FERTILIZER RECOMMENDATIONS - SECONDARY PLANT NUTRIENTS

Calcium (Ca), magnesium (Mg), and sulfur (S) are usually referred to as the secondary elements or those required in lesser amounts than N, P, and K. The following is a discussion of fertilizer recommendations for each of these elements.

Calcium (Ca)

Calcium is a secondary element normally supplied to the plant in the form of limestone. The calcium level is rarely low enough to cause deficiencies in crops other than peanuts and some vegetables. In most situations where the Ca test is low, the soil pH is also low and the lime application recommended to correct the pH will add ample amounts of calcium to the soil. Either calcitic limestone or dolomitic limestone can be used because both contain ample amounts of calcium.

Regarding peanuts, gypsum or landplaster ($CaSO_4$) is recommended to suppress excess uptake of potassium by the peanut peg. The rates recommended are: broadcast - 900 lbs per acre, or banded in the row - 600 lbs per acre. The gypsum that is used should contain at least 90% calcium sulfate. Calcium is not recommended for any other crops.

Magnesium (Mg)

Magnesium is another secondary element that is normally supplied to the plant in the form of limestone. Deficiencies of this element may occur when the Mg test level is Low or Low-. At these levels, the soil pH is also usually low and dolomitic limestone, which contains ample amounts of magnesium, should be recommended. In situations where the soil pH is optimum and no lime is needed but Mg tests Low or Low-, a separate magnesium fertilizer will be required. The recommended rate is: 30 lbs of magnesium (Mg) per acre in a soluble form such as magnesium sulfate, sulfate of potash magnesia, or promesium.

Sulfur (S)

Sulfur is the third of the secondary elements that is required by plants for optimum growth. It is normally supplied to plants in the form of rainfall containing sulfur gases from the atmosphere and sulfur-containing fertilizers. Sulfur crop needs were evaluated in Virginia in the mid 1950's, initiated again in the late 1960's, and continued up to the present time. Crop response to sulfur has been inconsistant and more research is needed before this element can be put on the recommendation list for Virginia crops.

FERTILIZER RECOMMENDATIONS - MICRONUTRIENTS

Crop Micronutrient Needs

Micronutrients are those elements that are required by plants in small amounts. They are sometimes referred to as trace elements and consist of zinc (Zn), manganese (Mn), boron (B), molybdenum (Mo), copper (Cu), iron (Fe), and chlorine (Cl). The primary source of micronutrients for plants is the soil. However, under certain conditions and for certain soils in Virginia, one or more micronutrients may be needed by certain crops for optimum growth. Extensive research has been conducted in Virginia over the past 12 years on micronutrients. Two of these elements, zinc and manganese, have been found to be deficient for certain major agronomic crops grown in Virginia, and soil tests, calibrated for Virginia soils, have been successfully developed for these crops. A third element, boron, has also been found to be deficient for certain Virginia crops, but efforts to develop a soil test have not been successful because of the unique properties of boron in the soil. For those crops that require supplementary boron for optimum growth and for which deficiencies have been observed, a general boron recommendation is made. A fourth micronutrient, molybdenum, is deficient for certain crops under conditions of low soil pH and recommendations are made accordingly to correct the deficiency. The remaining three micronutrients - copper, iron, and chlorine have not normally been found to be deficient on crops in Virginia and are not recommended.

The following is information on fertilizer recommendations for trace elements found to be deficient in Virginia.

Zinc (Zn)

Zinc deficiency has been found on corn, small grains, and grain sorghum in Virginia. The critical zinc level is 0.8 ppm (See Soil Test Calibration section). Zinc recommendations depend on application method. Recommendations for the above three crops are:

1. Broadcast and disked-in or plowed-down.

    a. Coastal Plain soils - apply 10 to 12 pounds of elemental zinc per acre when using zinc sulfate or zinc oxide as the source, or 2 to 3 pounds of elemental zinc per acre when using the zinc chelates, such as zinc EDTA, as the source.
    b. Piedmont, Appalachian Region soils - apply 20 to 25 pounds of elemental zinc per acre when using zinc sulfate or zinc oxide as the source. Zinc chelates are not economical sources when zinc is broadcast on Piedmont or Appalachian Region soils.
    c. Research to date indicates broadcast applications of the above rates will correct deficiencies for a period of 3 to 5 years. The most feasible way of broadcasting the zinc would be to have it mixed with a fertilizer that is to be spread.

2. Seed contact placement. Zinc can be applied in contact with the seed at planting time as part of a fertilizer application being made with a grain drill or with fertilizer attachments on the planters. Care should be used in the rate of application of the pop-up fertilizer for corn and grain sorghum to avoid germination injury. If this method of application is used, apply 1/2 pound of elemental zinc per acre using the zinc chelates as the source, or 1 pound per acre using zinc sulfate as the source. This method of application will not correct the deficiency in succeeding crops and would need to be applied each year these crops are planted.

3. Sideband placement for corn and grain sorghum. Zinc can be applied with the starter fertilizer at planting time. Where this method is used, apply 6 to 8 pounds of elemental zinc per acre using either zinc sulfate or zinc oxide as the source, or 1 to 2 pounds per acre when the zinc chelates are used as the source. This method of application will not correct the deficiency for succeeding crops, but would need to be applied each year these crops are grown.

4. Foliar application. Zinc can be supplied to crops through zinc-containing sprays applied directly to the leaves and stalks. If this method is used, apply 1/2 pound of elemental zinc per acre per application using the zinc chelates as the source, or 1 pound per acre per application using zinc sulfate or zinc oxide (micronized) as the source. Usually, the best time of application for corn and grain sorghum is when plants are 6 to 8 inches high. Use enough water to wet the plants.

Manganese (Mn)

Manganese deficiency has been found on soybeans and peanuts grown in Virginia. The critical manganese soil test level depends on soil pH (See Soil Test Calibration section). Recommendations for these crops depend on method of application and are as follows:

1. Foliar application. Apply 3/4 to 1 pound of elemental manganese per acre in enough water to wet the entire plant. Manganese sulfate, manganese oxide (micronized), and manganese chelates may be used as sources of manganese. If the chelates are used, use the 3/4 pound rate. Repeat the application if deficiency symptoms reappear (i.e., from 1 to 3 applications). Make all applications before August 15.

   Manganese can be applied with pesticides if the manganese source and the pesticide are compatible, if applying them as a mixture does not violate label restrictions on the pesticide, and if it does not violate state or federal regulations.

2. Sideband placement. If a starter fertilizer is to be applied at the time the crop is being planted, manganese can be added with the fertilizer. If this method is used, apply 8 to 10 pounds of elemental manganese per acre using manganese sulfate, manganese oxide, or manganese chelates as the source. Starter fertilizers

should be placed 2 inches to one side and 2 inches below seed level to avoid salt injury to the germinating seed.

3. Seed contact placement. (Important--for peanuts only! This method of application may damage soybeans!) Manganese can be applied in contact with the peanut seed at planting time with fertilizer attachments on the planters. Care should be used in the rate of application to avoid germination injury. If this method of application is used, apply 3 to 5 pounds of elemental manganese per acre using an available granular manganese fertilizer source. This method of application will only correct the deficiency in the immediate crop and would need to be applied each year the peanuts are planted.

4. Broadcast application. Broadcast application is not practical in a system of indirect fertilization. If manganese is to be broadcast, it should be applied within two to three weeks of the time the crop will be planted because of the short residual effect of broadcast applications. Apply 25 to 30 pounds of elemental manganese using manganese sulfate or manganese oxide as the source.

Boron (B)

Boron deficiency has been found on alfalfa, apples, cotton, peanuts, and on several commercial vegetable crops grown in Virginia. The following are suggested rates and methods of boron application (for boron fertilization of apples, refer to Soil Test Note 10):

1. Alfalfa. Apply 2 to 4 pounds of elemental boron per acre per year with a broadcast fertilizer.

2. Asparagus. Apply 2 pounds of elemental boron per acre every 3 years with a broadcast fertilizer.

3. Broccoli, Cauliflower, Cabbage. Apply 2 to 3 pounds of elemental boron per acre with a broadcast fertilizer.

4. Brussels Sprouts, Collards, Muskmelons, Onions, Peas, Peppers, White Potatoes. Apply 1 to 2 pounds of elemental boron per acre with a broadcast fertilizer.

5. Cotton. Apply 1/2 pound of elemental boron per acre per year in a compatible labeled pesticide spray or dust or as a separate foliar application.

6. Peanuts. Apply 1/2 pound of elemental boron per acre per year at early bloom stage in a compatible labeled pesticide spray or dust or as a separate foliar application. Information on specific boron sprays and dusts are found in the Peanut Production Guide for Virginia (VPI&SU MA-197).

Molybdenum (Mo)

Molybdenum deficiency has been found on alfalfa, soybeans, and on certain commercial vegetable crops grown in Virginia. Recommendations are based on soil pH (See Soil Test Calibration section). If molybdenum is needed, the following are suggested rates and methods of application for the particular crop to be grown:

1. Alfalfa. Molybdenum may be applied as a foliar spray at the rate of 1/2 pound of elemental molybdenum per acre or as a seed treatment at the rate of 1 ounce of elemental molybdenum per acre. Important - molybdenum is toxic to livestock! Do not graze forage if molybdenum is sprayed on foliage until after a soaking rain.

2. Broccoli, Cauliflower. Apply 1/4 pound of elemental molybdenum per acre with a broadcast fertilizer.

3. Soybeans. Molybdenum may be applied as a foliar spray at the rate of 1/2 pound of elemental molybdenum per acre or as a seed treatment at the rate of 1 ounce of elemental molybdenum per acre.

LIME RECOMMENDATIONS

How Recommendations Are Made

Lime recommendations are based on the following factors:

1. Crop to be Grown
2. Soil pH (determined in water)
3. Soil Buffering Capacity
4. Credit For Previous Lime Application
5. Order of Crop in Rotation (Whether it is the 1st or 2nd crop for which recommendations will be made)

The following is a discussion of each of these factors:

1. Crop to be Grown. The optimum soil pH for the crop to be grown is considered in making the recommendation. Optimum pH for the various crops, listed according to crop code number, is found in the following table.

Optimum pH*	Crop Code No.**
4.5-5.0	420,422,423,463,464
5.2	63,64,100-106,109-112,351,240-244, 222,353,310,313
5.6-6.2	401-412,421,437-462,465-496
5.8	15-18,107-108
6.2	80-81
6.5	1-14,31-36,38-47,50-62,65-74,95-96, 84-91,352,82-83,201-204,210-212,220, 221,223-234,245,246,250,301-303, 311-312,320-323,354
6.8	30,37

* Optimum pH is for mineral soils. For organic soils, the optimum pH is 5.2 (All Crops).

**For a list of crop names corresponding to the numbers in this table, refer to the Crop Code table that is listed in the table of contents.

2. Soil pH. Soil pH measures the activity of the soil solution. However, it is not used solely to make the lime recommendation. A measure or indication of reserve acidity (buffering capacity or resistance to change in pH) is also necessary.

3. Soil Buffering Capacity. Buffering Capacity provides an indication of reserve acidity and has an important effect on the lime recommendation. In general, sandy soils have little reserve acidity while clay soils have much more reserve acidity. For this reason, it takes considerably more lime to raise the pH of a clay soil than it does a sandy soil.

The soils in Virginia have been separated into 5 Lime Response Groups (LRG) according to their buffering capacity. Soils of LRG 1 generally have coarser textures and are low in reserve acidity while soils of LRG 5 are organic and high in reserve acidity. The higher the reserve acidity, the more lime that will be needed to counteract acidity. The LRG's for the soils of Virginia, for which the computer has been programmed to calculate recommendations, are found in the following table.

LIME RESPONSE GROUPS FOR THE SOILS OF VIRGINIA

(For explanation of abbreviations, see last page of tables)

SOIL	LIME RESPONSE GROUP	SOIL	LIME RESPONSE GROUP
Airmont fsl	2	Bland sicl	4
Airmont l	2	Bolton l	2
Alamance sil	3	Bowmansville sil	3
Albemarle fsl	3	Braddock gr. l	3
Albemarle l	3	Braddock l	3
Allen fsl	2	Braddock sil	3
Allen sl	2	Bradley fsl	4
Altavista fsl	3	Bradley gr. sl	4
Altavista l	3	Bradley sl	4
Altavista sil	3	Brandywine fsl	1
Appling fsl	3	Brandywine gr. l	1
Appling gr. sl	3	Brandywine l	1
Appling sl	3	Brandywine sil	2
Athol sil	4	Brays sicl	4
Atkins fsl	3	Brays sil	4
Atkins sil	4	Brecknock l	3
Atkins sl	3	Brecknock sil	3
Atlee fsl	3	Bremo l	2
Atlee l	3	Bremo sil	2
Atlee sil	3	Buckingham fsl	1
Augusta fsl	3	Buckingham gr. sl	1
Augusta l	3	Buckingham l	1
Augusta sil	3	Bucks l	3
Bayboro l	5	Bucks sil	3
Bayboro sil	5	Buncombe lfs	1
Beltsville l	3	Buncombe s	1
Beltsville sil	3	Burgin sic	4
Beltsville sl	3	Burgin sicl	4
Belvoir l	3	Cahaba fsl	2
Belvoir sil	3	Cahaba lfs	1
Berks sh. sil	2	Calverton l	2
Berks sil	2	Calverton sil	2
Bermudian sil	2	Calvin sh. sil	1
Bertie fsl	3	Calvin sil	1
Bertie l	3	Camp sh. sil	3
Bertie sil	4	Camp sil	3
Birdsboro l	3	Captina l	3
Birdsboro sil	3	Captina sil	3
Blacksburg sh. sil	2	Carbo sicl	4
Blacksburg sil	2	Carbo sil	4
Bladen fsl	5	Caroline cl	4
Bladen sil	5	Caroline fsl	4

LIME RESPONSE GROUPS FOR THE SOILS OF VIRGINIA (Continued)

SOIL	LIME RESPONSE GROUP	SOIL	LIME RESPONSE GROUP
Caroline vfsl	4	Cumberland sil	4
Catlett gr. sil	2	Dandridge sh. sil	1
Catlett l	2	Dandridge sil	1
Catlett sil	2	Davidson cl	4
Catoctin sil	2	Davidson sicl	4
Caylor l	3	Decatur sicl	4
Cecil cl	4	Decatur sil	3
Cecil csl	3	DeKalb fsl	3
Cecil fsl	3	DeKalb l	3
Cecil sl	3	Dragston fsl	2
Chester l	2	Dragston lfs	1
Chester sil	2	Dragston sl	2
Chesterfield fsl	3	Dunbar fsl	3
Chesterfield sl	3	Dunbar l	3
Chewacla l	3	Dunbar sl	3
Chewacla sil	3	Dunmore sicl	4
Chilhowie sicl	4	Dunmore sil	3
Clarksville ch. sil	2	Dunning sicl	4
Clarksville ch. sl	2	Dunning sil	4
Clifton sil	1	Durham csl	2
Clifton st. sil	1	Durham fsl	2
Coeburn sil	2	Durham sl	2
Colbert sicl	3	Dyke cl	4
Colbert sil	3	Dyke l	3
Colfax fsl	2	Dyke sicl	4
Colfax sl	2	Edgemont fsl	2
Congaree fsl	2	Edgemont l	2
Congaree l	2	Elbert l	4
Congaree sil	3	Elbert sicl	4
Corydon sicl	1	Elbert sil	4
Corydon sil	1	Elioak sil	2
Craven fsl	3	Elk l	3
Craven sil	4	Elk sil	3
Craven sl	3	Elkton fsl	3
Creedmore fsl	4	Elkton l	3
Creedmore sl	4	Elkton sil	4
Croton l	4	Elliber ch. sil	2
Croton sil	4	Emory sil	3
Culpeper fsl	3	Enders l	3
Culpeper l	3	Enders sil	3
Cumberland l	3	Enon fsl	3
Cumberland sicl	4	Enon l	3

LIME RESPONSE GROUPS FOR THE SOILS OF VIRGINIA (Continued)

SOIL	LIME RESPONSE GROUP	SOIL	LIME RESPONSE GROUP
Enon sil	3	Hagerstown sicl	4
Etowah l	3	Hagerstown sil	3
Etowah sil	3	Hartsells fsl	2
Eubanks fsl	3	Hartsells l	2
Eubanks l	3	Hayter fsl	2
Faceville fsl	3	Hayter l	3
Faceville lfs	2	Hazel l	2
Faceville sl	3	Hazel sil	2
Fairfax l	3	Helena fsl	4
Fairfax sil	3	Helena l	4
Fallsington fsl	2	Helena sl	4
Fallsington sl	2	Herndon sil	3
Fauquier sicl	4	Hiwassee cl	4
Fauquier sil	3	Hiwassee l	3
Fauquier st. sil	3	Hiwassee sicl	4
Fluvanna fsl	3	Hiwassee sil	3
Fluvanna l	3	Holston fsl	2
Fluvanna sil	3	Holston l	3
Frederick ch. sil	3	Huntington l	3
Frederick sil	3	Huntington sil	3
Galestown lfs	1	Iredell l	4
Galestown s	1	Iredell sil	4
Georgeville sicl	4	Jefferson fsl	1
Georgeville sil	3	Jefferson l	2
Glenelg sil	2	Jefferson sl	1
Glenville l	3	Kalmia lfs	1
Glenville sil	3	Kelly sil	4
Goldsboro fsl	2	Kempsville fsl	2
Goldsboro lfs	1	Kempsville lfs	1
Goldsboro sl	2	Kempsville sl	2
Goldston sh. sil	1	Keyport l	4
Goldston sil	1	Keyport sil	4
Goldvein gr. l	2	Klej lfs	1
Granville csl	2	Klej s	1
Granville fsl	2	Lakeland lfs	1
Granville sl	2	Lakeland s	1
Greendale l	3	Lamington sil	3
Greendale sil	3	Landisburg l	3
Groseclose sicl	4	Landisburg sil	3
Groseclose sil	3	Leadvale l	3
Grover l	3	Leadvale sh. sil	3
Grover sl	3	Leadvale sil	3

LIME RESPONSE GROUPS FOR THE SOILS OF VIRGINIA (Continued)

SOIL	LIME RESPONSE GROUP	SOIL	LIME RESPONSE GROUP
Legore sh. sil	2	Masada sl	3
Legore sil	2	Matapeake fsl	3
Lehew fsl	1	Matapeake l	3
Lehew sl	1	Matapeake sil	3
Lenoir fsl	3	Mattapex fsl	3
Lenoir l	4	Mattapex l	3
Lenoir sil	4	Mattapex sil	3
Letonia fsl	2	Mayodan csl	3
Letonia l	2	Mayodan fsl	3
Lewisberry fsl	1	Mayodan sl	3
Lewisberry sl	1	Meadowville l	3
Lignum l	3	Meadowville sil	3
Lignum sil	3	Mecklenburg cl	4
Lindside sil	3	Mecklenburg sicl	4
Litz sil	2	Mecklenburg sil	4
Lloyd l	4	Melvin sicl	4
Lloyd sicl	4	Melvin sil	4
Lloyd sil	4	Molena fsl	1
Lodi ch. l Suplimento	3	Molena lfs	1
Lodi fsl	2	Molena sl	1
Louisa l	1	Monongahela fsl	2
Louisa sl	1	Monongahela l	3
Louisburg csl	1	Monongahela sil	3
Louisburg fsl	1	Montalto sicl	3
Louisburg sl	1	Montalto sil	3
Lunt fsl	4	Montalto st. sil	3
Lunt sl	4	Montevallo sh. sil	1
Lynchburg fsl	2	Montevallo sil	1
Lynchburg lfs	1	Muskighum sl	1
Lynchburg sl	2	Muskinghum fsl	1
Madison l	3	Muskinghum l	1
Madison sl	3	Myatt fsl	3
Magnum sil	4	Myatt lfs	3
Manassas l	3	Myersville sil	3
Manassas sil	3	Myersville st. sil	3
Manor sil	1	Nason l	3
Manteo sh. sil	1	Nason sil	3
Manteo sil	1	Norfolk fsl	2
Marlboro fsl	3	Norfolk lfs	1
Marlboro sl	3	Orange sicl	4
Masada fsl	3	Orange sil	4
Masada l	3	Orangeburg fsl	2

LIME RESPONSE GROUPS FOR THE SOILS OF VIRGINIA (Continued)

SOIL	LIME RESPONSE GROUP	SOIL	LIME RESPONSE GROUP
Orangeburg sl	2	Ruston fsl	2
Othello fsl	4	Ruston lfs	1
Othello l	4	Ruston sl	2
Othello sil	4	Rutledge lfs	5
Pasquotank fsl	3	Rutledge s	5
Pasquotank sil	3	Sassafras fsl	2
Pedlar ro. sil	2	Sassafras lfs	1
Penn sh. sil	1	Sassafras sl	2
Penn sil	1	Seneca csl	2
Philo fsl	3	Seneca fsl	2
Philo l	3	Seneca sil	3
Philo sil	3	Seneca sl	2
Pisgah sil	4	Sequatchie fsl	2
Plummer lfs	5	Sequatchie l	2
Plummer s	5	Starr l	3
Pocomoke fsl	5	Starr sil	3
Pocomoke lfs	5	State fsl	2
Pope fsl	2	State l	2
Pope l	2	State sil	3
Porters l	2	Swain sicl	4
Portsmouth fsl	5	Swain sil	4
Portsmouth l	5	Taft sicl	4
Purdy sicl	4	Taft sil	4
Purdy sil	4	Talbott sicl	4
Rabun cl	4	Talbott sil	4
Rabun l	3	Tatum l	3
Ramsey fsl	1	Tatum sil	3
Ramsey l	1	Teas sh. sil	2
Ramsey sil	1	Teas sil	2
Ramsey sl	1	Tellico vfsl	4
Rapidan sicl	4	Thurmont cob. l	3
Rapidan sil	3	Thurmont gr. l	3
Raritan sil	3	Thurmont sil	3
Readington sil	3	Trego cob. l	3
Roanoke sicl	4	Trego gr. l	3
Roanoke sil	4	Trego sil	3
Robertsville sicl	4	Tumbez sic	4
Robertsville sil	4	Tumbez sicl	4
Rowland l	3	Turbeville fsl	3
Rowland sil	3	Turbeville l	3
Rumford lfs	1	Turbeville sl	3
Rumford s	1	Tusquitee l	3

LIME RESPONSE GROUPS FOR THE SOILS OF VIRGINIA (Continued)

SOIL	LIME RESPONSE GROUP	SOIL	LIME RESPONSE GROUP
Tusquitee sil	3	Wehadkee sil	4
Tusquitee st. l	3	Wellston fsl	3
Tyler sicl	4	Wellston l	3
Tyler sil	4	Wellston sil	3
Ungers l	2	Westmoreland sicl	3
Ungers sil	2	Westmoreland sil	2
Unison cob. l	3	White Shore fsl	4
Unison l	3	White Shore sl	4
Unison sil	3	Whiteford sil	2
Unison st. l	3	Wickham fsl	2
Vance fsl	3	Wickham l	2
Vance sl	3	Wickham sil	3
Wadesboro fsl	3	Wilkes fsl	1
Wadesboro l	3	Wilkes sil	1
Warners l	4	Wilkes sl	1
Warners sil	4	Woodstown fsl	2
Watt sil	2	Woodstown lfs	1
Waynesboro fsl	3	Worsham fsl	3
Waynesboro l	3	Worsham l	3
Weaver l	4	Worsham sil	3
Weaver sil	4	Worsham sl	3
Weeksville sil	5	Zion l	3
Weeksville vfsl	5	Zion sil	3
Wehadkee l	4		

Abbreviations Used in the Lime Response Group Table:

ch - cherty
cl - clay loam
cob - cobbly
csl - coarse sandy loam
fsl - fine sandy loam
gr - grainy
l - loam
lfs - loamy fine sand
ro - rocky
s - sandy
sh - shaley
sicl - silty clay loam
sil - silt loam
sl - sandy loam
st - stoney
vfsl - very fine sandy loam

When information on the soil name is not available, the soil type itself can be used to calculate the lime recommendation. The approximate corresponding LRG for each soil type is as follows: sandy - LRG 1, LRG 2, loamy - LRG 3, clayey - LRG 4. Organic soils, handled differently because of different optimum pH requirements, are equivalent to an LRG of 5.

4. Credit For Previous Lime Application. Limestone has a residual effect in the soil; i.e., it will remain in the soil and affect acidity for 2 to 3 or more years. Because of this, recent lime applications that were made before a soil sample was collected for analysis should be considered when making a lime recommendation.

The following allowances for previous lime applications made within the past 2 years are used to adjust the lime recommendation for the crop to be grown:

Last Lime Application, Months	Allowance For Previous Amount Applied, %
1. None applied	0
2. 1- 6	75
3. 6-12	50
4. 12-18	25
5. > 18	0

According to the table, if a person applied two tons/A of lime 12 months ago, he would be credited for one ton of lime/A, i.e., one ton/A would be subtracted from the recommendation.

This relationship is based on research conducted in Virginia by Moeschler (VPI & SU Tech. Bull. 159, 1962) where lime effects were studied on 11 soil types. For 9 of the 11 soils, the pH reached its maximum in 2 years. On the remaining 2 soils, it took between 2 1/2 to 3 years to reach the maximum. If 2 years is assumed to be the cutoff point for complete reaction, then at one year 50% of the lime would have reacted and, hence, the 50% allowance. Also, the lime on the market today is most likely finer than the lime Moschler used in his study and would probably react faster.

5. Order of Crop in Rotation. Where recommendations are to be made for 2 consecutive crops, if optimum pH is the same for both crops, no lime recommendations are required for the 2nd crop. Also, if optimum pH for the 2nd crop is lower than the optimum pH for the first crop, no lime recommendations are required. However, if optimum pH for the 2nd crop is greater than the optimum pH for the 1st crop, an adjustment is needed. It can be assumed that 50% of the lime for the 1st crop will have reacted after 1 year and 50% will remain (pH is halfway to optimum level for 1st crop after 1 year). Therefore, 50% of the lime recommended for the 1st crop will be credited to the lime recommendation for the 2nd crop; i.e., Final Lime Recommendation for 2nd crop = lime recommendation for 2nd crop - (lime recommendation for 1st crop x 0.50).

Lime Recommendations For Virginia Crops

Lime Recommendations - Commercial Crop Production (Except Commercial Turf, Surface-Mined Area Crops, Greenhouse, and Nursery Production)

pH Desired - 6.8

pH of Unlimed Soil	Soil Type		
	Sandy	Loamy	Clayey
	Lime, T/A		
4.8	4.25	5.75	7.0
5.0	4.0	5.25	6.25
5.5	3.0	4.0	4.75
6.0	2.0	2.75	3.25
6.5	1.25	1.5	2.0

pH Desired - ~~6.5~~ Now shoot for 6.2

pH of Unlimed Soil	Soil Type		
	Sandy	Loamy	Clayey
	Lime, T/A		
4.8	3.5	4.5	5.0
5.0	3.0	3.75	4.25
5.5	1.75	2.5	3.0
6.0	1.25	1.5	2.0
6.1 (75% of 6.0)		1.0	
6.2 (50% of 6.0)		0.75	

> 6.2 is O recomm.

pH Desired - 5.8

pH of Unlimed Soil	Soil Type		
	Sandy	Loamy	Clayey
	Lime, T/A		
4.8	2.25	3.0	3.5
5.0	1.75	2.5	3.0
5.2	1.25	2.0	2.5
5.5	0.75	1.25	1.5

Target pH = 6.2

VIRGINIA TECH LIME RECOMMENDATIONS

FOR AGRONOMIC CROPS

NOT INCLUDING
(-Alfalfa,-Tobacco)

Soil pH	Soil Texture		
	Sandy	Loamy	Clayey
	T/A		
4.8	3.00	3.75	4.25
5.0	2.50	3.25	3.75
5.2	2.00	2.50	3.00
5.4	1.50	2.00	2.50
5.6	1.00	1.50	2.00
5.7	1.00	1.25	1.75
5.8	0.75	1.00	1.25
5.9	0.50	0.75	1.00
6.0	0.00	0.00	0.00

higher clay = higher CEC = higher reserve [redacted] acidity

pH Desired - 5.2

pH of Unlimed Soil	Soil Type		
	Sandy	Loamy	Clayey
	Lime, T/A		
4.0	2.00	2.75	3.00
4.3	1.50	2.00	2.25
4.5	1.25	1.50	1.75
4.8	0.75	1.00	1.00
5.0	0.25	0.50	0.50

Lime Recommendations - Homeowner Crop Categories and Commercial Turf Production

pH Desired - 6.5

pH of Unlimed Soil	Soil Type		
	Sandy	Loamy	Clayey
	Lime, lbs/1000 sq.ft.		
4.8	135	180	200
5.0	120	145	170
5.5	80	85	110
6.0	45	60	70

pH Desired - 5.2

pH of Unlimed Soil	Soil Type		
	Sandy	Loamy	Clayey
	Lime, lbs/100 sq.ft.		
4.0	10	12	14
4.3	7	9	11
4.5	6	7	8
4.8	3	4	5
5.0	1	2	3

Lime Recommendations - Potted House Plants

pH Desired - 6.5

pH of Unlimed Soil	Lime, teaspoons/pot
4.8	2.5
5.0	2.0
5.5	1.5
6.0	0.5

Lime Recommendations - Greenhouse and Nursery Production

pH Desired - 6.5

pH of Unlimed Soil	Soil Type	
	1:1 Soil-Light weight Mix	Soil-less Mix
	Lime, lbs/100 sq.ft.*	
4.8	17 9.18	26 14.04
5.0	15 8.1	23 12.42
5.5	10 5.4	16 8.64
6.0	5 2.7	8 4.32

* lbs/100 sq.ft. X 0.54 = lbs/cu.yd.

pH Desired - 5.2

pH of Unlimed Soil	Soil Type	
	1:1 Soil-Light weight Mix	Soil-less Mix
	Lime, lbs/100 sq.ft.*	
4.0	11 5.94	17 9.18
4.3	9 4.86	14 7.56
4.5	7 3.78	11 5.94
4.8	4 2.16	6 3.24

* lbs/100 sq.ft. X 0.54 = lbs/cu.yd. spenciled #'s

Lime Recommendations - Surface-Mined Areas

pH of Unlimed Soil	pH Desired	
	4.5-5.0	5.5-6.2
	Lime, T/A	
3.0	5.5	10.25
3.5	4.5	8.0
4.0	3.0	5.75
4.3	2.0	4.75
5.0	-	2.5
5.2	-	2.0

Lime Recommendations - Organic Soils - All Crops

pH of Unlimed Soil	pH Desired - 5.2 Lime, T/A
4.0	6.0
4.3	4.5
4.5	3.5
4.8	2.0
5.0	1.0

LOWERING SOIL PH WITH SULFUR

On occasion, it is necessary to increase the acidity of the soil for certain "acid-loving" plants such as blueberries, azaleas, and rhododendron which grow best under acid conditions. The following are guidelines for lowering soil pH with sulfur:

1. For crops with optimum pH of 6.0 to 6.8, no sulfur is usually recommended regardless of how high the soil pH is because most crops in this category (1) will tolerate a pH of 7.0 to 8.0 and grow well, and (2), in most cases, the soil pH will gradually decrease with time.
2. For crops requiring pH of 5.5 to 6.0, sulfur is usually required to adjust the pH to 5.5 when the soil pH is above optimum.
3. For crops requiring a pH of 5.0 to 5.5, sulfur will be required to adjust the pH to 5.0 when it is above optimum.
4. No more than 16 lbs of S/1000 sq.ft. or equivalent should be applied at one time. Instead, the soil should be retested in 4 to 6 months to determine if further sulfur applications are needed.

The table on the following page contains rates of sulfur to apply to reduce soil pH.

Reducing Soil pH With Sulfur or Aluminum Sulfate

Initial Soil pH	Desired Soil pH 4.0			4.5			5.0		
	Sandy	Loamy	Clayey	Sandy	Loamy	Clayey	Sandy	Loamy	Clayey
	Sulfur Required*, lbs per 1000 sq.ft.**								
4.0	0	0	0						
4.5	4	10	16	0	0	0			
5.0	8	20	32	4	10	16	0	0	0
5.5	12	29	47	8	20	32	4	10	16
6.0	15	38	61	12	29	47	8	20	32
6.5	19	48	77	15	38	61	12	29	47
7.0	23	57	92	19	48	77	15	38	61
7.5	27	67	107	23	57	92	19	48	77

pH	Desired Soil pH 5.5			6.0		
	Sandy	Loamy	Clayey	Sandy	Loamy	Clayey
	Sulfur Required*, lbs per 1000 sq.ft.**					
4.0						
4.5						
5.0						
5.5	0	0	0			
6.0	4	10	16	0	0	0
6.5	8	20	32	4	10	16
7.0	12	29	47	8	20	32
7.5	15	38	61	12	29	47

* Aluminum sulfate = pounds of sulfur x 6. For lb/100 sq.ft. or oz/2 1/2 bu, move decimal one place to left. For lb/A, multiply by 43.56.

**Example: Assuming the soil pH is 6.5 in a loamy soil and the pH should be reduced to 5.5, reading across from pH 6.5 to the "loamy" column under pH 5.5, 20 pounds of sulfur per 1000 square feet is required to reduce the soil pH to 5.5.

COMMENTS USED ON SOIL TEST REPORTS

FIELD CROPS

*101. See Note 2 for correct timing of N application for small grain.

*102. Fertilizer recommendations are for both crops. Apply P2O5 and K2O to the small grain. For timing of N application, see Note 2.

*103. P2O5 and K2O recommendations are for both crops in the double-cropping rotation and should be applied to the small grain. N recommendations are for the small grain (See Note 2 for timing of N application). For grain sorghum, apply 150-175 lbs N/acre.

*104. P2O5 and K2O recommendations are for both crops in the double-cropping rotation and should be applied to the small grain. N recommendations are for the small grain (See Note 2 for timing of N application). For grain sorghum, apply 125-150 lbs N/acre.

*105. P2O5 and K2O recommendations are for both crops in the double-cropping rotation and should be applied to the small grain. N recommendations are for the small grain (See Note 2 for timing of N application). For grain sorghum, apply 100-125 lbs N/acre.

*106. P2O5 and K2O recommendations are for both crops in the double-cropping rotation and should be applied to the small grain. N recommendations are for the small grain (See Note 2 for timing of N application). For grain sorghum, apply 75-100 lbs N/acre.

*107. Important--apply the total amount of N, P2O5, and K2O recommended for corn and peanuts to the corn crop for best results.

*108. The total amount of N, P2O5, & K2O recommended for both corn and soybeans may be applied to the corn crop.

*109. If peanut vines (which supply nitrogen) were not removed, subtract 30 lbs/A from the nitrogen recommendation.

FORAGE CROPS

*121. P2O5 and K2O recommendations will supply the needed nutrients for establishment and one harvest year's growth.

*122. P2O5 and K2O recommendations are for annual application. However, rates can be doubled and applied every other year if desired.

*123. P2O5 and K2O recommendations are for single applications made every 3 to 4 years.

*124. The above are conservation recommendations for establishing vegetative cover according to ASCS SL-1 Guidelines.

*125. The above are conservation recommendations for improving established vegetative cover according to ASCS SL-2 Guidelines.

*126. For fall seedings where grasses are predominant, 40 to 60 lbs of N per acre may be applied the following spring for additional production.

*127. For fall seedings, 40 to 60 lbs of N per acre may be applied the following Spring for additional production.

*128. Apply another 40 to 60 lbs of N per acre after plants start spreading.

*129. Apply the recommended N before seeding. After each cutting, apply 40 to 60 lbs of N per acre for maximum production.

*130. Apply the recommended N at seeding. If small grains are to be established alone (without a legume), topdress with 50 to 60 lbs of N per acre in late winter or early spring.

*131. If additional production is needed later on, apply 40 to 60 lbs/A of N after each cutting. If you are planning to overseed a legume into the stand, omit the N recommendation.

*132. The N recommendation is for annual application. From 0 to 60 lbs/A of N may be applied depending on need for immediate grazing. For additional production later on, apply up to 2 additional applications of 40 to 60 lbs of N each.

*133. Apply the N in August. Where clover makes up more than 25% of the stand, use the 40 lb N rate. If clover is not present and you desire maximum production, apply the 90 lb N rate.

*134. The N recommendation represents the total amount of N to be applied during the season. Apply the N in at least 2 split-applications.

*135. Apply the N in 3 split applications - early spring, after 1st cut, and after 2nd cut (but no later than early August). Do not apply more than 120 lbs/A of N per application.

*136. ASC does not cost-share for the above crop.

*137. ASC conservation recommendations for the 1st crop will satisfy nutrient needs for the term of the program.

*138. P2O5 and K2O recommendations for the 1st crop will satisfy nutrient needs for 3 to 4 years.

*139. "Establishment" was specified for the second crop and was assumed to be an error. A maintenance "Hay" recommendation is given. If this is not correct, contact your Extension Agent.

*140. "Establishment" was specified for the second crop and was assumed to be an error. A maintenance "Pasture" recommendation is given. If this is not correct, contact your Extension Agent.

COMMERCIAL VEGETABLE CROPS

*141. Use lower end of N recommendation range for loamy soils and higher end of range for sandy soils.

COMMERCIAL TURF PRODUCTION

*161. For N recommendation, see enclosed Note.

*162. The preferred time for P2O5 and K2O application is late summer or fall. However, because of the large amounts needed, apply 1/2 of the P2O5 and K2O in late summer and the remaining half 30 to 60 days later. Do not apply more that 80 lbs of K2O in one application.

*163. The preferred time for P2O5 and K2O application is late summer or fall. However, because of the large amount of P2O5 needed, apply 1/2 in late summer and the remaining half 30 to 60 days later.

*164. The preferred time for P2O5 and K2O application is late summer or fall. However, because of the large amount of K2O needed, apply 1/2 in late summer and the remaining half 30 to 60 days later. Do not apply more than 80 lbs of K2O in one application.

*165. The preferred time for P2O5 and K2O application is late summer or early fall. May be applied in single or multiple application.

*166. The preferred time for P2O5 and K2O application is August. However, because of the large amounts needed, apply 1/2 of the P2O5 and K2O in August and 1/2 in December. Do not apply more than 80 lbs of K2O in one application.

*167. The preferred time for P2O5 and K2O application is August. However, because of the large amount of P2O5 needed, apply 1/2 in August and 1/2 in December.

*168. The preferred time for P2O5 and K2O application is August. However, because of the large amount of K2O needed, apply 1/2 in August and 1/2 in December. Do not apply more than 80 lbs of K2O in one application.

*169. The preferred time for P2O5 and K2O application is August. However, half of the fertilizer may be applied at this time and the remaining half applied during another season if so desired.

*170. The preferred time for P2O5 and K2O application is August. However, because of the large amounts needed, apply 1/2 of the P2O5 and K2O in August and 1/2 in early spring. Do not apply more than 80 lbs of K2O in one application.

*171. The preferred time for P2O5 and K2O application is August. However, because of the large amount of P2O5 needed, apply 1/2 in August and 1/2 in early spring.

*172. The preferred time for P2O5 and K2O application is August. However, because of the large amount of K2O needed, apply 1/2 in August and 1/2 in early spring. Do not apply more than 80 lbs. of K2O in one application.

*173. The preferred time for P2O5 and K2O application is August. However, half of the fertilizer may be applied at this time and the remaining half applied during another season if it is so desired.

*174. Do not apply the above P2O5 and K2O recommendations to established sod. For more information on fertilization for scd production, see VPI & SU Extension Publication MA-130.

COMMERCIAL FOREST TREE AND FRUIT CROPS

*181. FERTILIZER RECOMMENDATIONS: SEE Note 10 (Enclosed).

*182. FERTILIZER RECOMMENDATIONS: N, P2O5, and K2O fertilizer is needed for optimum peach production. For rates and times of fertilizer application, see Note 11 (enclosed).

*183. FERTILIZER RECOMMENDATIONS: N and P2O5 fertilizer is needed for optimum peach production. For rates and times of fertilizer application, see Note 11 (enclosed).

*184. FERTILIZER RECOMMENDATIONS: N and K2O fertilizer is needed for optimum peach production. For rates and times of fertilizer application, see Note 11 (enclosed).

*185. FERTILIZER RECOMMENDATIONS: Nitrogen-only fertilizer is needed. For rates and times of fertilizer application, see Note 11 (enclosed).

*186. See Note 12 for further information on fertilization and liming.

HOME TURF

*201. FERTILIZER RECOMMENDATIONS: Apply 50 lbs of 5-10-10 or 25 lbs of 10-20-20 per 1000 square feet. Work fertilizer (and lime, if needed) into the soil to a depth of 4 to 6 inches prior tc seeding. After the turf has been established (6 to 8 weeks), follcw one of the three maintenance fertilization programs suggested in the enclosed Note on lawn care.

*202. FERTILIZER RECOMMENDATIONS: Apply 10 lbs of 0-46-0 per 1000 square feet to correct a shortage of phosphate in the scil. Also apply 25 lbs of 25-4-7 (or equivalent), or 7 lbs of 33-0-0 (ammonium nitrate), or 15 lbs of 16-0-0 (nitrate of soda) per 1000 square feet to supply nitrogen. Work fertilizer (and lime, if needed) into the soil to a depth of 4 to 6 inches prior to seeding. After the turf has been established (6 to 8 weeks), follow one of the three maintenance fertilization programs suggested in the enclosed Note on lawn care.

*203. FERTILIZER RECOMMENDATIONS: Apply 5 lbs of 0-0-50 or 4 lbs of 0-0-60 per 1000 square feet to correct a shortage of potash in the soil. Also apply 10 lbs of 25-4-7 (or equivalent), or 7 lbs of 33-0-0 (ammonium nitrate), or 15 lbs of 16-0-0 (nitrate of soda) per 1000 square feet to supply nitrogen. Work fertilizer (and lime, if needed) into the soil to a depth of 4 to 6 inches prior to seeding. After the turf has been established (6 to 8 weeks), follow one of the three maintenance fertilization programs suggested in the enclosed Note on lawn care.

*204. FERTILIZER RECOMMENDATIONS: Apply 10 lbs of 25-4-7 (or equivalent), or 7 lbs OF 33-0-0 (ammonium nitrate), or 15 lbs of 16-0-0 (nitrate of soda) per 1000 square feet. Work fertilizer (and lime, if needed) into the soil to a depth of 4 to 6 inches prior to seeding. After the turf has been established (6 to 8 weeks), follow one of the three maintenance fertilization programs suggested in the enclosed Note on lawn care.

*205. FERTILIZER RECOMMENDATIONS: Apply 10 lbs of 0-20-20 per 1000 square feet now and again in the spring (or fall). This will correct a shortage of phosphate and potash in the soil but does not supply nitrogen. Therefore, apply an additional amount of fertilizer by following one of the three fertilization programs suggested in the enclosed Note on lawn maintenance. Water-in all fertilizer immediately.

*206. FERTILIZER RECOMMENDATIONS: Apply 6 lbs of 0-46-0 per 1000 square feet. This will correct a shortage of phosphate in the soil but does not supply nitrogen. Therefore, apply an additional amount of fertilizer by following one of the three fertilization programs suggested in the enclosed Note on lawn maintenance. Water-in all fertilizer immediately.

*207. FERTILIZER RECOMMENDATIONS: Apply 4 lbs of 0-0-50 or 3 lbs of 0-0-60 per 1000 square feet. This will correct a shortage of potash in the soil but does not supply nitrogen. Therefore, apply an additional amount of fertilizer by following one of the three fertilization programs suggested in the enclosed Note on lawn maintenance. Water-in all fertilizer immediately.

*208. FERTILIZER RECOMMENDATIONS: Follow one of the three maintenance fertilization programs suggested in the enclosed Note on lawn care.

GARDEN COMMENTS

*221. FERTILIZER RECOMMENDATIONS: Apply 4 lbs of 5-10-10 per 100 square feet. For additional information on fertilization, see Note 19 (enclosed).

*222. FERTILIZER RECOMMENDATIONS: Apply 4 lbs of 5-10-5 per 100 square feet. For additional information on fertilization, see Note 19 (enclosed).

*223. FERTILIZER RECOMMENDATIONS: Apply 2 lbs of 10-10-10 per 100 square feet. For additional information on fertilization, see Note 19 (enclosed).

SMALL FRUITS FOR HOME USE

*241. FERTILIZER RECOMMENDATIONS: Complete Fertilizer Needed - See Note 22.

*242. FERTILIZER RECOMMENDATIONS: Nitrogen-Only Fertilizer Needed - See Note 22.

*243. FERTILIZER RECOMMENDATIONS: Complete Fertilizer Needed - See Note 21.

*244. FERTILIZER RECOMMENDATIONS: Nitrogen-Only Fertilizer Needed - See Note 21.

HOME SHRUBS AND TREES

*261. FERTILIZER RECOMMENDATIONS: See Note 20 (Enclosed).

POTTED HOUSE PLANTS

*281. FERTILIZER RECOMMENDATIONS: See Note 19 (Enclosed).

GREENHOUSE PRODUCTION

*301. FERTILIZER RECOMMENDATIONS: Apply 1/2 to 3/4 lbs of 20-20-20 per 100 sq. ft. or per 25 gal. of water.

*302. FERTILIZER RECOMMENDATIONS: Apply 1/2 to 3/4 lbs of 20-5-30 per 100 sq. ft. or per 25 gal. of water.

*303. FERTILIZER RECOMMENDATIONS: Only supplemental N fertilizer is needed. Apply 1/2 lb of calcium nitrate per 100 sq. ft. (or 1/4 lb of calcium nitrate per 25 gal. of water).

NURSERY PRODUCTION

*321. FERTILIZER RECOMMENDATIONS: Apply 2000 lbs of 5-10-5 per acre.

*322. FERTILIZER RECOMMENDATIONS: Apply 1000 lbs of 10-10-10 per acre.

*323. FERTILIZER RECOMMENDATIONS: Apply 150 lbs of ammonium nitrate per acre in early spring.

pH, LIME, SULFUR

*601. The above lime recommendation is for adjusting the soil pH to 6.5. Omit lime applicaton for acid-loving plants.

*602. Optimum soil pH for crops grown on organic soils (soils greater than 15% organic matter) is 5.2. While this pH level is dangerously low for mineral soils, crops grow well at this level on organic soils.

*603. The above lime recommendation is for a sandy loam soil. For a greens mixture without a soils component (ex. sand, peat), reduce the lime recommendation by 50%.

*604. The above lime recommendation is for a 1:1 soil-lightweight mix. For an all-sand mix, reduce the lime recommendation by 50%. For a soilless (eg., peat) mix, increase the lime recommendation by 50%.

*605. Lime recommended for the 1st crop will satisfy lime needs for 3 to 4 years.

*606. Soil pH is too low for good growth of forage crops. A pH of 5.5 to 6.0 is required.

*607. LIME RECOMMENDATIONS: Apply ____ tons of agricultural lime per acre.

*608. LIME RECOMMENDATIONS: Apply __ pounds of agricultural limestone (ground or pulverized) per 100 square feet.

*609. LIME RECOMMENDATIONS: Apply ___ pounds of agricultural limestone (ground or pulverized) per 1000 square feet.

*610. LIME RECOMMENDATIONS: Apply ___ teaspoons of agricultural limestone (ground or pulverized) per 5" pot.

*611. TYPE OF LIME TO APPLY: Apply dolomitic limestone which will supply needed magnesium in addition to correcting acidity.

*612. TYPE OF LIME TO APPLY: Apply calcitic limestone which will supply needed calcium in addition to correcting acidity.

*613. If tobacco is to be grown in the rotation in the next three years and the pH is 5.5 or higher, do not apply lime. If the pH is less than 5.5, apply only one half the lime recommended.

*614. If this field is used, disease problems may be more serious because of the high pH. Choose another field, if possible.

*615. If soil is organic (greater than 15% organic matter), and pH is 5.2 or higher, do not apply lime. If pH is less than 5.2, apply only one-fourth of the recommended limestone.

*630. Sulfur is needed to reduce soil pH. Apply __ lbs of aluminum sulfate per 100 square feet. Retest soil in 6 months to determine if further applications are needed.

TRACE ELEMENTS, CALCIUM, MAGNESIUM

*640. Zinc, manganese, boron, and molybdenum are needed. For rates of application, see Note 4 (enclosed).

*641. Manganese, boron, and molybdenum are needed. For rates of application see Note 4 (enclosed).

*642. Zinc, boron, and molybdenum are needed. For rates of application, see Note 4 (enclosed).

*643. Zinc, manganese, and molybdenum are needed. For rates of application, see Note 4 (enclosed).

*644. Zinc, manganese, and boron are needed. For rates of application, see Note 4 (enclosed).

*645. Boron and molybdenum are needed. For rates of application, see Note 4 (enclosed).

*646. Manganese and molybdenum are needed. For rates of application, see Note 4 (enclosed).

*647. Manganese and boron are needed. For rates of application, see Note 4.

*648. Zinc and molybdenum are needed. For rates of application, see Note 4.

*649. Zinc and boron are needed. For rates of application, see Note 4.

*650. Zinc and manganese are needed. For rates of application, see Note 4.

*651. Molybdenum is needed. For rate of application, see Note 4 (enclosed).

*652. Boron is needed. For rate of application, see Note 4 (enclosed).

*653. Manganese is needed. For rate of application, see Note 4 (enclosed).

*654. Zinc is needed. For rate of application, see Note 4 (enclosed).

*655. Zinc is needed for the small grain crop. See Note 4 (enclosed).

*656. The zinc test is not calibrated for this crop. For further information, see Note 1 (enclosed).

*657. Manganese is needed for the soybean crop. See Note 4 (enclosed).

*658. The manganese test is not calibrated for this crop. For further information, see Note 1 (enclosed).

*659. Manganese may be needed. Apply if deficiency symptoms occur. See Note 4 (enclosed) for method of application.

*660. Molybdenum is needed for the soybean crop. See Note 4 (enclosed).

*661. Apply 30 lbs of magnesium (Mg) per acre in a soluble form such as magnesium sulfate, sulfate of potash magnesia, or promesium.

*662. Apply gypsum at one of the following rates: broadcast - 900 lbs per acre, or banded over the row - 600 lbs per acre.

SOLUBLE SALTS

*671. Low soluble salts indicate that fertilizer is needed.

*672. Soluble salts approaching optimum level.

*673. Soluble salts are in desirable range. No fertilizer is needed, but light applications can be made.

*674. Soluble salts are OK for established plants. For seedlings and cuttings, salts are approaching borderline - partial leaching recommended. See Note 13 (enclosed).

*675. Soluble salts are OK for established plants. For seedlings and cuttings, salts are too high and should be leached. See Note 13 (enclosed).

*676. Soluble salts are in critical range. Leach media. See Note 13 (enclosed).

*677. Soluble salts are adequate for normal crop growth.

*678. Soluble salts are high and may, under certain conditions, cause problems with plant growth. See your Extension Agent.