring states. Target pH was lowered from 6.5 to 5.5 for perennial grass and from 6.5 to 6.0 for annual grasses and warm season legumes. Target pH for alfalfa was raised from 6.5 to 7.0.

Georgia - Lime recommendations were changed in 1985 for all agronomic crops, except alfalfa, to attain a maximum pH (target pH) of 6.0. Previous lime recommendations were based on attaining a pH between 6.0 and 6.5. The tendency of farmers to apply more lime than recommended had resulted in many sandy soils in the Coastal Plain region with pH >6.5, resulting in micronutrient deficiencies. Review of data from Georgia and Virginia provided no justification for the 6.5 target pH.

Louisiana - Lime not recommended in soybean-rice rotations until soil pH falls below 5.3 and Ca, extracted with neutral N ammonium acetate at a soil to solution ratio of 1:10, falls below 1000 ppm. Lime not recommended for sweet potatoes due to potential for increased soil rot.

Mississippi - Threshold and target pH of soils with high CEC are lower than those for other soils. Experience has shown that clay soils do not require pH's as high as sandy loams to get equivalent yields. The respective values are shown in the following table:

Soil CEC (meq/100g)	Threshold pH	Target pH
<19	5.6	6.2
19-28	5.4	5.8
>28	5.2	5.5

South Carolina - Decreased threshold pH to 5.0 and target pH to 5.5 for soils with >10% organic matter. Decreased threshold pH to 5.7 for other soils except when alfalfa is crop to be grown. Increased target pH from 6.2 to 6.5 for several soil groups. Retained target pH of 6.2 for soils where Mn deficiency is a potential problem and soybeans or small grains are to be grown. (Piedmont soils and soils with clay subsoil within 20 inches of the surface already had target pH of 6.5).

Tennessee - Threshold pH for recommending lime on soybeans was reduced from 6.5 to 6.0. For monoculture soybean production no lime is recommended, provided the soybean seed are properly treated with molybdenum. Threshold pH for burley tobacco was increased from 5.5 to 6.0.

Virginia – Target pH for all crops except alfalfa and tobacco was decreased from 6.5 to 6.2 in 1984. Threshold pH set at 5.9. These changes were based on research which showed no crop response to the higher pH levels.

CURRENT THRESHOLD AND TARGET pH'S FOR IMPORTANT CROPS

Two important aspects of arriving at a liming recommendation are the so-called "threshold pH" and the "target pH." The threshold pH is the highest pH at which the decision to lime is made. If a soil is above the threshold pH for the crop in question, it is judged that soil pH is not low enough to adversely effect the crop's production potential and liming is not recommended. Conversely, if the soil pH is at or below the threshold level, liming is judged to have potential beneficial effects and lime is recommended. Another term used to describe this concept is "critical pH."

The target pH is the pH anticipated to be reached as a result of liming. In practice, the target pH chosen for a particular crop is frequently well above the limit of documented crop response. Conventional explanations for this practice usually included savings in the cost of lime application due to the resultant less frequent need for liming.

Current (1986-87) threshold and target pH levels for important crops of the region are presented in Tables 2, 3, 4, and 5. The values reported are normally used in conjunction with a lime requirement test to produce liming recommendations for the particular soil and crop.

PROCEDURES USED IN DETERMINING LIME RECOMMENDATIONS

Determination of the actual amount of lime to recommend in a particular situation varies from state to state. The criteria used by the Southern state soil testing laboratories are summarized in Table 6. Of the fourteen states (for the sake of simplicity in this publication Puerto Rico will be referred to as a state), eleven use a chemical test to aid in estimating the amount of lime required to change soil pH. The other three state laboratories use soil texture as an estimate of the soil's buffering capacity and thus the quantity of lime needed to accomplish the desired pH change. One of the latter states is planning to adopt a chemical lime requirement test in the near future.

The Adams-Evans procedure (1) developed at Auburn University is the most widely-used laboratory method, some form of the procedure being the basis for determining lime requirement in five states and being considered in a sixth. Two state laboratories have modified the original Adams-Evans procedure to fit their own experience and soil conditions. Other methods include the SMP buffer method (used in two states), a modified Woodruff, the Mehlich buffer (9), and a calcium hydroxide titration procedure.

The concepts of threshold and target pH are used in conjunction with lime requirement test measurements or estimates of buffering capacity to arrive at the rate of lime (in tons/acre) to recommend. The crop for which soil pH is being adjusted is usually the major factor determining target pH.

Responsibility for agricultural liming recommendations made by public-sector agencies in the Southern region of the United States is generally shared by research and extension personnel of the land grant institutions. Tradition and administrative structure within individual states are the principal factors that influence who is responsible for liming recommendations and how many persons are involved. Groups of 10 to 30 people are responsible for keeping liming recommendations current in most states, but as few as three individuals and as many as 200 may make recommendations in other states.

Only four states have liming recommendations summarized in a single document. Many noted the difficulty in establishing the published link between recommendations and the data upon which they are based.

Two philosophical approaches to liming recommendations are dominant in the region. One approach calls for liming to reach an "ideal pH" for a particular crop while the other approach calls for liming for "economical returns."

Nine of the states made significant changes in liming recommendations during the 1981 through 1985 period. When employed by farmers, most changes would result in a reduction in agricultural limestone consumption.

Eleven states use a chemical test for lime requirement, with another considering adoption of a chemical test in the near future. The Adams-Evans buffer is used in five states, two of which have modified some aspect of the original method. Equations used by the various laboratories or references to published materials specifying lime requirement are presented.

REFERENCES

1. Adams, F., and C.E. Evans. 1962. A rapid method for measuring lime requirement of Red-Yellow Podzolic soils. Soil Sci. Soc. Am. Proc. 26:355-357.

2. Brupbacher, R.H., W.P. Bonner, and J.E. Sedberry, Jr. 1968. Analytical methods and procedures used in the soil testing laboratory. La. Agric. Exp. Sta. Bull. 632, Baton Rouge, LA.

3. Clemson University Soil Fertility Committee. 1982. Lime and fertilizer recommendations based upon soil tests. Clemson Univ. Exten. Circ. 476, Clemson, SC.

4. Cope, J.T., Jr., C.E. Evans, and H.C. Williams. 1981. Soil test fertilizer recommendations for Alabama crops. Ala. Agri. Exp. Sta. Circ. 251, Auburn, AL.

5. Dierolf, T.S., and G. Kidder. 1986. Laboratory evaluation of the Adams-Evans lime requirement method for Florida's sandy soils. Soil Crop Sci. Soc. Fla. Proc. 45:29-33.

6. Donohue, S.J., and G.W. Hawkins. 1979. Guide to computer programmed soil test recommendations. Va. Polytech. Inst. Exten. Pub. 834, Blacksburg, VA.

7. Funderburg, E.R., and K.K. Crouse. 1987 (tentative). Procedures used for the routine analysis of soils by the Mississippi Soil Testing and Plant Analysis Laboratory. Miss. Coop. Exten. Serv., Mississippi State, MS.

8. Johnson, G.V., and B.B. Tucker. 1982. OSU soil test interpretations: 1. pH and buffer index. OSU Exten. Facts No. 2229. Okla. State Univ., Stillwater, OK.

9. Mehlich, A. 1976. New buffer pH method for rapid estimation of exchangeable acidity and lime requirement of soils. Comm. in Soil Sci. Plant Anal. 7(7):637-652.

10. Miranda-Siraguas, F. 1965. Guía técnica para extensionistas. Uso de cal en los suelos. Servicio de Extensión Agrícola Pub. M-5, Mayaguez, PR.

11. Muñiz, O. 1988 (tentative). Guía técnica para extensionistas. La acidez de los suelos y el uso de enmiendas calizas en Puerto Rico. Servicio de Extensión Agrícola, Mayaguez, PR.

12. Page, N.R., G.W. Thomas, H.F. Perkins, and R.D. Rouse. 1965. Procedures used by state soil testing laboratories in the Southern region of the United States. So. Coop. Series Bull. 102.

13. Plank, C.O. 1985. Soil test handbook for Georgia. Ga. Coop. Exten. Serv. Athens, GA.

14. Tucker, M.R., and R. Rhodes. 1987. Crop fertilization based on North Carolina soil tests. Agron. Div., N.C. Dept. Agri., Circ. 1. Raleigh, NC.

15. University of Arkansas Division of Agriculture. 1987. Soil test recommendations guide. Univ. of Ark. Div. Agri. Misc. Pub., Fayetteville, AR.

16. University of Kentucky Cooperative Extension Service. 1986. 1986-1987 Lime and fertilizer recommendations. Univ. Ky. Exten. Pub. AGR-1, Lexington, KY.

17. Welch, C.D., C. Gray, D. Pennington, and M. Young. 1980. Soil testing procedures. Texas A&M University, Texas Agric. Exten. Serv. Pub., College Station, TX.

A summary of specifications found in the lime laws of the states of the Southern region is shown in Table 7. Some details have been excluded for clarity of presentation. This information should be used for approximate comparisons only.

Table 1. Agencies, Departments, and Approximate Number of People Involved in Producing Liming Recommendations.

State	Agencies	Departments	Approximate Number of People
AL		Agronomy & Soils Horticulture	11
AR	Experiment Station Extension Service	Agronomy Horticulture & Forestry	15
FL	Institute of Food & Agricultural Sciences	Agronomy Vegetable Crops Fruit Crops Ornamental Horticulture Forestry Soil Science	200
GA	Extension Service Experiment Station	Agronomy Horticulture	60
KY		Agronomy Horticulture	25
LA	Extension Service Experiment Station	Agronomy Horticluture	120
MS	Extension Service		20
NC	Land Grant University State Department of Agriculture	Crop Science Horticultural Science Soil Science	5
OK		Agronomy	3
PR	Experiment Station Extension Service State Department of Agriculture	Agronomy & Soils	6
SC	Extension Service Experiment Station	Agronomy & Soils Horticulture	15
TN	Institute of Agriculture	Plant & Soil Science Ornamental Horticulture & Landscape Design	30
TX	Extension Service Experiment Station	Soil & Crop Sciences Horticultural Science Range Science	35
VA	Extension Service Experiment Station	Agronomy Horticulture Forestry	25

Table 2. Threshold (thres) and Target (targ) pH for Important Row Crops.[1] The threshold pH is the highest pH which would trigger a lime recommendation. The target pH is the anticipated pH resulting from liming.

State	soybean		corn		wheat		cotton		grain sorghum		flue-cured tobacco		burley tobacco		peanuts	
	thres	targ	thres	targ	thres	targ	thres	targ	thres	targ	thres	targ	thres	targ	thres	targ
AL	5.7[2]	6.5	5.7[2]	6.5	5.7[2]	6.5	5.7[2]	6.5	5.7[2]	6.5	4.9	5.5			5.7	6.5
AR	5.7	6.5	5.7	6.5	5.7	6.5	5.7	6.5	5.7	6.5			5.7	6.5	5.9	6.5
FL	5.9	6.5	5.9	6.5	5.9	6.0	5.9	6.5	5.9	6.5	5.9	6.0			5.9	6.5
GA		6.0		6.0		6.0		6.0		6.0		6.0		6.0		6.0
KY	6.0	6.4	5.8	6.4	6.0	6.4			6.0	6.4			6.0	6.4		
LA	5.7[3]	6.5	5.7	6.0	5.7	6.0	5.8	6.5	5.7	6.5						
MS	5.6	6.2	5.6	6.2	5.6	6.2	5.6	6.2	5.6	6.2						
NC	5.7	6.0	5.7	6.0	5.7	6.0	5.9	6.2	5.7	6.0	5.7	6.0	5.7	6.0	5.7	6.0
OK	5.5	6.8[4]			5.5	6.8[4]			5.5	6.8[4]					5.7	6.8[4]
SC	5.7	6.5	5.7	6.5	5.7	6.5	5.7	6.5	5.7	6.5	5.5	6.0			5.7	6.5
TN	6.0	6.5	6.0	6.5	6.0	6.5	6.0	6.5	6.0	6.5	5.5	6.0	6.0	6.5		
TX	6.0		5.6		5.6		5.6		5.6						5.6	
VA	5.9	6.2	5.9	6.2	5.9	6.2	5.9	6.2	5.9	6.2	5.5	5.8	5.5	5.8	5.9	6.2

[1] Lime is not recommended for rice in AR, LA, PR, or TX. In PR, target pH for most tropical crops is 5.5-6.0.

[2] For soils with CEC >9 meq/100g, use 5.5 rather than 5.7.

[3] When growing in rotation with rice, use 5.2 rather than 5.7.

[4] Target pH modified locally according to farmer's situation.

Table 3. Threshold and Target pH for Important Forage Crops.

State	alfalfa		bermudagrass		fescue-bluegrass		bahiagrass		mixed grass legume		hay meadows	
	thres	targ	thres	targ	thres	targ	thres	targ	thres	targ	thres	targ
AL	6.4	7.0	5.5	6.5	5.7[1]	6.5	5.5	6.5	5.9	6.5	5.7[1]	6.5
AR	6.4	7.0	5.7	6.5	5.7	6.5	5.7	6.5	6.0	7.0	5.7	6.5
FL	5.9	7.0	5.5	5.5			5.5	5.5	5.9	6.5	5.5	5.5
GA		6.5-7.0		6.0		6.0		6.0		6.0		
KY	6.4	6.8	6.0	6.4	6.0	6.4			6.0	6.4	6.0	6.4
LA	6.5	7.5	5.2	5.5			5.2	5.5	5.8	6.5	5.5	6.0
MS	6.0	6.5	5.6	6.2					5.6	6.5		
NC		6.5		6.0				6.0		6.0		6.0
OK	6.5	6.8	5.7	6.8	4.5	6.8						
PR[2]												
SC	6.5	7.0	5.7	6.5	5.7	6.5	5.7	6.5	5.7	6.5		
TN	6.5	7.0	6.0	6.5	6.0	6.5			6.0	6.5	6.0	6.5
TX	6.5		5.6		5.6		5.6		6.0		5.6	
VA	6.5	6.8	5.9	6.2	5.9	6.2	5.9	6.2	5.9	6.2	5.9	6.2

[1] For soils with CEC >9 meq/100g, use 5.5 rather than 5.7.

[2] Threshold pH is 5.0 and target pH is 5.5 for stargrass, pangolagrass, and guineagrass.

Table 4. Threshold and Target pH for Important Fruit Crops and Landscape Plants.

State	Fruits[1]						Landscape					
	peaches		pecans		apples		nursery ornamentals		lawns		others	
	thres	targ	thres	targ	thres	targ	thres	targ	thres	targ	thres	targ
AL	5.9	6.5	5.9	6.5	5.9	6.5	5.7	6.5	5.5	6.5	5.0[2]	5.5
AR	6.3	6.5	5.4	6.0	6.3	6.5	5.9	6.5	5.7	6.5		
FL	5.9	6.5	5.9	6.0	5.9	6.5	5.9	6.5	5.9	6.5		5.5[2]
GA	5.9	6.0-6.5	5.9	6.0-6.5	5.9	6.0-6.5	5.5	6.0	[3]	6.0	[3]	
KY	6.4	6.6			6.4	6.6			6.0	6.4		
LA	5.2	5.5	NR[4]	NR			NR	NR	5.5	6.0		
MS												
NC		6.0		6.0		6.0		[5]		6.0		
OK									5.7	6.8		
SC	6.0	6.5	5.7	6.5	5.7	6.5	5.7	6.5	5.7	6.5	[6]	6.0
TN	6.5	7.0			6.5	7.0	variable		6.0	6.5		
TX	6.0		4.8		6.0		5.6		5.6		3.8	5.0[7]
VA	5.9	6.2	5.9	6.2	5.9	6.2	5.9	6.2	5.9	6.2	4.9	5.2[8]

[1] For oranges, FL has 5.9 threshold and 6.5 target pH's. Lime is not recommended for oranges in LA. Oranges are grown on high pH soils in TX. In PR, target pH for pineapple is 5.0; for all other tropical fruits it is 5.5.

[2] For centipede in AL and for centipede, carpetgrass, and bahiagrass in FL.

[3] Threshold pH of 5.0 for azaleas, camellias, rhododendrons, centipede, and carpetgrass.

[4] Lime not generally recommended.

[5] Target pH of 5.5 for conifers and 6.0 for hardwoods.

[6] Threshold pH of 5.0 for azaleas, camellias, and rhododendrons and 5.5 for centipede and carpetgrass.

[7] Rabbiteye blueberries.

[8] Acid-loving plants.

Table 5. Threshold and Target pH of Important Vegetable Crops.

State	tomatoes		cucumbers		watermelons		sweet corn		greenbeans	
	thres	targ	thres	targ	thres	targ	thres	targ	thres	targ
AL	5.9	6.5	5.7[1]	6.5	5.7[1]	6.5	5.7[1]	6.5	5.7[1]	6.5
AR	6.0	6.5	6.0	6.5	6.0	6.5	6.0	6.5	6.0	6.5
FL	5.9	6.5	5.9	6.5	5.9	6.5	5.9	6.5	5.9	6.5
GA	5.9	6.0-6.5	5.9	6.0-6.5	5.9	6.0-6.5	5.9	6.0-6.5	5.9	6.0-6
KY	6.0	6.5	6.0	6.5	6.5	7.0	6.0	6.5		
LA	5.8	6.5	5.5	6.5	5.5	5.5	5.7	6.0	6.0	6.5
MS										
NC		6.5		6.0		6.0		6.0		6.0
OK										
PR[2]										
SC	5.7	6.5	5.7	6.5	5.7	6.5	5.7	6.5	5.7	6.5
TN	6.0	6.5	6.0	6.5	6.0	6.5	6.0	6.5	6.0	6.5
TX	6.0		6.0		5.6		5.6		6.0	
VA	5.9	6.2	5.9	6.2	5.9	6.2	5.9	6.2	5.9	6.2

[1] For soils with CEC >9 meq/100g, use 5.5 rather that 5.7.

[2] Target pH is 5.5-6.0 for root and tuber crops.

Table 6. Criteria Used in Determining Lime Recommendations.

State	Criteria	References Cited
AL	soil pH_w (pH determined in water), Adams-Evans (A-E) buffer pH, target pH for particular crop, and tables based on A-E equation	1, 4
AR	soil pH_w, texture (CEC), and lime history	15, 12
FL	soil pH_w, A-E buffer pH, target pH for particular crop, and the following equation: tons ag lime per acre = 26.1 - 3.40(A-E buffer pH) + 1.02(target pH - soil pH_w)	5
GA	soil pH_w, A-E buffer pH, target pH for particular crop, and tables based on A-E equation	13
KY	soil pH_w, SMP buffer pH, and table relating results to lime requirement	16
LA	soil pH_w, incremental titration of soil with $CaCO_3$, and table relating results to lime requirement	2
MS	soil pH_w, modified Woodruff buffer pH, and following equation: pounds ag lime per acre = 10,000 (7.2 - buffer pH)	7
NC	soil pH_w, Mehlich buffer acidity (Ac), residual lime credit (RC), target pH, and following equation: $\text{tons ag lime per acre} = Ac \frac{(\text{target pH} - \text{soil } pH_w)}{(6.6 - \text{soil } pH_w)} - RC$	9, 14
OK	soil pH_w, SMP buffer pH, correlation tables relating buffer pH and lime required to bring soil pH to 6.8	8
PR	soil pH_w, soil series, liming curves, & empirical knowledge	10, 11
SC	soil pH_w, pH in modified A-E buffer, target pH for particular crop, and tables unique to Clemson soil testing lab	3
TN	soil pH_w, A-E buffer pH, target pH for particular crop, and tables based on A-E equation	1
TX	soil pH_w, soil texture, and lime history	17
VA	soil pH_w, soil texture, time and amount of last lime application, and crop (Note: Lab anticipates adoption of A-E buffer procedure in near future.)	6

Table 7. Summary of Agricultural Lime Specifications Found in State Laws.

State[1]	Particle Size		Neutralizing Potential	Criterion for
	Mesh Size	Min. % Thru Sieve	Minimum CCE[2]	Dolomite
AL	10	90	90 (80% for chalk)	>6% Mg
	60	50		
	10	90 (chalk only)		
AR[3]	10	90	80	None
	60	40		
	100	25		
FL	8	90	90	>10% Mg
	20	80		
	50	50		
GA	10	90	85	>6% Mg (elemental) from $MgCO_3$
	50	50		
	100	25		
KY	10	90	80	None
	50	35		
LA	10	90	90	>6% Mg
	100	25		
NC	20	90	90[4]	>6% Mg
	100	35 (dolomitic)		
		25 (calcitic)		
OK[5]				None
SC[6]	10	90	85	>16% of CCE is from Mg compounds
	50	50		
	100	25		
TN	10	85	85	None for % Mg
	40	50		
		(pulverized)		
VA	20	95	85%	>15% of CCE is from $MgCO_3$
	100	70		
		(ground)		
	20	90		
	60	50		
	100	30		

[1] Mississippi, Puerto Rico, and Texas do not have lime laws.

[2] Calcium carbonate equivalent.

[3] Recommended percentages. Arkansas has a labeling law only.

[4] No minimum CCE but product must be labeled to show the amount necessary to equal a liming material having 90% CCE.

[5] Lime in Oklahoma is sold on basis of effective calcium carbonate equivalent (ECCE).

$$ECCE = \%\ CCE \times \frac{(\%\ passing\ 8\ mesh + \%\ passing\ 60\ mesh)}{2}$$

[6] Values shown are for "standard ground" agricultural liming materials. To be classified as "pulverized," 95% must pass through 20 mesh and 75% must pass through 100 mesh. "Coarse ground" differs from "standard ground" in that only 40% must pass through 50 mesh.