Preface to electronic version of EC 476 “Nutrient Management for South Carolina Based on Soil Test Results” February 2001, and a previous electronic reedited version dated July 2001.

Several changes have been made to the nutrient management tables and accompanying text (pages 29 to 70) for some crops. The changes include the following:

1. Reference numbers have been added to the text that accompanies the various tables. These numbers are the same as comment numbers included in soil test reports and which provide guidance regarding the scheduling of nutrient applications.

2. Recommendations for several turf crops have been modified to reflect the most current recommendations and the availability of formulated fertilizers sold in most garden stores. We acknowledge the help of Drs. Robert Mazur, Burt McCarty, and James Camberato in arriving at the current recommendations.

3. Phosphorus rates for some crops were not always equal for a given soil test rating. The same was true for potassium. This has been corrected. We believe these inconsistencies stemmed from the availability of preformulated fertilizers at the time the recommendations were first developed.

4. The desired pH range for St. Augustinegrass, 5.8 to 6.5, was not correct in previous editions.

Ralph Franklin
Kathy Moore
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Nutrient Management for South Carolina

Based on Soil Test Results

EC 476

Agronomic and Horticultural Crops, Home Gardens, Turfgrasses, Plant Nutrients, Soil Testing and Analysis, Nutrient Waste Management, and South Carolina Land Resource Information

Cooperative Extension Service **Clemson University**

The original Extension Circular 476 was prepared by C.L. Parks; previous revisions were printed in October 1982 and January 1998.

This revision was prepared by Ralph Franklin, Department of Crop & Soil Environmental Science, with the cooperation of faculty in the Departments of Crop & Soil Environmental Science, Horticulture, Forest Resources, and the Agricultural Service Laboratory, and colleagues who have retired or are no longer associated with Clemson University. James Camberato and Kathy Moore provided many editorial comments and suggestions for improvement.

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Major changes from January 1998 edition:

- Explanation of nutrient recommendations
- Comment about “Yield Goals”
- Nutrient recommendations added for canola, zoysiagrass and St. Augustinegrass
- Recommendations modified for carpetgrass and centipedegrass
- New lime tables for the Standard Adams–Evans method, adopted in November 1998
- Advisory warning regarding risk of exceeding the lime requirement/recommendation
- Revised Crop Codes

Trade names used in this publication are for identification only and do not imply endorsement of products named nor criticism of similar products not mentioned.

CONTENTS

INTRODUCTION

The Clemson University Agricultural Service Laboratory is a part of the educational program of the Clemson University Cooperative Extension Service. The service is available to all citizens of South Carolina. The soil testing service will be helpful to producers of agronomic and horticultural crops and those interested in landscaping or home beautification, gardening, tree farming, and managing golf courses. Soil tests and nutrient recommendations are based on many years of research that have confirmed the reliability of soil test methods and verified nutrient recommendations. Soil testing and following the accompanying nutrient recommendations provides an environmentally sound basis for managing plant nutrients in soil.

Some of the soils in South Carolina will require lime, some will not require lime, and others have been over-limed. Most soils will need one or more of the fertilizer nutrients required for optimum crop growth. Some of the soils will require high rates of certain fertilizers, others will require medium rates, and a few will require a low rate or no fertilizer. The soil testing service will provide information on how much lime and what nutrients should be applied to improve the nutrient status of soils that have been depleted of their nutrient supplies (see page 10).

The three major steps in providing a good soil testing service are: (1) obtaining a representative sample of the area; (2) a reliable soil test; and (3) proper interpretation of the results. The most vulnerable step is that of obtaining a representative sample.

Soil Groups/Soil Codes

There are more than 200 soil series in South Carolina. For purposes of soil-testing and nutrient management, these soils are divided into four groups (Groups 1-4). A general guide to these common soil series according to the four groups is given in Table 1 on page 3. In addition to these four, two additional groups are defined: Group 5 for subsoil samples and Group 6 for Carolina Bays and organic soils. These six soil groups are also referred to as *soil codes* on the back of the "Soil Analysis Record Sheet."

Group 1/Code 1: Coarse-textured soils where the depth to the clay layer is greater than 40 inches. These soils are sands or loamy sands throughout with no obvious change in soil texture to a depth greater than 40 inches. Zinc deficiency on corn may be observed on these soils the year after liming or when the soil is limed to a pH of 6.5 or higher.

Group 2/Code 2: Coarse-textured soils where the depth to the clay layer is 20 to 40 inches. The surface materials are sands or loamy sands to a depth of 20 inches and not more than 40 inches. Underlying materials are sandy loams, sandy clay loams and clay loams. Zinc deficiency on corn may be a problem the year after liming or when the soil is limed to a pH above 6.5. Manganese deficiency on soybeans is likely to occur on the poorly drained soils in this group if limed to a pH greater than 6.2.

Group 3/Code 3: The depth to the clay layer is less than 20 inches. Surface soil materials are mostly loamy sands, sandy loams and fine sandy loams to a depth of less than 20 inches. Subsoil materials are sandy clay loams, clay loams, silt loams and silty clay loams. Zinc deficiency on these soils should not be a problem if the soils are not limed to a pH higher than 6.5. Manganese deficiency on soybeans could be a problem if the poorly drained soils in this group are limed to a pH greater than 6.2. A subsoil test for potassium, magnesium and sulfur would be helpful when making a fertilizer recommendation for these soils.

Group 4/Code 4: Surface soils are mostly sandy loams, fine sandy loams, silt loams and clay loams. Subsoils are clay, sandy clays, silty clays and heavy clay loams. Soils should be limed according to recommendations for the crop to be grown. Good plant growth can be obtained with proper soil pH; adequate nitrogen, phosphorus and potassium; and a favorable environment.

Group 5/Code 5: This soil code is reserved for any subsoil sample.

Group 6/Code 6: Soils from Carolina Bays and soils with greater than 10 percent soil organic matter. Use a Target pH of 5.5 for these soils. By keeping the pH of these soils between 5.0 and 5.5, good plant growth can be obtained and correcting copper deficiency, if it occurs, will be considerably easier than if the pH is greater than 5.5.

Land Areas

Geographically, the five major soil groups (Groups 1-4 and Group 6) are associated with five land resource areas as described below and shown in Figure 1 on page 4.

Land Area 1. The Blue Ridge mountain soils, designated as area "130" in Figure 1, occupy 2 percent of the state and are predominantly those soils listed in Soil Group 3. There are a few soils from Soil Group 4 in this area, but all can be successfully managed as Group 3 soils.

Land Area 2. The Piedmont soils, designated as area "136," occupy 35 percent of the state and are mostly Group 4 soils with small areas of Group 3 soils. No problems should occur if all the soils in this region are managed as Group 4 soils.

Land Area 3. The Carolina Sandhill soils, areas designated "137," occupy 11 percent of the state and are Group 1 and Group 2 soils. If the recommended liming program is used, the only micronutrients that will be required are those recommended for specific crops. If the soil pH is too high, zinc deficiency could be a problem. Manganese deficiency should not be a problem in this area unless the soil pH is above 7.0.

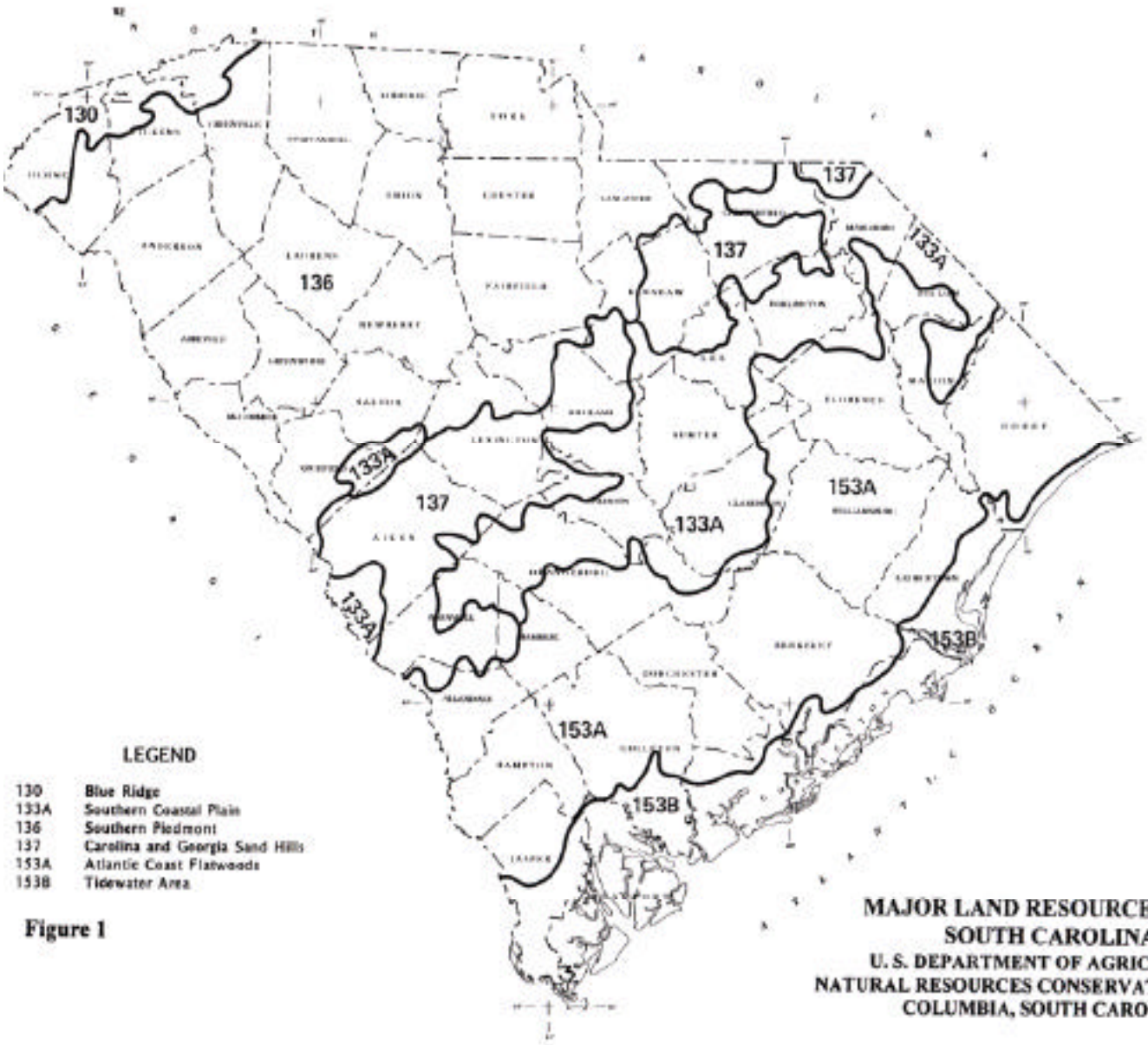
Land Area 4. The Upper Coastal Plains soils, areas designated "133A", make up 14 percent of the state and are mostly Group 3 soils with some of Groups 1 and 2 throughout the region. With proper liming to maintain the desired soil pH, zinc and manganese deficiency should not be a problem. Some zinc deficiency may occur on corn in cool seasons if the soil pH gets above the 6.5 level. There will also be a few regions in the area that are poorly drained and manganese deficiency may occur on soybeans if the pH is above 6.2.

Land Area 5. The Lower Coastal Plains, including the Atlantic Coast Flatwoods and the Tidewater soils, designated areas "153A" and "153B," occupy 38 percent of the state and are mostly Groups 1, 2 and 3 soils with some Group 4 and Group 6 soils. Managing the soil to prevent the occurrence of manganese deficiency in this area is the major soil fertility problem. The best approach is to manage the soil pH, use soil tests to identify the suspected fields, and be prepared to take corrective steps if the problem occurs. The problem most often occurs on the poorly drained soils in Groups 2 and 3.

Table 1. General Guide to Soil Series of S.C. for Nutrient Management.

Drainage and Profile Characteristics	|----------Group 1----------|		Group 2	Group 3	Group 4
	Sandy, Loamy Sands, or Sandy Loams Throughout More than 80 in. to subsoil	|---------- Subsoil texture 18-35% clay ----------| 40-80 in. to subsoil	20-40 in. to subsoil	0-20 in. to subsoil	Subsoil more than 35% clay Usually less than 10 in. to subsoil
Excessively drained Sandy throughout Water table is more than 72 inches deep	Alpin Eustis Kershaw Lakeland Wando		Ailey (X) Blaney (X) Fuquay (P) Lucy (R) Wagram		
Well-drained Top 30 inches has no gray mottles Subsoil is bright colored	Alaga Foxworth Kenansville Louisburg (D) (Y) Toccoa (I) Wateree (D) (Y)	Blanton Eddings Troup	Bonneau Chisolm	Alamance (Z) Brevard (R) Congaree (I) Dothan (P) Durham Edneytown (D) Emporia Evard (D) Grover (D) Lockhart Noboco Norfolk Orangeburg Rion (D) Suffolk Vaucluse (X)	Appling Cataula (X) (R) Ccil (R) Davidson (R) Enon (D) (pH) Faceville (R) Georgeville (R) (Z) Hayesville (R) Herndon (Z) Hiwassee (R) Madison (D)(R) Marlboro Mecklenburg (D) (pH) Nason (D) Z) Pacolet (D) (R) Tatum (D) (R) (Z) Vance (D) Varina (P) Wilkes (D) (pH) (Y) Winnsboro (D) (pH)
Moderately well-drained Upper subsoil free of gray mottles	Centenary (S) Chipley Echaw (S) Seabrook		Bonneau Chisolm Uchee	Clarendon (P) Eunola Goldsboro Kirksey (D)(Z) Pelion Yauhannah	Craven Duplin Eulonia Helena Hornsville Iredell (D)(pH) Nemours Persanti
Somewhat poorly drained Gray mottles in top of subsoil	Cartecay (I) Kiawah (pH) Seewee (S) Witherbee (S)	Albany Murad	Coosaw (D) Ocilla	Chewacla (I) Lynchburg Yemassee	Dunbar Lenoir Okeetee (pH) Smithboro Tawcaw (I) Wahee
Poorly dained All of subsoil more than 60% gray with less than 7 inches of black surface	Leon (S) Osier	Plummer	Elloree (pH) Pelham Williman	Myatt Ogeechee Rains (O) Wadmalaw (pH) Wehadkee (I) Yonges (pH)	Argent (pH) Bethera (O) Bladen (O) Cantey (O) Chastain (I) Coxville (O) Grady (O) Leaf (O) Meggett (pH) McColl (O) (D) Rembert (D) (O) Worsham
Very poorly drained More than 7 inches of black surface over gray subsoil	Johnston Lynn Haven (S) Pickney Pocomoke (O) Rutledge (O)			Deloss Hobcaw Pantego (O) Paxville (O) Portsmouth (D)	Bayboro Brookman (pH) Byars (O) Cape Fear Santee (pH)

D – Clay content decreases with depth in the B horizon
I – Floodplain soils with indistinct horizons
O – May occur in Carolina bays
P – Plinthite in B horizons
pH – pH increases with depth indicating high base saturation
R – Red color in B horizon (subsoil)
S – Has a brittle stained subsoil layer
X – Firm, dense subsoil
Y – Hard bedrock at 40-80”
Z – High in silt



LEGEND

130	Blue Ridge
133A	Southern Coastal Plain
136	Southern Piedmont
137	Carolina and Georgia Sand Hills
153A	Atlantic Coast Flatwoods
153B	Tidewater Area

Figure 1

MAJOR LAND RESOURCE AREAS
SOUTH CAROLINA
U. S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
COLUMBIA, SOUTH CAROLINA

Soil Sampling for Nutrient Management

Recommendations based on soil tests can be no better than the soil sample on which they are based. When taking soil samples, be sure that each sample is representative of the area to be managed. For example, if more than one soil type exists within a field and it is practical to manage the nutrient supplies separately, then separate composite samples shoul be collected for each soil type. Also, be careful not to contaminate samples with soil from other areas or with fertilizer. Soil should be collected from 10 to 20 spots in the field or area to be sampled using a soil probe or spade and mixed well before taking a composite sample for testing. A sample should represent no more than 20 acres but around the home and garden a sample may represent an area less than 100 square feet. Whether the area is a large field or a small garden plot, soil needs to be collected from several locations to obtain a composite sample representative of the entire area.

Soil should be taken from the surface 6 to 8 inches or to the plow depth on cultivated fields and garden plots that will be tilled. Pastures, hay fields and areas that will not be cultivated should be sampled to a depth of 2 to 3 inches. If Precision Farming Technology is used, a different and probably more intensive soil-sampling pattern may be appropriate. Low spots, eroded areas or other areas that may be managed differently should be sampled separately and if practical, treated differently than the main area.

Soil samples should be obtained and tested every year whether or not any fertilizers are added, since fertilizer recommendations are made on a year-to-year basis. Lime recommendations generally will maintain the soil pH within the desired range for periods of three years or more.

Subsoil Sampling for Soil Groups 2 and 3 in the Coastal Plain

Research in South Carolina and adjacent states has shown that potassium, magnesium and sulfur accumulate in the subsoil (clay layer) of Coastal Plain soils. These nutrients may be present in sufficient amounts to supply most or all of the crop requirement for the nutrient involved. For example, even though the surface soil may be low or medium in potassium, there may be a potassium supply in the subsoil that plants can use with potential for savings in fertilizer.

Clemson's nutrient recommendations based on surface soil samples can be adjusted based on the nutrient level of the subsoil when the following conditions are met:

- A representative subsoil sample is analyzed for potassium, magnesium, and/or sulfur.
- Physical impediments to rooting into the subsoil, such as hardpans, are absent or disrupted by subsoiling or comparable deep tillage.
- Depth of the subsoil is no greater than 20 inches.
- Subsoil pH is no less than 5.0.
- The crop is capable of growing roots to the depth of the subsoil.

Therefore, in addition to surface samples taken as described above, we recommend that subsoil samples be taken and tested for sandy Coastal Plain soils, *when subsoiling is practiced.* These samples should be obtained from the top 3 to 4 inches of the more clayey layer and can also be obtained from the same auger-hole bored for a surface sample. However, these subsoil samples should be kept separate from surface samples and clearly labeled **"Soil Group 5"** on the outside of the sample box. Clemson's nutrient recommendations based on surface soil samples can be adjusted if potassium, magnesium or sulfur in the subsoil is sufficiently high. Actual details of these adjustments are described in a subsequent section (see Table 3, page 10).

We strongly recommended that subsoil sampling be made a part of regular soil sampling. Similarly, in-row subsoiling should be made a part of the cultural practice for row crops.

Soil Testing

The standard soil test includes determination of:

- Soil pH (soil active acidity)
- Buffer pH (used to estimate total exchangeable acidity)
- Plant-available phosphorus, potassium, calcium, magnesium, zinc, manganese, copper, and boron
- Cation exchange capacity (CEC)
- Acidity
- % base saturation

In addition, a test for extractable sulfur is available for subsoil samples. Upon request, and for an additional fee, soil samples can also be tested for organic matter, nitrate-nitrogen and soluble salts.

Soil pH is a measure of the concentration of hydrogen ions in the soil solution. Soil pH, also referred to as water pH, measures the amount of active acidity in the soil. Only a small portion of the exchangeable acidity in soil is active. The soil pH is determined with a glass electrode and pH meter on a 1:1 soil water suspension (20-grams soil to 20-milliters of de-ionized water). A 16-ml scoop is used to estimate 20 grams of soil.

Buffer pH is used to measure the total exchangeable or potential acidity in the soil (hydrogen and aluminum ions). Clemson's laboratory uses the Adams-Evans buffer method for measuring exchangeable acidity. Twenty milliliters of Adams-Evans buffer solution, pH 8.0, are added to the soil-water mixture used to determine soil pH. After mixing and equilibrating for one hour, the buffer pH is measured with a glass electrode and pH meter.

Exchangeable and Plant-Available Nutrients: Phosphorus, potassium, calcium, magnesium, zinc, manganese, copper and boron are extracted with 0.05 N HCl + 0.025 N H_2SO_4, known as Mehlich No. 1 extractant or the "Dilute Double Acid" method. Four ml of soil (approximately 5 grams of soil) are mixed with 20 milliliters of extractant, shaken for 5 minutes and then filtered. The nutrient concentrations in the extract are determined by inductively coupled plasma (ICP) spectrometry.

The quantity of each nutrient extracted, which is related to plant availability, is reported in units of pounds per acre. This unit of measure is based on the assumption that the surface 6-inch layer of soil over an area of one acre weighs approximately 2 million pounds. The amount of the nutrient extracted does not exactly equal availability, but it is used as an index or guide for comparing the relative amount of extractable nutrients in different samples. The values are meaningful because they have been correlated with crop responses in the field. Table 2 (opposite) interprets the levels of extractable phosphorus, potassium, calcium and magnesium based on research in South Carolina and neighboring states.

The test for sulfur measures the amount of sulfate-sulfur present. Sulfate is extracted with a solution of 0.5 *N* ammonium acetate in 0.25 *N* acetic acid. The sulfur content of the extract is determined by ICP. Sulfur is considered sufficient (S) if the sulfate concentration is 20 pounds or more per acre in surface samples and 40 pounds or more for subsoil samples (Soil Group 5). Concentrations less than these values are considered Insufficient (I).

Cation Exchange Capacity (CEC): Clay particles and soil organic matter have negatively charged exchange sites on their surfaces that attract and bind positively charged ions (cations) such as aluminum, calcium, hydrogen, potassium and magnesium. The amount or quantity of cations that can be retained by the soil is referred to as the Cation Exchange Capacity (CEC). CEC is calculated from the exchangeable acidity, as described above, and the sum of the base-forming cations, described below. We report CEC in units of millequivalents per 100 grams of soil (meq/100g). What is the significance of CEC? The higher the CEC of a soil, the larger its storage capacity for cations such as calcium, magnesium and potassium. However, CEC is not a useful index or measure of soil productivity. The best way to measure the nutrient status of a soil and manage nutrient supplies is by using soil testing and following nutrient recommendations such as provided in this circular.

Base Saturation and Acidity: Cations held by exchange sites can be divided into acid-forming (hydrogen and aluminum) and base-forming cations (mainly calcium, magnesium, potassium and sodium). Base Saturation is the proportion of the CEC consisting of basic cations and is usually expressed as a percent of the CEC. For example, the base saturation of a soil containing 3 meq/100g of exchangeable calcium, magnesium, potassium and sodium (sum of all four) and having a CEC of 6 meq/100g would be 50 percent. The proportion of the CEC consisting of acid-forming cations, hydrogen and aluminum, is called acid saturation. In this example, the acid saturation would be also be 50 percent since the sum of the acid and base saturation must equal 100 percent.

Lime Requirement: Both the soil pH and the buffer pH are given on the soil test report form. The lower the buffer pH and the soil pH, the higher the lime requirement. Both pH values are needed to estimate the lime requirement and it is important to realize that two soils may have the same soil pH, but different lime requirements. Also, two soils may have the same lime requirements, but different soil pHs. Since most crops respond best when soils are slightly acidic, lime recommendations are adequate to neutralize only a portion of the exchangeable acidity, depending on the desired soil pH. At pH 6.0, soils typical of this region are about 40 percent saturated with acidic ions and 60 percent saturated with basic cations (calcium, magnesium, potassium and sodium). At pH 6.5, these soils are about 25 percent acid saturated and 75 percent base saturated. The lime recommendation is the amount of lime required to raise the pH of the soil to the desired level (Target pH), which is **6.0 or 6.5** for most crops.

Soil Test Ratings

Tables 2 and 2A give soil test ratings and corresponding ranges in extractable phosphorus, potassium, calcium and magnesium upon which Clemson University fertilizer recommendations are based. Note that phosphorus and magnesium ratings depend upon the soil group and that soil test phosphorus and potassium ratings for peanuts (Table 2A) are different from other crops

Table 2. Range in Extractable P, K, Ca, and Mg Represented by the Soil Test Ratings of the Clemson University Agricultural Service Laboratory.

SOIL-TEST RATING	-(all crops except peanuts)---		----------(all crops)----------			
	P		K	Ca	Mg	
	Soil Groups		All Soil Groups	All Soil Groups	Soil Groups	
	1,2,3 & 6	4 & 5			1,2,3, & 5	4 & 6
	lb/acre	lb/acre	lb/acre	lb/acre	lb/acre	lb/acre
VL	0-10	0-6	0-24	0-200	0-10	0-20
L	11-20	7-12	25-48	201-300	11-20	21-32
L+	21-30	13-20	49-70	301-400	21-32	33-46
M-	31-40	21-26	71-98	401-530	33-40	47-66
M	41-50	27-32	99-128	531-670	41-50	67-86
M+	51-60	33-40	129-156	671-800	51-60	87-100
H-	61-80	41-54	157-182	801-1200		
H	81-100	55-68	183-208	1201-1600	61+	101+
H+	101-120	69-80	209-235	1601-2000		
VH	121-240	81-240	236+	2001+		

Table 2 applies to all conditions except phosphorus and potassium for peanuts.

Table 2A. Soil Test Ratings and Corresponding Ranges in Extractable P and K for Peanuts. Applicable for all soils on which peanuts are grown.

Soil-Test Rating	P lb/acre	K lb/acre
VL	0-4	0-20
L	5-10	21-28
M	11-19	29-40
H	20-50	41-100
VH	>50	>100

Interpreting Soil Test Rating for Phosphorus, Potassium, Calcium and Magnesium

Very Low. Soil is deficient and application of the nutrient in question can be expected to produce a significant yield increase provided adequate soil moisture is available and other environmental conditions are favorable. High rates of the plant nutrient are needed if soil reserves are to be built up. Part of the fertilizer, especially phosphorus, should be banded beside the row for row crops planted in the spring when the soil temperature is low.

Low. Application of the nutrient can be expected to increase yield.

Medium. The supply of nutrient in the soil is adequate for many agronomic crops, but a yield response can be expected about 50 percent of the time. On Soil Groups 1 and 2, it may not be economical to build potassium, calcium, and/or magnesium levels higher than this level.

High. The supply of nutrient in the soil is adequate for most agronomic crops. No fertilizer is recommended for most crops and no yield response is expected. Certain agronomic crops and horticultural crops may benefit from fertilization at this level.

Very High. Supply of the nutrient is adequate for all agronomic crops and certain horticultural crops, and fertilizer is not recommended for those crops.

Excessively High. Supply of nutrients is excessively high and is more than adequate for all crops. The continued application of the nutrient could be detrimental to plant growth and may impact water quality.

Explanation of Recommendations

Clemson University's soil test report includes nutrient and lime recommendations based on expectation that a plant response is likely to occur, as explained in the previous section. Recommendations provided with the Clemson University soil test report depend on the soil test results, the crop or plant to be grown, and yield response experiments conducted in South Carolina and adjacent states. These experiments have been conducted over many growing seasons and weather conditions on soils typical of South Carolina and the Southeast.

The plant nutrients needed in largest amounts are nitrogen, phosphorus and potassium. In many cases, these are the only plant nutrients that need to be applied on a regular basis. Our recommendations are adequate to provide for optimal yields under most soil and crop management conditions. Experience has documented that yield increases are not observed when the recommended rates are exceeded or when application is made when soil test rating is High or above. When the recommended amounts of nutrients are applied, and if appropriate weed and other pest management practices are followed, rainfall and soil moisture conditions almost always limit yield.

Nitrogen is recommended each year for all crops except legumes. Most of the plant-available nitrogen in soil is in the form of nitrate, which readily leaches from soil. Unless a special request is made, a soil test for nitrogen is not included with the regular soil test because most soils in this region have little carryover of plant-available nitrogen and are low in soil organic matter content. Therefore, soils in this region cannot supply enough nitrogen to provide for optimal yields

without nitrogen fertilization. If there is reason to believe that a substantial amount of plant-available nitrogen remains in the soil from the previous application, that needs to be confirmed by having a 3-foot soil core analyzed for nitrate-nitrogen.

Generally, the yield of most non-leguminous crops is more sensitive to nitrogen than any other nutrient except water. For several crops, comments provided with our nitrogen recommendations describe when nitrogen rates should be adjusted, up or down, depending on past experience, soil conditions and crop management. For example, our normal recommendation for nitrogen on unirrigated corn is 120 pounds per acre, but when it is grown on very sandy soils having a yield potential of 80 bushels per acre or less, we recommend decreasing the rate to 80 pounds per acre. In contrast, when it is grown in river bottoms and other locations where yields of 130 bushels per acre or more are commonly obtained, we suggest increasing the rate to 150 pounds per acre. We provide similar guidance for adjusting the nitrogen rate for Coastal bermudagrass, bahiagrass, cotton, small grain used for grazing and for several of the horticultural crops. This guidance is provided in the comments that accompany the recommendation.

Will the nitrogen rates we recommend provide for your yield goal? Agronomists find that fertilization rates of 1.0 to 1.25 pounds of nitrogen per bushel of corn and 1.25 to 1.4 pounds per bushel of wheat typically will support reasonable yield goals. Considering two important crops, corn and wheat, and based on these estimates for yield responses, the ranges of recommended nitrogen rates and yield potentials are:

Crop	**N Rate, lb/acre**		**Yield Potential, bu/acre**	
	Low	High	Low	High
Wheat	80	100	57-64	71-80
Corn, unirrigated	100	150	80-100	120-150
Corn irrigated	180	220	144-180	176-220

If yields above or below these ranges are expected, the nitrogen rate should be adjusted up or down, accordingly.

Phosphorus and **potassium** are recommended for all crops when soil test levels are Medium, Low or Very Low, and for a few crops even when soil test levels are High.

Calcium and **magnesium** are usually supplied when lime is applied to raise the soil pH. When lime is not needed but soil test levels of either of these nutrients are low, they can be supplied by addition of gypsum for calcium and Epsom salt or sulfate of potash magnesia (SUL-PO-MAG) for magnesium.

Sulfur is routinely recommended only for soils that do not have a clay layer within 20 inches of the surface (Soil Groups 1 and 2). Other soils may not need sulfur application dependent on factors described in the section describing subsoil sampling.

Manganese: except for poorly drained Coastal Plain soils with pH above 6.1 and other coarse textured Coastal Plain soils that have a pH greater than 6.4, most soils can supply adequate amounts of manganese. Manganese deficiencies are most common when the pH of well-drained soils rises above 6.7. Crops prone to manganese deficiency when soil pH is too high are soybeans, peanuts, oats, wheat, and cotton.

Zinc is routinely recommended only for corn grown on deep sandy soils (Soil Groups 1 and 2, soils that do not have a clay layer within 20 inches of the surface). When zinc deficiency on pecan, peaches or apples is confirmed, the most effective treatment to correct the problem is a foliar application of a zinc chelate.

Boron is routinely recommended only for the following crops: alfalfa, apples, broccoli, cabbage, cauliflower, clover (when reseeding or if to be harvested for seed), cotton, peanuts and root crops. Other crops normally obtain enough boron from the natural soil.

Copper is reported for diagnostic purposes but is not normally recommended. Copper deficiency is likely to be a problem only with soils especially high in organic matter, and coarse textured soils that have been overlimed.

Modification of Nutrient Recommendations for Coastal Plain Soils
Based on Subsoil Sample Analysis

Potassium, sulfur and magnesium are leached from the surface of sandy Coastal Plain soils and accumulate in the more clayey subsoil. These nutrients are available to crops if and when roots reach and penetrate this layer where clay has accumulated. Subsoiling is a very important management practice on Coastal Plain soils because it allows roots to proliferate into the clay layer and extract water and nutrients.

Generally, if the clay layer is within 20 inches of the surface, the subsoil can be an important source of potassium, sulphur and magnesium if the subsoil pH is not too acidic (soil pH should be 5.0 or more) and subsoiling is practiced. When subsoiling penetrates the clay layer, plant roots are able to use nutrients and water in the clayey subsoil provided it's not too acidic. Therefore, subsoil samples should routinely be taken from Coastal Plain soils ***if subsoiling is practiced and its pH is 5.0 or more***. The sample should be taken to a depth of 3 to 4 inches below the top of the more clayey layer (or top of the subsoil). A subsoil sample can be obtained from the same auger-hole from which a surface sample is obtained. All the general guidelines taken for routine sampling should be followed for subsoil sampling.

Potassium fertilizer recommendations based on available potassium in the surface soil should be reduced if available potassium in the subsoil is Medium or Higher. See Table 3 for recommended adjustments. The soil test report for Group 5 samples includes these adjustments.

Table 3. Adjustments to Nutrient Recommendations Based on Subsoil Sample Analysis.

Subsoil Nutrient Level	Recommended Adjustment
Potassium (K)	
Low	Based on the soil-test results, no adjustment is recommended in fertilizer rates based on the topsoil sample.
Medium	Subsoil contains medium level of K. The recommended rated of K_2O should be reduced by one-fourth. In-row subsoiling needs to be a part of routine cultural practices for row crops.
High	Subsoil contains a high level of K. The recommended rate of K_2O should be reduced by one-half. In-row subsoiling needs to be a part of routine cultural practices for row crops.
Very High	Subsoil contains a very high level of K. The recommended rate of K_2O should be reduced by three-fourths. In-row subsoiling needs to be a part of routine cultural practices for row crops.
Magnesium (Mg)	Subsoil contains adequate magnesium; disregard any recommendation for magnesium based on topsoil sample.
Medium to Very High	However, in-row subsoiling may need to be a part of the cultural practices for row crops.
Sulfur (S)	Test for sulfur indicates there is sufficient sulfur in the subsoil for good plant growth. Disregard any other recommendation for
Sufficient	sulfur on this area. However, in-row subsoiling should be a part of the cultural practices for row crops.

Essential Plant Nutrients

Nitrogen (N)

A realistic measure of nitrogen in the soil can not be obtained from analysis of surface soil samples submitted for routine soil testing. Small amounts of nitrogen, perhaps 10 to 20 pounds per acre per year, will be released from decomposing organic matter in the soil during the warm season. In addition, some of the nitrogen remaining from the previous fertilizer application (residual nitrogen) may remain in the root zone and become available during the following growing season. Poor growing conditions in the previous year and low rainfall through the cool season can result in significant nitrogen remaining in the soil profile. Residual nitrogen in the profile can be estimated by obtaining soil samples taken to a depth of up to 36 inches and testing for nitrate-nitrogen.

The amount of nitrogen soils in this region can supply for plant growth due to the decomposition of soil organic matter is small compared to the amount needed for optimal crop production. Unless significant residual nitrate remains in the soil from the previous crop, nitrogen recommendations for non-legume crops are based on nitrogen rate experiments and plant responses conducted on soils in South Carolina and on similar soils and in neighboring states. These nitrogen recommendations are suggested as being the most profitable provided good management is practiced. Growers should increase or decrease the nitrogen rate if a local situation has shown the change to be desirable. Too much nitrogen applied too close to harvest will cause excessive vegetative growth and delay harvest.

Nitrogen is not recommended for legume crops since they benefit from atmospheric nitrogen fixed by soil micro-organisms associated with the roots of legumes. Thus air is the source of nitrogen for legumes. A lower rate of nitrogen is recommended for crops that follow legume crops because a nitrogen credit of 25 pounds per acre is given to the following crops and their nitrogen recommendation should be reduced when following a legume crop. Seeds of all leguminous crop should be inoculated before sowing unless legumes have been grown on the field within the past two to four years. Inoculation ensures optimum nodule formation and growth and therefore effective nitrogen fixation. Specific Rhizobium strains may be required for effective nitrogen fixation by some crops such as cowpea and Southern peas. If nitrogen fertilizer is applied to legumes, biological nitrogen fixation is likely to be reduced.

Organic nitrogen, such as that contained in biosolids and manure, cannot be utilized by plants until it has been converted to an ammonium form. This conversion process, termed mineralization, is carried out by naturally occurring soil microorganisms and occurs as plant residues and other organic substances are decomposed. The process occurs more rapidly during the warm season than during the cool season. Once nitrogen is in an ammonium form, it is converted to nitrate by soil microorganisms in one to three weeks, during the warm season.

Nitrogen fertilizer should be applied at planting, or as close as practical to the time when crops need it. Split applications of nitrogen are a way to achieve this. For example, we recommend that only 20 to 30 pounds of the total nitrogen recommendation for small grain be applied at fall planting. The balance should be top-dressed in February. Likewise, 30 pounds per acre of the nitrogen for corn should be applied at planting and the balance side-dressed when the plants are 18 to 30 inches high. This practice conserves resources, saves money by maximizing fertilizer use efficiency and protects water resources.

Phosphorus (P)

The amount of phosphorus extracted by our soil test procedure (Mehlich No. 1 extraction) has been correlated with crop responses to varying rates of phosphorus fertilization and has been found to provide a reliable basis for phosphorus fertilizer recommendations. The recommended phosphorus rate is based on the soil test, the soil group and the crop. Use a fertilizer program designed to maintain the soil test level at a high rating, but not higher, and follow good conservation practices. The phosphorus in fertilizer usually remains in the surface soil. Most of the phosphorus in soil is unavailable to plants because it is tightly bound to soil particles or precipitated as aluminum, iron and calcium compounds having extremely low solubility in the soil solution. Although some phosphorus may move downward when soil available phosphorus reaches very high levels in coarse-textured soils, leaching of phosphorus is

usually not a problem. Significant amounts of phosphorus are not lost by leaching, but on Soil Groups 1, 2 and 3 there may be some downward movement as a result of tillage. Normally, the subsoil will test low in phosphorus even though the surface may be high in available phosphorus. While leaching is not a problem with phosphorus, surface losses can be significant. Erosion of soil and phosphorus that is attached to soil particles can contribute to excessive levels of phosphorus in surface waters. Phosphorus enrichment of surface waters can stimulate growth of aquatic plants such as algae.

Soils that have been fertilized for several years using only, or primarily, poultry litter, dairy wastes and other animal manure tend to build up very high levels of available phosphorus. In most cases, application rates are based on the nitrogen content of the organic material. Most animal manure contains similar concentrations of nitrogen and phosphorus yet most crops take up five to 10 times more nitrogen than phosphorus. Thus phosphorus will build up in the soil under such nutrient management practices.

Although soil acidity and soil moisture and temperature are sometimes associated with phosphorus availability, the effect of soil temperature on corn seedling response to phosphorus is the one most likely to be observed. In cool springs, purple coloration of corn leaves may be seen. This effect is not due to phosphorus being in an unavailable form but most likely due to slow root growth and a lower rate of absorption of phosphorus by plant roots in the cold soil.

There are three situations when banding of phosphorus is desirable:

- For transplants when phosphorus is recommended.
- When planting in cold soil in late winter or early spring and the soil test for phosphorus is low or very low.
- When the soil test for phosphorus is very low.

In the event that the soil test for phosphorus is high or above and none is applied, soil sampling should be done the following year. Additional phosphorus may not be needed for soybeans or peanuts if the recommended amount of phosphorus has been applied to the preceding crop.

Potassium (K)

Recommendations for potassium, as for phosphorus, are based on the likelihood of obtaining a response to potassium fertilizer. Potassium is subject to luxury consumption, that is, the plant will take up much more than is needed if more potassium is added than is recommended. Also, potassium is subject to leaching loss, especially in soils of the Coastal Plains. When potassium is applied immediately prior to planting, leaching of potassium should not be enough to reduce yield with normal rainfall. However, in years when rainfall is high, leaching of potassium may affect yield on Soil Groups 1 and 2 but not for other soil groups.

Because of luxury consumption, considerable potassium is removed when the entire plant is harvested, and subsequent crops will require more potassium. The recommended rate should be taken from the table for the specific crop and soil group. Luxury consumption and leaching loss make it undesirable to try to build the potassium level above medium. When the soil potassium level is high, potassium not removed by the crop will tend to leach to the clay layer. If a subsoil test is run on Soil Group 2 (having a clay layer within 20 inches of the surface) or Soil Group 3 and the test is high, the recommended rate based on the surface soil sample may be reduced. When the level of magnesium in the soil is low, a high rate of potassium may induce magnesium deficiency. In the event that the soil test for potassium is high or above and none is applied, soil sampling should be done the following year.

Calcium (Ca)

Soil testing measures the amount of available or exchangeable calcium in soil. The calcium requirement for most crops is satisfied if the lime recommendation is followed. Using either calcitic or dolomitic limestone and a good liming program will normally maintain a favorable calcium level. When calcium tests low, a small amount of lime (500 to 1,000 pounds per acre) may be used to correct the deficiency if the soil pH is not too high, and thus the possibility

of inducing micronutrient deficiency does not exist. If soil pH is near the desired level, use another source of calcium, such as gypsum. The crops most sensitive to low calcium levels are tomatoes, pimentos, peanuts, fruit and nuts.

Magnesium (Mg)

Magnesium requirements are usually supplied most economically by using dolomitic limestone. Soil acidity, low magnesium and low calcium can be corrected with dolomitic limestone at the recommended rate. When magnesium deficiency occurs, it is often due to low soil pH. When lime is required and the soil test for magnesium is medium or less, use dolomitic limestone. When lime is required and the soil test for magnesium is medium plus or above, any source of lime may be used. The use of dolomitic limestone every time the soil is limed will not result in magnesium toxicity or cause a cation imbalance situation in the soils in South Carolina. When the soil tests low in magnesium and lime **is not** required, apply 10 to 15 pounds per acre of magnesium as magnesium sulfate or sulfate of potash-magnesia. If the subsoil contains adequate magnesium, a magnesium recommendation based on a surface soil sample test should be disregarded. A subsoil test should be done to assess the magnesium requirement accurately. Vegetable crops like beets, broccoli, cabbage, carrots, cauliflower, collards, eggplant, onions, pepper, pole beans, spinach or greens are very susceptible to magnesium deficiency when magnesium or pH levels are low.

Sulfur (S)

The increased use of ammonium phosphate and concentrated superphosphate (triple superphosphate) rather than superphosphate in fertilizers has resulted in an increase in the occurrence of sulfur deficiency. Organic matter is a source of sulfur, but most soils in the Coastal Plain of South Carolina contain too little organic matter for this to be an adequate source. Precipitation contributes 8 to 11 pounds per acre of sulfur per year in South Carolina. This sulfur is injected into the atmosphere from natural and artificial sources.

Sulfur deposited from the atmosphere is retained on clay surfaces and is adequate to satisfy crop requirements in the Piedmont. For this reason a need for sulfur is not expected for the soils in Group 4. However, in the Coastal Plain sulfur will leach from the surface soil, but it is retained in the clay layer. A subsoil testing program should be used for soils in Soil Group 2 if the clay layer is within 20 inches of the surface and for Soil Group 3. The test will indicate if the level of sulfur in the subsoil is Sufficient (S) or Insufficient (I). If the test is (I) Insufficient, the fertilizer used should supply 10 pounds of sulfur per acre. When depending on subsoil sulfur, it must be possible for plant roots to grow into the subsoil. In-row subsoiling or chisel plowing may be necessary on some soils if plant roots are to reach this source of sulfur.

During periods of low temperature and/or when excessive rainfall occurs in the spring, sulfur deficiencies may be observed on plants, especially corn growing in sandy soils. The plants will usually recover when roots reach the subsoil zone where sulfur has accumulated, but side-dressing with a nitrogen-sulfur solution may be desirable.

It may be possible to get good crop yield on Soil Groups 1 and 2 for a few years without adding sulfur. However, we recommend sulfur fertilization of these soils since their organic matter content is low, sulfur will readily leach from these coarse-textured soils, and the depth to clay is greater than 20 inches. Until a practical soil test procedure for predicting sulfur deficiency in Soil Groups 1 and 2 is developed, we recommend application of 10 pounds of sulfur annually in the fertilizer or pesticide applications for all crops grown in Soil Groups 1 and 2. For Soil Group 5 (subsoil samples), the amount of sulfur is considered Insufficient (I) if the value is 40 pounds per acre. For Soil Groups 1, 2, 3, 4 or 6, the amount of sulfur is considered Insufficient (I) if the value is 20 pounds per acre or less.

Boron (B)

A soil test for boron is included as a part of the standard soil test. When extractable boron is 0.1 pound per acre or more, there is adequate boron in the soil. However, application of small amounts of boron are routinely recommended for several crops as described below. A plant analysis is the best method for determining when boron is actually needed. Boron in the soil is in organic and inorganic forms. There may be 20 to 200 lb/acre in the surface layer of

soil, but only a small amount is available. Boron is made available as soil organic matter is mineralized and as boron-containing minerals slowly dissolve. Boron is often contained in soil amendments including manure, superphosphate and lime. Calcium, potassium and nitrogen can affect boron nutrition. The calcium-boron relationship is the most important. Soils high in calcium will require more boron. Lower rates of boron will be required for soils low in calcium, and chances of boron toxicity are greater. Crops differ in tolerance to high levels of boron in soils. Sensitive crops are peaches, strawberries and soybeans. A few of the more tolerant crops are cotton, sunflowers and alfalfa. Corn, tobacco, tomatoes and small grains are somewhere in between. Boron is recommended routinely for cotton, peanuts, reseeding clover or where clover seeds are to be harvested, alfalfa, apples, root crops, cabbage, broccoli, and cauliflower. Ranges of boron application rates for some crops when deficiency symptoms are observed are given in Table 4. Boron toxicity is definitely possible, and care should be taken not to exceed the recommended rates. The amount of boron required is dependent upon the crop, soil conditions, the source of boron and the method of application. For any given crop, higher rates of boron may be applied to clayey soils, soils with a high pH or high calcium level, and soils with a high organic matter content. Broadcast applications may be higher than either banded or foliar application.

Table 4. Rates of Boron Suggested for Correcting Boron Deficiency of Various Crops.
(The amounts given are pounds of elemental boron per acre. The actual amount of material applied will depend on the boron concentration in the source).

Crop	Amount lb/acre
Alfalfa	2.0-4.0
Apples	0.3-1.4
Cabbage	1.0-4.5
Carrots	1.0-1.7
Clovers	0.6-2.3
Corn	0.6-1.0
Cotton	0.6-1.0
Grapes	0.6-1.0
Peanuts	0.3-0.5
Peas	0.9-1.2
Potatoes	0.6-1.0
Strawberries	0.6-1.0
Sweet potatoes	0.6-1.7
Tobacco	0.3-0.6
Tomatoes	0.6-1.7

Zinc (Zn)

Soil and plant analysis can be used to help determine whether a zinc problem exists. The standard soil test includes zinc analysis. If there is a problem, it may be either a toxicity or deficiency. A toxicity might result from several years of use of a fungicide containing zinc such as in old peach orchards. The use of high rates of sludge, slag, or poultry litter containing high concentration of zinc can cause zinc toxicity. The effect of zinc toxicity may be reduced or eliminated by using lime to raise the soil pH above what would normally be considered adequate.

When soils are tested for zinc, they are rated “S” (Sufficient) or “I” (Insufficient). If the test indicates less than 1.6 pounds of zinc per acre, it is regarded as Insufficient (I), and zinc is recommended for certain crops. The rate to use would be 3 to 5 lb of Zn/acre.

Zinc deficiency may be observed on early planted corn during a cool, wet season and when polyphosphate is banded. The plants usually recover when soils dry out and warm up. Zinc is routinely recommended for corn on sandy soils (Groups 1 and 2) when the soil pH is above 6.5. Also, zinc application is suggested for pecans, peaches and apples, unless a plant analysis indicates it is not required. To correct a zinc deficiency for peaches, plums or nectarines, apply a foliar spray of chelated zinc according to the label or apply 3 ounces of zinc sulfate per 100 gallons of spray, three times at three-week intervals. If a fungicide containing zinc is used, additional zinc will not be required.

Manganese (Mn)

If manganese deficiency is suspected, both plant tissue and soil samples should be submitted for analysis to confirm that manganese deficiency is the problem. Manganese deficiency should be corrected by soil or foliar application. For soybeans, 15 to 75 pounds of manganese sulfate (26 to 28 percent manganese) or its equivalent per acre may be applied for optimum yield when the soil pH is around 6.4. However in soils with a high pH, correcting manganese deficiencies by soil application is difficult as the applied manganese will most likely be converted to an unavailable form in the soil. In the case of soybeans, the best way to correct the deficiency is to apply 1 pound manganese per acre as $MnSO_4$ as a foliar spray twice during the season. Then, rotate to corn, which should lower the soil pH sufficiently to correct the problem.

Soil factors that contribute to manganese deficiency are: (1) water-logged conditions during a portion of the year, and (2) poorly drained soils with low manganese supply and high pH. Manganese deficiency most likely occurs on soybeans, peanuts, oats, wheat and cotton on Soil Groups 1, 2 and 3 in area 5 and on a few poorly drained fields in area 4 when the soil pH is too high.

When the soil is tested for manganese, it will be rated “S” Sufficient or “I” Insufficient. The soil test level considered to be sufficient depends on the soil pH as shown below:

Sufficiency Level	Soil pH
0.0-0.9	5.1
1.0-1.9	5.2
2.0-2.9	5.3
3.0-3.3	5.4
3.4-3.9	5.5
4.0-4.9	5.6
5.0-5.9	5.7
6.0-6.9	5.8
7.0-7.9	5.9
8.0-8.9	6.0
9.0-9.9	6.1
10.0-10.3	6.2
10.4-10.9	6.3
11.0-11.9	6.4
12.0-12.9	6.5
13.0-13.9	6.6
14.0-14.9	6.7
15.0-15.9	6.8
16.0-16.9	6.9
>17.0	7.0

Any soil test value less than 6 pounds per acre, regardless of the pH value, is rated “I” (Insufficient) and any value 6 pounds per acre or greater, regardless of the pH value, will be rated “S” (Sufficient).

Iron (Fe)

Iron deficiency in plants in most cases is not due to the lack of iron in the soil. Rather, it is caused by soil conditions such as high soil pH; low soil oxygen levels caused by water logging or prolonged periods of excessive soil moisture; excessive temperature; and excessive phosphorus, copper, manganese and zinc. For these reasons, and the lack of a useful correlation between extractable iron and plant responses, soil samples are not tested for iron.

Crops in South Carolina that may exhibit iron deficiencies are pecans (when over fertilized with zinc), centipede-grass, blueberries and certain ornamentals, such as azaleas and camellias. Foliar application of iron is the most effective way to correct iron deficiency. A 1-percent solution of ferrous sulfate (add a little sulfuric acid to keep it in solution) should correct iron deficiency when sprayed on deficient plants. A 2-percent solution using chelated iron would be equally as effective.

Copper (Cu)

Copper is included as a part of the standard soil test. Copper deficiency *may* be a problem on high organic soils and very sandy soils that have been over-limed and thus have a high pH. Copper will be leached from the very sandy soils low in organic matter, but it is retained in available forms by clayey soils. Copper deficiencies on organic soils may require application of 20 to 50 pounds per acre of copper sulfate or foliar application of 1 to 2 pounds per acre of copper sulfate. Copper deficiency has not been a major problem in South Carolina and recommendations for copper should be based on analysis of plant tissue. There is a very narrow range between deficiency and toxicity of copper.

Molybdenum (Mo)

Soil samples are not tested for molybdenum. The soil normally contains 1 to 6 pounds per acre of molybdenum. Soil pH is the major soil factor affecting the availability of molybdenum to plants. Generally, if the pH is 6.0 or higher, a deficiency will not occur. Therefore, molybdenum application is not normally recommended. If the soil pH is below 6.0 and molybdenum deficiency is suspected, the recommended application rate for most legume crops is 2 to 8 ounces per acre applied as a seed treatment or foliar spray. Molybdenum is not recommended for non-legume crops.

Chlorine (Cl)

Although chlorine is an essential element, soil samples are not tested for chlorine because it is so abundant in nature. Chlorine excesses are more common than deficiencies. Plants can also absorb chlorine from the air through their leaves. For tobacco, the use of sulfate or nitrate sources of potassium is recommended rather than potassium chloride (muriate of potash), because of the adverse effects of chlorine on tobacco quality. Also, for blueberries, acid-forming fertilizers that do not contain chlorides are preferred.

Lowering Soil pH

Soil pH is lowered as a result of natural processes and by the use of ammonium forms of nitrogen. Acid is produced when ammonium forms of nitrogen are naturally converted to nitrate-nitrogen. Intensive cropping using large amounts of ammonium forms of nitrogen will accelerate soil acidification. Occasionally, it will be desirable to lower the soil pH for a lawn with centipede grass or in preparing plant beds for blueberries, azaleas, camellias, rhododendron, and so-called "acid-loving plants." Two or more soil samples should be taken from the area for a firm estimate of the soil pH and the amount of chemical to add. The amount of aluminum sulfate or elemental sulfur required to lower the pH to different levels is given in Table 5.

Table 5. Amount of Aluminum Sulfate Required to Lower Soil pH of a Loamy Soil.

(For **sandy soils** reduce the amount indicated by one-third and for **clayey soils** increase it by one-half. Multiply the values for aluminum sulfate by 0.15 to convert to **elemental sulfur.**)

	Desired pH				
Present pH	6.5	6.0	5.5	5.0	4.5
	pounds of aluminum sulfate per 10 square feet				
8.0	1.8	2.4	3.3	4.2	4.8
7.5	1.2	2.1	2.7	3.6	4.2
7.0	0.6	1.2	2.1	3.0	3.6
6.5		0.6	1.5	2.4	2.7
6.0			0.6	1.5	2.1

Lime Recommendations

The main reasons for applying lime are to supply calcium or magnesium and to raise the pH to a level that optimizes the availability of phosphorus and several trace elements. Applying lime when it isn't needed or over-liming may raise the soil pH too high and induce deficiencies for micronutrients such as manganese and zinc. Crops such as soybean and corn grown on coarse-textured soils in the Coastal Plains are especially prone to this problem. Therefore, to use lime when it isn't needed may be as detrimental as not using lime when it is required. Soil testing is the only practical way to determine when to lime and at what rate. Lime requirement of a soil is based on the soil pH and the amount of exchangeable acidity. A buffer solution is used to determine exchangeable acidity.

Soil pH and the buffer pH are needed to determine the amount of lime needed to raise the soil pH to a "Target pH" (the maximum soil pH considered safe) for the crop to be grown. The soil pH values considered desirable for crops produced in South Carolina are given in Table 6, page 18. Note that the Target pH for alfalfa and short stake tomatoes in the Piedmont is 6.5. Formerly, the Target pH was 7.0. Also, for other crops not specifically cited in Table 6, including most field crops such as soybeans, corn and small grain, the Target pH is either 6.0 or 6.5. Most of these crops will grow equally well at either pH.

Table 6. Desired pH for Different Crops.

Crop	Lime if pH is Less Than	Target pH
Alfalfa and short stake tomatoes in the Piedmont	6.0	6.5
Clovers, vegetables, fruit, and nuts	6.0	6.5
Christmas trees, pines, tobacco, Irish potatoes, sweet potatoes, and centipede and carpetgrass	5.5	6.0
Azaleas, rhododendron, and camellias	5.0	6.0
All crops except those listed above	5.8	6.0 or 6.5

Note: The pH for Carolina Bays or soils with more than 10 percent organic matter should be maintained between 5.0 and 5.5.

Using a lower Target pH will result in more frequent applications of small amounts of lime, which is generally a more effective management strategy for neutralizing soil acidity. However, sometimes it is preferable to lime less frequently but use large amounts of lime. For example, when a permanent pasture or hayfield is being established, that is an opportune time to incorporate lime into the soil profile. After establishment lime applications, by necessity, must be surface applied. Since lime has very low solubility, soil acidity much below the surface cannot be easily or effectively neutralized. Also, short versus long-term lease agreements may affect the economics of scheduling lime applications. The potential for exceeding the Target pH on coarse-textured Coastal Plain soils is still another consideration. Thus there are many soil, crop and economic considerations that affect the selection of a Target pH. When in doubt about Target pH, ask your Extension agent, Certified Crop Adviser or crop consultant for advice.

The amounts of lime needed to raise the soil pH to 5.5, 6.0, 6.5 or 7.0 for a range of soil pH and buffer pH values are given on the following pages in Tables 7, 8, 9 and 10, respectively. The amounts of lime indicated are based on a soil mixing depth of 8 inches. The requirements are given in 100-pound increments. Lime recommendations are now reported to the nearest 100 pounds per acre of agricultural limestone, that is, we no longer round up to the nearest 0.5 ton because of the potential for over-liming poorly buffered soils in the Coastal Plain. For example, exceeding the actual lime requirement by several hundred pounds may raise the pH of such soils to more than 7.5, inducing micronutrient deficiencies.

In most instances it may be impractical to apply less than 0.5 to 1 ton per acre. The farmer and/or crop adviser must decide when to apply lime if the recommendation is for only a few hundred pounds per acre. In some cases it may be acceptable to round up to the nearest 0.5 ton. In other cases it may be preferable to wait until the lime recommendation is close to 0.5 ton per acre. Cost of application, difference between soil pH and target pH, and potential to induce a micronutrient deficiency in the crop to be grown are factors to be considered. If variable rate application is used, application of small amounts of lime may be practical.

The pH for Carolina Bays or soils with more than 10 percent organic matter should be maintained between 5.0 and 5.5.

Table 7. The quantity of limestone required to raise the soil pH of the surface 8 inches to 5.5 based on the Adams-Evans method.

Buffer pH	Soil pH Value										
	5.4	5.3	5.2	5.1	5.0	4.9	4.8	4.7	4.6	4.5	4.4
	pounds/acre agricultural limestone										
7.95	0	100	100	200	200	200	300	300	300	400	400
7.90	100	200	300	300	400	500	600	600	700	800	900
7.85	100	300	400	500	600	700	800	900	1000	1200	1300
7.80	200	400	500	700	800	1000	1100	1200	1400	1500	1800
7.75	200	400	700	800	1000	1200	1400	1500	1700	1900	2200
7.70	300	500	800	1000	1200	1400	1700	1900	2100	2300	2700
7.65	300	600	900	1200	1400	1700	1900	2200	2400	2700	3100
7.60	400	700	1000	1400	1600	1900	2200	2500	2800	3100	3600
7.55	400	800	1200	1500	1800	2200	2500	2800	3100	3500	4000
7.50	500	900	1300	1700	2100	2400	2800	3100	3400	3800	4500
7.45	500	1000	1400	1900	2300	2600	3000	3400	3800	4200	4900
7.40	600	1100	1600	2000	2500	2900	3300	3700	4100	4600	5400
7.35	600	1200	1700	2200	2700	3100	3600	4000	4500	5000	5800
7.30	600	1300	1800	2400	2900	3400	3900	4300	4800	5400	6300
7.25	700	1300	2000	2500	3100	3600	4100	4600	5200	5800	6700
7.20	700	1400	2100	2700	3300	3900	4400	5000	5500	6100	7100
7.15	800	1500	2200	2900	3500	4100	4700	5300	5900	6500	7600
7.10	800	1600	2300	3000	3700	4300	5000	5600	6200	6900	8000
7.05	900	1700	2500	3200	3900	4600	5200	5900	6600	7300	8500
7.00	900	1800	2600	3400	4100	4800	5500	6200	6900	7700	8900

This table is only applicable to results from Clemson University Soil Testing Laboratory.

Example: A soil pH of 4.8 and a buffer pH of 7.65 will require 1,900 pounds of lime per acre.

Table 8. The quantity of limestone required to raise the soil pH of the surface 8 inches to 6.0 based on the Adams-Evans method.

Buffer pH	Soil pH Value								
	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.4
	pounds/acre agricultural limestone								
7.95	100	100	200	300	300	400	400	500	500
7.90	100	300	400	600	700	800	900	1000	1100
7.85	200	400	700	900	1000	1200	1300	1500	1600
7.80	200	600	900	1100	1400	1600	1800	2000	2200
7.75	300	700	1100	1400	1700	2000	2200	2500	2700
7.70	300	900	1300	1700	2000	2400	2700	3000	3300
7.65	400	1000	1500	2000	2400	2800	3100	3500	3800
7.60	400	1100	1700	2300	2700	3100	3500	4000	4300
7.55	500	1300	2000	2600	3100	3500	4000	4500	4900
7.50	500	1400	2200	2800	3400	3900	4400	5000	5400
7.45	600	1600	2400	3100	3800	4300	4900	5500	6000
7.40	600	1700	2600	3400	4100	4700	5300	6000	6500
7.35	700	1900	2800	3700	4400	5100	5800	6500	7100
7.30	700	2000	3100	4000	4800	5500	6200	7000	7600
7.25	800	2100	3300	4300	5100	5900	6700	7500	8100
7.20	800	2300	3500	4500	5500	6300	7100	8000	8700
7.15	900	2400	3700	4800	5800	6700	7500	8500	9200
7.10	900	2600	3900	5100	6100	7100	8000	9000	9800
7.05	1000	2700	4100	5400	6500	7500	8400	9400	10000
7.00	1000	2800	4400	5700	6800	7900	8900	9900	10000

This table is only applicable to results from Clemson University Soil Testing Laboratory.

Table 9. The quantity of limestone required to raise the soil pH of the surface 8 inches to 6.5 based on the Adams-Evans method.

Buffer pH	Soil pH Value										
	6.4	6.2	6.0	5.8	5.6	5.4	5.2	5.0	4.8	4.6	4.4
	pounds/acre agricultural limestone										
7.95	100	200	300	300	400	400	500	500	500	600	600
7.90	100	300	500	600	800	900	900	1000	1100	1100	1300
7.85	200	500	800	1000	1100	1300	1400	1500	1600	1700	1900
7.80	300	700	1000	1300	1500	1700	1900	2000	2200	2300	2500
7.75	300	900	1300	1600	1900	2100	2300	2500	2700	2900	3100
7.70	400	1000	1500	1900	2300	2600	2800	3000	3200	3400	3800
7.65	500	1200	1800	2300	2700	3000	3300	3500	3800	4000	4400
7.60	500	1400	2000	2600	3000	3400	3700	4000	4300	4600	5000
7.55	600	1500	2300	2900	3400	3800	4200	4600	4900	5200	5600
7.50	700	1700	2600	3200	3800	4300	4700	5100	5400	5700	6300
7.45	700	1900	2800	3600	4200	4700	5200	5600	5900	6300	6900
7.40	800	2100	3100	3900	4600	5100	5600	6100	6500	6900	7500
7.35	900	2200	3300	4200	4900	5600	6100	6600	7000	7500	8100
7.30	900	2400	3600	4500	5300	6000	6600	7100	7600	8000	8800
7.25	1000	2600	3800	4800	5700	6400	7000	7600	8100	8600	9400
7.20	1000	2800	4100	5200	6100	6800	7500	8100	8600	9200	10000
7.15	1100	2900	4300	5500	6400	7300	8000	8600	9200	9800	10000
7.10	1200	3100	4600	5800	6800	7700	8400	9100	9700	10000	10000
7.05	1200	3300	4900	6100	7200	8100	8900	9600	10000	10000	10000
7.00	1300	3400	5100	6500	7600	8500	9400	10000	10000	10000	10000

This table is only applicable to results from Clemson University Soil Testing Laboratory.

Table 10. The quantity of limestone required to raise the soil pH of the surface 8 inches to 7.0 based on the Adams-Evans method.

Buffer pH	Soil pH Value												
	6.9	6.7	6.5	6.3	6.1	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.5
	pounds/acre agricultural limestone												
7.95	100	200	300	400	500	500	500	600	600	600	600	700	700
7.90	200	500	700	800	900	1000	1100	1100	1200	1200	1300	1300	1400
7.85	300	700	1000	1200	1400	1500	1600	1700	1800	1900	1900	2000	2000
7.80	400	900	1300	1600	1800	2000	2200	2300	2400	2500	2600	2600	2700
7.75	500	1200	1700	2000	2300	2500	2700	2800	3000	3100	3200	3300	3400
7.70	600	1400	2000	2400	2800	3000	3200	3400	3600	3700	3800	4000	4100
7.65	700	1700	2300	2800	3200	3500	3800	4000	4200	4300	4500	4600	4800
7.60	800	1900	2700	3200	3700	4000	4300	4600	4800	4900	5100	5300	5400
7.55	900	2100	3000	3600	4100	4500	4900	5100	5400	5600	5700	5900	6100
7.50	1000	2400	3300	4000	4600	5000	5400	5700	5900	6200	6400	6600	6800
7.45	1100	2600	3700	4500	5100	5500	5900	6300	6500	6800	7000	7200	7500
7.40	1200	2800	4000	4900	5500	6000	6500	6800	7100	7400	7700	7900	8200
7.35	1300	3100	4300	5300	6000	6500	7000	7400	7700	8000	8300	8600	8800
7.30	1300	3300	4700	5700	6400	7000	7500	8000	8300	8600	8900	9200	9500
7.25	1400	3500	5000	6100	6900	7500	8100	8500	8900	9300	9600	9900	10000
7.20	1500	3800	5300	6500	7400	8000	8600	9100	9500	9900	10000	10000	10000
7.15	1600	4000	5700	6900	7800	8600	9200	9700	10000	10000	10000	10000	10000
7.10	1700	4300	6000	7300	8300	9100	9700	10000	10000	10000	10000	10000	10000
7.05	1800	4500	6300	7700	8700	9600	10200	10000	10000	10000	10000	10000	10000
7.00	1900	4700	6700	8100	9200	10000	10000	10000	10000	10000	10000	10000	10000

This table is only applicable to results from Clemson University Soil Testing Laboratory.

Manure Utilization as a Crop Nutrient Source

Manure should be managed based on its content of plant-available nutrients. Nutrient content of manure varies depending on several factors including the source, moisture content, the amount of bedding or other material that is mixed with the manure, and whether the manure has been composted. A composite sample should be analyzed for its nutrient content to determine the amount of plant-available nutrients, which is needed to determine the appropriate application rate. As with other nutrient sources, including inorganic commercial fertilizers, the application rate should be based on soil test results and accompanying nutrient recommendations.

If manure is used as the sole source of plant nutrients, soil phosphorus levels will gradually increase and after several years are likely to reach very high levels. In such situations soil enriched with phosphate can be moved by drainage waters into surface waters causing water quality problems. Very high levels of soil test phosphorus can be avoided by basing manure applications on phosphorus rather than nitrogen before the soil phosphorus levels reach the Very High level. As a result of concerns about water quality, among other things, operators of confined animal facilities are required to develop comprehensive nutrient management plans. These plans along with monitoring requirements, ceiling concentrations and soil loading with respect to copper and zinc are described in Regulation 61-43, *Standards for the Permitting of Agricultural Animal Facilities*, dated June 26, 1998, applies to swine and other animal facilities.

Land Application of Nonagricultural Wastes as Crop Nutrient Sources

Regulations

Many wastes—including agricultural, industrial and municipal—are suitable for application to crop land so that their nutrient contents can be recycled naturally. In addition, land application of nonhazardous wastes has many environmental advantages compared to land filling and other disposal methods that fail to capture useful resources present in these wastes. Manure and other agricultural wastes have been land applied since agriculture began. However, land application of nonagricultural wastes is relatively new, and special regulations that ensure public and environmental health and safety have been developed.

Sewage sludge, also called “wastewater biosolids,” and many industrial sludges and wastes contain nitrogen and other plant nutrients that can be used by crops, including lawns and gardens. The South Carolina Department of Health and Environmental Control (DHEC) regulates land application of sewage sludges and nonhazardous solid wastes in South Carolina. DHEC’s guidelines for sludge are presented in *Beneficial Use of Wastewater Biosolids* dated February 1996. The state regulations covering land application of solid wastes were covered by regulation R. 61-107.15, *Solid Waste Management: Land Application of Solid Waste*.

The regulations and guidelines for land application of wastes are designed to protect human health and the environment while allowing for beneficial recovery of plant nutrients. The regulatory requirements and guidelines are described in the publications mentioned above. In this publication we address only the nutrient management aspects of land application of wastes that are declared by DHEC to be nonhazardous and therefore appropriate for land application. In many cases, waste management plans stipulate waste application rates based on the agronomic considerations described in this publication.

Nutrient Management

From the standpoint of nutrient management practices, wastes should be managed with the same considerations as for fertilizer, lime and other nutrient sources with regards to nitrogen rate, time of application and maintenance of soil pH. Wastes should be applied so as not to exceed the agronomic rate.

Agronomic rate has been defined in government regulations as the amount of waste that will provide all the nitrogen needs of the crop (in South Carolina that means the nitrogen recommendations given in this publication), while minimizing the amount of nitrogen that leaches below the root zone to groundwater. Waste must be chemically analyzed to determine its nitrogen content and the concentrations of several other constituents that may affect the application rate.

The agronomic rate for wastes such as lime-stabilized sewage sludge and alkaline wastes that have significant liming potential is determined by the lime requirement of the soil and the calcium carbonate equivalent of the waste. In special cases agronomic rate may be determined by soluble salts, boron concentration or the sodium content of the waste. Soil pH should be monitored and care taken not to allow over-liming when alkaline- or lime-stabilized sludges are applied. If soil pH raises above much above 6.5, zinc and manganese deficiencies may become a problem. Consult your local Extension office if you need assistance in determining the agronomic rate for waste applications.

When nitrogen determines the agronomic rate, wastes should be applied at rates according to Clemson's crop-specific recommendations for nitrogen as given in this book. For wastes that have significant liming potential, agronomic rate is determined by the lime equivalent and the lime requirement of the soil to which the waste will be applied.

Regarding nitrogen, sewage sludge and similar biosolids contain nitrogen in both organic and inorganic forms. Most of the nitrogen in sludge is in the organic form, which is unavailable to plants until it is converted to inorganic nitrogen. All of the inorganic nitrogen is considered plant-available nitrogen (PAN). Most of the inorganic nitrogen is in the form of ammonium and ammonia. Ammonia nitrogen is subject to loss by volatilization. Losses of ammonia are greater for alkaline material left on the surface. Injection below the soil surface minimizes ammonia losses. Estimates of volatilization losses for three methods of application are as follows:

Application Method	Ammonia Volatilization Factor
Surface spreading	0.50
Surface spreading followed by incorporation	0.75
Subsurface injection	1.00

The ammonia (includes ammonium) concentration is multiplied by the ammonia volatilization factor to obtain the percentage of ammonium that will be PAN.

Small amounts of nitrate, another inorganic form of nitrogen, are present in sludge. All nitrate is PAN. Ammonium and ammonia in soil are converted to nitrate by naturally occurring microorganisms within a few days to a few weeks depending on soil temperature and moisture. A portion of the organic nitrogen is mineralized, converted to an inorganic form as the organic compounds in sludge are decomposed, and thus becomes available during the growing season after sludge is applied to the land. The inorganic ammonium, ammonia and nitrate produced during decomposition of the organic substances in sludge are identical to the ammonium, ammonia and nitrate found in commercial fertilizers. However, there is a major uncertainty in estimating the mineralization rate of the organic forms and therefore the agronomic rate. An estimate of the mineralization rate is needed to calculate the PAN and subsequently the agronomic rate for the sludge application. The following are crude estimates of mineralization rates for various sludges:

Treatment Process	Mineralization Factor
Unstabilized primary and waste activated sludges	0.4
Alkaline stabilized	0.3
Aerobically digested	0.3
Anaerobically digested	0.2
Composted	0.1

Nitrogen is reported as percent total Kjeldahl nitrogen (%TKN). The TKN includes both the organic and inorganic forms of nitrogen. The nitrate and ammonium nitrogen concentrations are subtracted from TKN to obtain the organic nitrogen concentration. The organic nitrogen concentration must be multiplied by the mineralization factor to obtain the contribution of organic nitrogen to the PAN. For example, percent PAN from the organic fraction (percent mineralized during the growing season) is:

mineralized organic nitrogen = mineralization factor X (%TKN - % nitrate - % ammonium)

The three sources of nitrogen — 1) nitrate, 2) ammonium (adjusted for volatilization) and 3) organic nitrogen subject to mineralization — are added to obtain the % PAN for the sludge. Following is an sample calculation for an aerobically digested sludge found to be a) 0.5 percent nitrate, b) 0.8 percent ammonium and c) 5.75 percent TKN. In this example the sludge was surface spread, then immediately incorporated:

From above, the mineralization factor for aerobically digested sludge is 0.3 and the ammonia volatilization factor under these conditions is 0.75; therefore,

% PAN =	nitrate	+ ammonia adjusted for volatilization		+ organic nitrogen to be mineralized	
=	0.5%	+	0.8% X 0.75	+	(5.75% - 0.5% - 0.8%) X 0.3
=	0.5%	+	0.6%	+	4.45% X 0.3
% PAN =	2.435% or 48.7 pounds per dry ton				

How much PAN is needed? PAN requirements vary depending on the crop. If the nitrogen recommendation for a crop were 100 lb/acre, then the amount of sludge needed to supply that amount of nitrogen would be 100 lb nitrogen /48.7 lb nitrogen per ton or 2.05 tons/acre. The application rate determined by this calculation
is appropriate for determining the agronomic rate for sludge applications when nitrogen is the rate determining factor. In other cases, such as lime stabilized sludge, which has a high acid neutralizing power, the lime requirement of the soil and the neutralizing power of the sludge will determine the application rate.

What Farmers and Crop Advisers Need to Know

In most cases sewage sludge or biosolids from wastewater treatment plants will be dealt with just as agricultural wastes or fertilizer, with a couple of exceptions. The waste generator and waste hauler/applicator are responsible for obtaining the necessary permits and approvals as well as keeping records as required by the regulations. The regulatory and permitting process provides assurance that the waste is suitable for land application and that the methods, including timing of application and the agronomic rate, are appropriate for the conditions that exist. Regarding the timing of applications, the same nutrient management practices used for commercial fertilizers and manure apply to sewage sludge since the same soil and crop management principles and soil processes are involved. Generally, farmers and crop advisers will be more knowledgeable about agronomic and horticultural practices than the waste applicator will be.

Records

The waste generator and the waste applicator (the permittee) must keep certain records regarding the chemical analyses of wastes, land used for application, dates of application, and an inventory of metal loading of soil. These historical records are vital to successful implementation of the regulations and making sure that the assumptions made in the risk analyses are applicable. Farmers are not required to maintain such records but we recommend that they maintain copies of the waste analyses data sheets that generators and haulers are required to provide the landowner or operator, as well as records of fields that were treated and the soil-test results.

Lime-stabilized Sludge

Lime-stabilized sludge has significant lime equivalent. Consequently, the application rate must be based on its alkalinity, measured by its equivalency to calcium carbonate, and the lime requirement of the soil. Application of lime-stabilized sludges can be made only each three to five years depending on the soil pH and the lime requirement as determined by a soil test. Obviously, soil testing becomes a vital step in scheduling applications. The same will be true for some solid wastes, such as paper mill wastes and some coal or wood ashes, if they have significant alkalinity.

Other Limiting Factors

In some instances, as with poultry litter and other animal wastes, waste management/nutrient management plans limit application rates if soil test phosphorus concentrations become too large. Also, the DHEC guidance manual for land application of sewage sludge, sometimes referred to as "biosolids", indicates that application must cease if loading of nitrate within the upper 4-feet of soil reaches 200 pounds per acre and remains at that level for more than one year.

Setbacks

Fertilizer may be applied to the "fence line" without regard to property boundaries, roads, and social concerns. The same is not true for sewage sludge, manure and other wastes. Buffer zones, or setbacks, around property boundaries, roadways, drainage ways, surface waters and residential areas significantly limit land that can
be treated.

Social Considerations

Social concerns can be major obstacles to effective use of wastes as crop nutrient sources, especially if concerns are ignored. Farmers and crop advisers will probably not become involved in estimating application rates or permitting. However, as agricultural leaders in the community, they may receive questions from other farmers, neighbors of farmers who utilize sewage sludge, concerned citizens, county council members, and even those directly involved in the permitting and regulatory process such as wastewater treatment plant engineers and commercial applicators. Each individual may be viewing the issue from a different perspective and have substantial misinformation. Our purpose here is to provide some background information to help farmers and crop advisers respond to these concerns. Be aware of the degree of environmental and health protection provided by the regulatory and permitting process and use this information to correct misunderstandings about the land application of sewage sludge and other wastes.

Land application is a preferred way to deal with many wastes. It is preferred to placement in a land-fill, incineration or some other disposal method that fails to capture the beneficial value and which may lead to unnecessary pollution of soil, air or water. The regulations that have been developed protect health and the environment. If the regulations are followed there should be no problem. If the regulations are not followed, the consequences may range from annoyance and anti-propaganda to shutting down land application programs.

Waste Management for Forest Areas

Land areas under forest or woodlands are not normally fertilized like other agronomic or horticultural crops. However, these sites offer opportunity to land-apply and recycle organic and inorganic wastes on a large scale. In so doing, productivity of forest products can be increased. Wastes — including poultry, dairy, organic, biosolids, domestic, and industrial — can be applied to the forest lands, based on sound management practices that meet environmental regulations.

Application periods and quantities vary based on the types of soil and trees and the annual cycle of temperature and moisture. Application schedules should be based on the nutritional needs of the tree types, soil pH,
constituent analysis of the wastes, metal loading capacities of the soil and equipment accessibility for spreading the material. Sufficient tree-spacing may be considered if newly establishing a forest land for facilitating future waste recycling efforts. Soil type should be considered because of potential leaching of nitrogen or other contaminants. Landscape factors like slope are also important for erosion control. Generally, applications can be made year-round for pine trees, but for hardwoods, applications should be restricted to the warm periods between February and October.

The following soil pH ranges are recommended:

Pine trees.....5.0 - 6.5
Hardwood or other trees..5.8 - 6.5

Applications are preferred on sites with five to 10 years of tree stand, with trees growing vigorously and ready to close at the crown level. This will ensure maximum nutrient uptake by the plants. It is recommended that 80 percent of the forest floor be covered with greater than 1/2 inch of leaf litter to reduce runoff and erosion potential. Depth to seasonal high water should be considered, as is done in the case of agricultural sites. Periods of excessive soil moisture should be avoided to prevent soil compaction.

An effective monitoring plan should be developed based on crop needs and landowner management objectives. This is very important in order to ensure compliance with all the environmental regulations. For further help, contact your local Extension agent or faculty in the Department of Forest and Recreation Resources or Soils & Land Resources at Clemson University.

Summary

- Metals, pathogens and vector attraction reduction will not be problems if regulations are followed.
- Keep records of waste analyses, soil test data, and dates and amounts of applications.
- Request the waste applicator to have soils analyzed for metal content before application is made if repeated applications are planned. This will provide documentation of the initial soil concentrations and will be useful for diagnostic purposes should problems arise.

References and Documentation

A Plain English Guide to the EPA Part 503 Biosolids Rule. EPA/832/R-93/003. September 1994. U.S. Environmental Protection Agency. Washington, DC.

Beneficial Use of Wastewater Biosolids. South Carolina Department of Health & Environmental Control and Clemson University. February 1996.

40 Code of Federal Regulations, Part 503B, *Standards for the Use or Disposal of Sewage Sludge*. Federal Register Volume 58, No. 32, Friday, February 19, 1993. Available from the National Technical Information Service.

SC DHEC South Carolina Regulation 61-107. *Solid Waste Management: Land Application of Solid Waste*. July 26, 1996.

Solid Waste Policy and Management Act of 1991. S. C. Code 4-96-10. Available from DHEC.

SC DHEC South Carolina Regulation 61-43, *Standards for the Permitting of Agricultural Animal Facilities*

State regulations relating to animal waste and other wastes can be viewed, and in many cases downloaded, from the DHEC water website, accessed from the agency's Environmental Home Page: *http://www.state.sc.us/dhec/eqc*.

NUTRIENT MANAGEMENT PRACTICES FOR AGRONOMIC CROPS

Crop Code No. 050

Alfalfa

Soil Groups 3 or 4				Desired pH 6.0-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	0-240-300	0-240-200	0-240-100	0-240-0
Low	0-200-300	0-200-200	0-200-100	0-200-0
Medium	0-100-300	0-100-200	0-100-100	0-100-0
High	0- 0-300	0- 0-200	0- 0-100	0- 0-0
Very High	0- 0-300	0- 0-200	0- 0-100	0- 0-0

49–When alfalfa is being established, lime and phosphorus should be applied and worked into the soil prior to planting. Maintenance fertilizer applications and lime, if needed, should be applied in the spring. If the pH is below 6.5, the recommended rate of lime should be at least 1 ton per acre. It may be possible to extend the life of an alfalfa stand by applying recommended potassium in two equal applications, one-half in the spring, and one-half after the third harvest. Seed should be inoculated. Three pounds of actual boron per acre should be applied annually.

Crop Code No. 007

Annual Legumes (Arrowleaf, Yuchi, Crimson, etc.)

Soil Groups 1, 2, 3 or 4				Desired pH 6.0-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	0-120-100	0-120-40	0-120-0	0-120-0
Low	0- 80-100	0- 80-40	0- 80-0	0- 80-0
Medium	0- 50-100	0- 50-40	0- 50-0	0- 50-0
High	0- 0- 100	0- 0-40	0- 0-0	0- 0-0
Very High	0- 0- 100	0- 0-40	0- 0-0	0- 0-0

48–Apply 1½ pounds per acre of actual boron for reseeding or clover seed harvest. 50–Seed should be inoculated.

Crop Code No. 005

Annual Legumes (Arrowleaf, Yuchi, Crimson, etc.) on Summer Grass Pasture (Bahia, Dallis or Bermudagrass)

Soil Groups 1, 2, 3 or 4				Desired pH 6.0-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	0-120-80	0-120-40	0-120-0	0- 120-0
Low	0- 80-80	0- 80-40	0- 80-0	0- 80-0
Medium	0- 40-80	0- 40-40	0- 40-0	0- 40-0
High	0- 0-80	0- 0-40	0- 0-0	0- 0- 0
Very High	0- 0-80	0- 0-40	0- 0-0	0- 0- 0

48–Apply 1½ pounds per acre of actual boron for reseeding or clover seed harvest. 50–Seed should be inoculated.

Crop Code No. 006

Annual Legumes (Arrowleaf, Yuchi, Crimson, etc.)
on Winter Grass Pasture (Ryegrass and/or Small Grain)

Soil Groups 1, 2, 3 or 4				Desired pH 6.0-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	60-120-100	60-120-60	60-120-0	60-120-0
Low	60-100-100	60-100-60	60-100-0	60-100-0
Medium	60- 60-100	60- 60-60	60- 60-0	60- 60-0
High	60- 0-100	60- 0-60	60- 0-0	60- 0-0
Very High	60- 0-100	60- 0-60	60- 0-0	60- 0-0

41–Total recommended nitrogen should be split into three equal applications for best results when ryegrass and crimson clover are used. No more than 50 pounds of nitrogen should be used in early fall. A third application of nitrogen in the spring will increase total yield and length of grazing period when ryegrass is present. When arrowleaf clover or hairy vetch is seeded with small grain, all the recommended nitrogen should be applied at planting.
50–Seed should be inoculated.

Crop Code No. 035

Coastal Bermudagrass, Establishing

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	60-150-100	60-150-50	60-150-0	60-150-0
Low	60-100-100	60-100-50	60-100-0	60-100-0
Medium	60- 50-100	60- 50-50	60- 50-0	60- 50-0
High	60- 0-100	60- 0-50	60- 0-0	60- 0-0
Very High	60- 0-100	60- 0-50	60- 0-0	60- 0-0

42–Recommended phosphorus and lime should be applied during land preparation and worked into the soil. Recommended nitrogen and potassium should be applied at time of sprigging and additional nitrogen, if needed, should be applied after clipping.

Crop Code No. 033 or 034

Coastal Bermudagrass (034) **or Bahiagrass** (033) **Pasture**

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	150-100-80	150-100-40	150-100-0	150-100-0
Low	150- 80-80	150- 80-40	150- 80-0	150- 80-0
Medium	150- 40-80	150- 40-40	150- 40-0	150- 40-0
High	150- 0-80	150- 0-40	150- 0-0	150- 0-0
Very High	150- 0-80	150- 0-40	150- 0-0	150- 0-0

47–Apply 60 pounds of nitrogen per acre and the recommended rate of phosphorus and potassium in the spring before growth begins, and repeat nitrogen applications as required to produce sufficient forage up to September. If stocking rate changes, adjust nitrogen rate accordingly.

Crop Code No. 036

Coastal Bermudagrass or Bahiagrass for Hay

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	240-150-200	240-150-100	240-150-0	240-150-0
Low	240-100-200	240-100-100	240-100-0	240-100-0
Medium	240- 50-200	240- 50-100	240- 50-0	240- 50-0
High	240- 0-200	240- 0-100	240- 0-0	240- 0-0
Very High	240- 0-200	240- 0-100	240- 0-0	240- 0-0

45–Nitrogen rates can be varied from 240 to 400 pounds of nitrogen per acre. Apply 60 to 100 pounds of nitrogen per acre in the spring before growth begins and 60 to 100 pounds of nitrogen per acre after each harvest. If rainfall is normal, 240 pounds per acre should produce 4 to 5 tons of hay per acre with four harvests and the 400 pounds-per-acre rate should produce 6 to 7 tons per acre on good coastal sod. Reduce chances of winterkill by applying one-half of the potassium recommendation after the second or third cutting. All phosphorus should be applied in the spring or at the time of potassium application.

Crop Code No. 104

Canola

Soil Groups 1, 2, 3 4 or 6				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	160-100-80	160-100-40	160-100-0	160-100-0
Low	160- 80-80	160- 80-40	160- 80-0	160- 80-0
Medium	160- 40-80	160- 40-40	160- 40-0	160- 40-0
High	160- 0-80	160- 0-40	160- 0-0	160- 0-0
Very High	160- 0-80	160- 0-40	160- 0-0	160- 0-0

550–Apply 30 to 40 pounds of nitrogen per acre in the spring at planting; the balance of the nitrogen should be applied in two separate applications: apply one-half 90 days after planting and the second half 30 days later. The total rate of nitrogen for canola following a legume should be 135 pounds per acre. Apply 1 pound per acre of boron with the last nitrogen application.
9–For Soil Groups 1 or 2, fertilizer should contain sufficient sulfur to supply 10 pounds of sulfur per acre.

Crop Code No. 020

Corn, Grain

Soil Groups 1, 2, 3, 4 or 6				pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	120-100-80	120-100-50	120-100-0	120-100-0
Low	120- 80-80	120- 80-50	120- 80-0	120- 80-0
Medium	120- 50-80	120- 50-50	120- 50-0	120- 50-0
High	120- 0 -80	120- 0-50	120- 0-0	120- 0-0
Very High	120- 0 -80	120- 0-50	120- 0-0	120- 0-0

16–The most profitable nitrogen rate depends on rainfall (unless irrigated), soil productivity, temperature, plant population and cultural practices. For unirrigated corn, 120 pounds per acre is suggested for most areas of the state. For very sandy soils that have a yield potential of 80 bushels per acre or less, 100 pounds of nitrogen per acre is adequate. In river bottoms or locations where the yields of 130 bushels per acre or more are often obtained, it may desirable to use 150 pounds of nitrogen per acre. 17–At planting 30 pounds of nitrogen per acre should be applied. Best results are obtained when it is banded by the row. Balance of nitrogen should be applied as sidedressing when the plants are 18 to 30 inches high. When following soybeans or other legumes in rotation, reduce the rate by 20 to 30 pounds per acre.
18–On sandy and coarse loamy soils, when soil pH is above 6.5, 3 to 5 pounds per acre of zinc application is recommended. The plant analysis program is the best method to determine when zinc should be included in the fertilizer program.

Crop Code No. 021

Corn in Rotation before Peanuts or Soybeans

Soil Groups 3, 4 or 6				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	120-140-120	120-140-60	120-140-40	120-140-0
Low	120-120-120	120-120-60	120-120-40	120-120-0
Medium	120- 60-120	120- 60-60	120- 60-40	120- 60-0
High	120- 30-120	120- 30-60	120- 30-40	120- 30-0
Very High	120- 0-120	120- 0-60	120- 0-40	120- 0-0

16–The most profitable nitrogen rate depends on rainfall (unless irrigated), soil productivity, temperature, plant population and cultural practices. For unirrigated corn, 120 pounds of nitrogen per acre is suggested for most areas of the state. For very sandy soils that have a yield potential of 80 bushels per acre or less, 100 pounds of nitrogen per acre is adequate. In river bottoms or locations where the yields of 130 bushels per acre or more are often obtained, it may desirable to use 150 pounds of nitrogen per acre. 17–At planting 30 pounds of nitrogen per acre should be applied. Best results are obtained when it is banded by the row. Balance of nitrogen should be applied as sidedressing when the plants are 18 to 30 inches high. 15–When following soybeans or other legumes in rotation, reduce the rate by 20 to 30 pounds per acre.

If the recommended amounts of phosphorus and potassium are applied, no additional phosphorus or potassium should be needed the following year for peanuts or soybeans.
18–On sandy and coarse loamy sands (Soil Groups 1 and 2), apply 3 to 5 pounds per acre of zinc if the soil pH is above 6.5 or if zinc deficiency has been diagnosed previously. Plant tissue testing is the best way to determine when zinc should be included in the fertility program.

Crop Code No. 022

Corn, Irrigated

Soil Groups 1, 2, 3, 4 or 6				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	200-120-100	200-120-60	200-120-30	200-120-0
Low	200-100-100	200-100-60	200-100-30	200-100-0
Medium	200- 60-100	200- 60-60	200- 60-30	200- 60-0
High	200- 30-100	200- 30-60	200- 30-30	200- 30-0
Very High	200- 0-100	200- 0-60	200- 0-30	200- 0-0

21–When irrigated, most profitable nitrogen rate depends on soil productivity, temperature, plant population and cultural practices. A rate of 180 to 220 pounds of nitrogen per acre is recommended for irrigated corn. A preplant or at-planting rate of 30 pounds of nitrogen per acre is recommended and best results are obtained when banded by the row. The balance may be applied as a sidedress when the corn is 18 to 30 inches tall, or in three or four equal rates with irrigation beginning when the corn is 18 inches high at seven- to 10-day intervals.
9–For irrigated corn grown on soils of code 1 and 2 (soils with a deep sandy surface with the clay layer at 20 inches or more), fertilizer should contain sufficient sulfur to supply 10 pounds per acre of sulfur. 18–On sandy and coarse loamy sands (Soil Groups 1 and 2), apply 3 to 5 pounds per acre of zinc if the soil pH is above 6.5 or if zinc deficiency has been diagnosed previously. Use the plant analysis program to ensure that plants contain adequate levels of all nutrients. Nutrients that are deficient can be sidedressed or added in the irrigation water. Contact your local county agent for additional information.

Crop Code No. 023

Corn for Silage

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	180-120-100	180-120-50	180-120-0	180-120-0
Low	180-100-100	180-100-50	180-100-0	180-100-0
Medium	180- 50-100	180- 50-50	180- 50-0	180- 50-0
High	180- 0- 100	180- 0-50	180- 0-0	180- 0-0
Very High	180- 0- 100	180- 0-50	180- 0-0	180- 0-0

17–At planting 30 pounds of nitrogen per acre should be applied. Best results are obtained when it is banded by the row. Balance of nitrogen should be applied as sidedressing when the plants are 18 to 30 inches high. When following soybeans or other legumes in rotation, reduce the rate by 20 to 30 pounds per acre. 18–On sandy and coarse loamy soils, if zinc deficiency has been diagnosed previously or if the soil pH is above 6.5, zinc at the rate of 3 to 5 pounds per acre should be applied. Plant tissue analysis is strongly recommended to determine zinc deficiency or toxicity.
20–If grown for silage for more than a year in the same field, and soil test showed that potassium levels are very low or low, then K_2O rate should be increased to 200 pounds per acre after the first year. 19–Similarly if soil test potassium levels are in the medium range, then K_2O rate should be increased to 100 pounds per acre when silage is grown for more than a year on the same field.

Crop Code No. 031 or 032

Cool-Season Perennial Grass Pasture (Fescue [031] **or Orchardgrass** [032]**)**

Soil Groups 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	100-100-80	100-100-40	100-100-0	100-100-0
Low	100- 80-80	100- 80-40	100- 80-0	100- 80-0
Medium	100- 40-80	100- 40-40	100- 40-0	100- 40-0
High	100- 0-80	100- 0-40	100- 0-0	100- 0-0
Very High	100- 0-80	100- 0-40	100- 0-0	100- 0-0

53–The profitable nitrogen rate for fescue or orchardgrass pastures may range from 60 to 160 pounds per acre depending on stocking rate and forage needs. Apply one-half or not more than 80 pounds of nitrogen in late August and the balance in February. If stocking rate is reduced, adjust nitrogen rate accordingly.
54–Apply all the phosphorus and potassium in the fall.

Crop Code No. 001

Cotton

Soil Groups 1, 2, 3 or				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	70-140-100	70-140-60	70-140-0	70-140-0
Low	70-100-100	70-100-60	70-100-0	70-100-0
Medium	70- 60-100	70- 60-60	70- 60-0	70- 60-0
High	70- 0- 100	70- 0- 60	70- 0- 0	70- 0- 0
Very High	70- 0- 100	70- 0- 60	70- 0- 0	70- 0- 0

10–The nitrogen rate should be decreased by 20 to 30 pounds per acre on land where excessive growth has caused problems with late maturity or boll rot. In contrast, where vegetative growth has been inadequate, increase the nitrogen rate by 20 to 30 pounds per acre. When cotton follows soybeans or other legume in rotation, reduce nitrogen rate by 20 to 30 pounds per acre. Apply one-fourth to one-third of the nitrogen at planting and the balance as a sidedressing. Sidedressing should be applied by June 15. If it is necessary to apply after July 1, it would be desirable to use a nitrate source applied at low rates (10 to 15 pounds of nitrogen per acre).
11, 12–Fertilizer should supply 10 pounds per acre of sulfur and 0.4 pound per acre of boron. As an alternative, boron may be supplied in the insecticide in one or more applications so long as the total amount applied does not exceed 1.0 pound per acre of boron. 13–Apply 5 to 15 pounds per acre of manganese when the soil pH is greater than 6.2 and manganese deficiency has been observed in the field in previous years. This manganese deficiency problem usually occurs on the following soil series: Coosaw, Ocilla, Pelham, Williman, Chewacla, Lynchburg, Yemassee, Myatt, Ogeechee, Rains, Wadmalah, Wehadkee or Yonges. If manganese deficiency symptoms occur and are confirmed by plant analysis, manganese may be applied as a foliar spray either alone or mixed with a pesticide. In such cases, make one or two applications of 1 or 2 pounds per acre of actual manganese. Contact your county agent for additional information. 61–Apply 10 to 15 pounds per acre of magnesium with fertilizer if no lime is recommended and magnesium according to soil test is less than 50 pounds per acre.

Crop Code No. 037

Cool-Season Perennial Grass-Legume Pasture

Soil Groups 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	0-120-100	0-120-50	0-120-0	0-120-0
Low	0-100-100	0-100-50	0-100-0	0-100-0
Medium	0- 50-100	0- 50-50	0- 50-0	0- 50-0
High	0- 0-100	0- 0-50	0- 0-0	0- 0-0
Very High	0- 0-100	0- 0-50	0- 0-0	0- 0-0

54–If less than one-third of the ground cover is legume, apply 60 pounds of nitrogen per acre in late August and again in the spring for additional production. Nitrogen is not required when ground cover with legumes is more than one-third of the area. Stocking rate should be adequate to consume forage as it is produced on grass-legume pastures.

Crop Code No. 010 or 011

Common Lespedeza (010) **or Sericea Lespedeza** (011)

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	0-100-80	0-100-40	0-100-0	0-100-0
Low	0- 80-80	0- 80-40	0- 80-0	0- 80-0
Medium	0- 40-80	0- 40-40	0- 40-0	0- 40-0
High	0- 0-80	0- 0 -40	0- 0-0	0- 0-0
Very High	0- 0-80	0- 0-40	0- 0-0	0- 0-0

37–The recommended fertilizer should be sufficient for two years when available potassium level from soil test is less than 157 pounds per acre and available phosphorus levels are 61 pounds per acre or less for Soil Groups 1, 2 and 3, or less than 41 pounds per acre on Soil Group 4.
38–When establishing a new stand, 20 pounds of nitrogen per acre should be applied.

Crop Code No. 025, 026, 027 or 028

Grain Sorghum (025)**, Sweet Sorghum** (026)**, Sugarcane** (027) **or Sunflowers** (028)

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	100-100-80	100-100-50	100-100-0	100-100-0
Low	100- 80-80	100- 80-50	100- 80-0	100- 80-0
Medium	100- 50-80	100- 50-50	100- 50-0	100- 50-0
High	100- 0-80	100- 0-50	100- 0-0	100- 0-0
Very High	100- 0-80	100- 0-50	100- 0-0	100- 0-0

34–Apply one-half of the nitrogen at planting and the remainder as a sidedressing. 12–For sunflowers, apply 0.4 pound per acre of boron but not more than 1.0 pound per acre either with fertilizer or in pesticide.

Crop Code No. 008

Peanuts

Soil Groups 1, 2 or 3			Desired pH 5.8-6.5	
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	0-100-80	0-100-40	0-100-0	0-100-0
Low	0- 80-80	0- 80-40	0- 80-0	0- 80-0
Medium	0- 40-80	0- 40-40	0- 40-0	0- 40-0
High	0- 0-80	0- 0-40	0- 0-0	0- 0-0
Very High	0- 0-80	0- 0-40	0- 0-0	0- 0-0

50–Seed should be inoculated if peanuts have not been grown on the field within the past three years. 29–Potash fertilizer should be broadcast and worked into the soil prior to planting. Apply 0.3 to 0.5 pound per acre of actual boron with fertilizer or with insecticides. 30–For Virginia-type peanuts apply 600 to 800 pounds per acre of gypsum in a 16- to 18-inch band over the row or broadcast 1,200 to 1,600 pounds per acre at blooming time. For Spanish and runner types, band 400 to 500 pounds per acre of gypsum or broadcast 800 to 1,000 pounds per acre of gypsum.

Crop Code No. 029

Small Grain

Soil Groups 1, 2, 3, 4 or 6			Desired pH 5.8-6.5	
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	80-100-80	80-100-40	80-100-0	80-100-0
Low	80- 80-80	80- 80-40	80- 80-0	80- 80-0
Medium	80- 40-80	80- 40-40	80- 40-0	80- 40-0
High	80- 0-80	80- 0-40	80- 0-0	80- 0-0
Very High	80- 0-80	80- 0-40	80- 0-0	80- 0-0

35–When grazing is not intended, all of the recommended lime and other fertilizers and 20 to 30 pounds of nitrogen per acre should be applied at planting; the balance of the nitrogen should be applied as a top-dressing in early February. The total rate of nitrogen for wheat following a legume should be 80 pounds per acre. In other cases, a rate of 80 to 100 pounds per acre can be used. If used for grazing, 60 to 100 pounds of nitrogen per acre should be applied in the fall at planting and an additional 60 to 100 pounds of nitrogen per acre in February. Higher rates should be used for above normal stocking rates. 9–For Soil Groups 1 or 2, fertilizer should contain sufficient sulfur to supply 10 pounds of sulfur per acre.

Crop Code No. 030

Small Grain in Rotation before Peanuts or Soybeans

Soil Groups 1, 2, 3, 4 or 6				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	80-150-150	80-150-75	80-150-0	80-150-0
Low	80-100-150	80-100-75	80-100-0	80-100-0
Medium	80- 80-150	80- 80-75	80- 80-0	80- 80-0
High	80- 0-150	80- 0-75	80- 0-0	80- 0-0
Very High	80- 0-150	80- 0-75	80- 0-0	80- 0-0

35–When grazing is not intended, all of the recommended lime and other fertilizers and 20 to 30 pounds of nitrogen per acre should be applied at planting; the balance of the nitrogen should be applied as a top-dressing in early February. The total rate of nitrogen for wheat following a legume should be 80 pounds per acre. In other cases, a rate of 80 to 100 pounds per acre can be used. If used for grazing, apply 60 to 100 pounds of nitrogen per acre in the fall at planting and an additional 60 to 100 pounds of nitrogen per acre in February. Higher rates should be used for above-normal stocking rates.
9–For Soil Groups 1 or 2, fertilizer should contain sufficient sulfur to supply 10 pounds of sulfur per acre.

Crop Code No. 024

Sorghum for Silage

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	120-120-100	120-120-50	120-120-0	120-120-0
Low	120-100-100	120-100-50	120-100-0	120-100-0
Medium	120- 50-100	120- 50-50	120- 50-0	120- 50-0
High	120- 0- 100	120- 0- 50	120- 0-0	120- 0- 0
Very High	120- 0- 100	120- 0- 50	120- 0-0	120- 0- 0

17–At planting 30 pounds of nitrogen per acre should be applied. Best results are obtained when it is banded by the row. Balance of nitrogen should be applied as sidedressing when the plants are 18 to 30 inches high. When following soybeans or other legumes in rotation, reduce the rate by 20 to 30 pounds per acre. 19–If grown for silage for more than a year in the same field, and soil test showed that potassium levels are very low or low, then K_2O rate should be increased to 200 pounds per acre after the first year.
20–Similarly if soil test potassium levels are in the medium range, then K_2O rate should be increased to 100 pounds per acre when silage is grown for more than a year on the same field.
18–As with corn, on sandy and coarse loamy sands, apply 3 to 5 pounds per acre of zinc if the soil pH is above 6.5 or if zinc deficiency has been diagnosed previously. The plant analysis program is the best method to determine when zinc should be included in the fertility program.

Crop Code No. 004

Soybeans

Soil Groups 1, 2, 3, 4 or 6				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	0-120-100	0-120-50	0-120-0	0-120-0
Low	0-100-100	0-100-50	0-100-0	0-100-0
Medium	0- 50-100	0- 50-50	0- 50-0	0- 50-0
High	0- 0-100	0- 0-50	0- 0-0	0- 0-0
Very High	0- 0-100	0- 0-50	0- 0-0	0- 0-0

32–A good peat-based inoculum on soybean seed should be used when the field has been cropped for more than two years to nonleguminous crops; avoid using premixed combinations of inoculum fungicides and/or molybdenum.

Crop Code No. 019

Soybeans with Sorghum for Silage

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	60-120-100	60-120-50	60-120-0	60-120-0
Low	60-100-100	60-100-50	60-100-0	60-100-0
Medium	60- 50-100	60- 50-50	60- 50-0	60- 50-0
High	60- 0-100	60- 0-50	60- 0-0	60- 0-0
Very High	60- 0-100	60- 0-50	60- 0-0	60- 0-0

19–If grown for silage for more than a year in the same field, and a soil test showed that potassium levels are very low or low, then K_2O rate should be increased to 200 pounds per acre after the first year. 20–Similarly if soil test potassium levels are in the medium range, then K_2O rate should be increased to 100 pounds per acre when silage is grown for more than a year on the same field.
32–A good peat-based inoculum on soybean seed should be used when the field has been cropped for more than two years to non-leguminous crops; avoid using premixed combinations of inoculum fungicides and/or molybdenum.

Crop Code No. 038 or 039

Temporary Annual Grazing, Winter (038) **or Summer** (039)

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	60-100-80	60-100-40	60-100-0	60-100-0
Low	60- 80-80	60- 80-40	60- 80-0	60- 80-0
Medium	60- 40-80	60- 40-40	60- 40-0	60- 40-0
High	60- 0-80	60- 0-40	60- 0-0	60- 0-0
Very High	60- 0-80	60- 0-40	60- 0-0	60- 0-0

39–Apply nitrogen, phosphorus and potassium as recommended before growth begins. Apply 60 pounds of nitrogen per acre each time the forage is grazed down or hay is cut. 40–For small grain or ryegrass planted on fallow fields in early September, apply 100 pounds of nitrogen per acre at planting and 60 pounds per acre in early spring.

Crop Code No. 099

Tobacco (099)

Soil Groups 1, 2 or 3			Desired pH 5.5-6.0	
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	70-150-200	70-150-120	70-150-100	70-150-80
Low	70-120-200	70-120-120	70-120-100	70-120-80
Medium	70- 80-200	70- 80-120	70- 80-100	70- 80-80
High	70- 40-200	70- 40-120	70- 40-100	70- 40-80
Very High	70- 20-200	70- 20-120	70- 20-100	70- 20-80

89–Apply "preplant" fertilizer in two bands about 8 to 12 inches apart and slightly below the root crown at time of transplanting or within 10 days of transplanting.

If the clay layer is within 12 inches of the surface, the nitrogen rate should be decreased to 60 pounds, and if the clay layer is deeper than 16 inches from the surface, the nitrogen rate should be increased to 80 pounds. If the tobacco is following soybeans or highly fertilized corn (greater than 120 pounds of nitrogen per acre) it may be advisable to reduce the nitrogen rate to 50 to 60 pounds per acre.

Any nitrogen in addition to that applied preplant and recommended potassium should be sidedressed. All nitrogen should be in the nitrate form. Use calcium nitrate or sodium nitrate if no potassium is recommended. Potassium nitrate is preferred if additional potassium is needed. If formulated fertilizer is used, all nitrogen in the mixture should be in the nitrate form and all potassium should be in the nitrate or sulfate form. Potassium chloride (muriate of potash) should not be used as a potassium source.

90–For Extended Harvest System use the following adjustments to the normal rate:

Early Harvest: 3/4 normal nitrogen rate
Mid-harvest: normal nitrogen rate
Late Harvest: 1 and 1/4 normal nitrogen rate

If lime is to be applied to the previous crop to raise the soil pH to 6.5, the lime rate should be reduced by 25 percent. If the soil pH is above 6.0, call your county agent for additional information.

Crop Code No. 098

Tobacco Bed

Soil Groups 1, 2 or 3	Desired pH 5.5-6.0

96–When the soil test for phosphorus is very low or low, apply 50 pounds of 20 percent superphosphate and 50 to 75 pounds of 12-6-6 per 1,000 square feet or 300 feet row of plant bed. If the soil test for phosphorus is medium or higher, apply 50 to 75 pounds of 12-6-6 per 1000 square feet of plant bed. Superphosphate is not needed. 97–Use the lower rate of 12-6-6 when plants are grown under plastic cover. Mix the fertilizer with the top 2 to 3 inches of soil.

Wet the bed thoroughly after seeding. Recommendations given for 1,000 square feet will also be satisfactory for 100 square yards.

Caution: Fertilizer injury may occur if excessive fertilizer rates are used.

NUTRIENT MANAGEMENT PRACTICES FOR HORTICULTURAL CROPS

Crop Code No. 051

Asparagus, Establishing

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	70-240-125	70-240-70	70-240-35	70-240-0
Low	70-175-125	70-175-70	70-175-35	70-175-0
Medium	70-100-125	70-100-70	70-100-35	70-100-0
High	70- 70-125	70- 70-70	70- 70-35	70- 70-0
Very High	70- 35-125	70- 35-70	70- 35-35	70- 35-0

147–Recommended rate of phosphorus should be applied and mixed with the surface 6 inches before planting. Establishing a good supply of phosphorus is essential since this is a perennial crop.

Crop Code No. 066

Asparagus, Maintenance

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	100-200-200	100-200-100	100-200-50	100-200-25
Low	100-100-200	100-100-100	100-100-50	100-100-25
Medium	100- 50-200	100- 50-100	100- 50-50	100- 50-25
High	100- 25-200	100- 25-100	100- 25-50	100- 25-25
Very High	100- 0-200	100- 0-100	100- 0-50	100- 0-25

148–Maintenance applications of all fertilizers should be split; the first application should be made when spears emerge and the second after cutting.

Crop Code No. 014, 052, 053, 054, 055, 056, 057, 058, 059

Watermelons (059), **Cucumbers** (053), **Squash** (058), **Cantaloupes** (052), **Pumpkins** (014), **Okra** (056), **Lettuce** (054), **Snapbeans** (057) **or Lima Beans** (055)

Soil Groups 1, 2, 3, or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	*-160-160	*-160-120	*-160-80	*-160-40
Low	*-120-160	*-120-120	*-120-80	*-120-40
Medium	*-100-160	*-100-120	*-100-80	*-100-40
High	*- 80-160	*- 80-120	*- 80-80	*- 80-40
Very High	*- 0-160	*- 0-120	*- 0-80	*- 0-40

503–*When grown without irrigation on open ground, the recommended nitrogen application rate for all these crops, except lettuce, is 80 pounds per acre.
504–*For lettuce the recommended nitrogen rate is 120 to 150 pounds per acre. The lower rate of 120 pounds per acre should be used for Group 3 soils and the higher rate of 150 pounds per acre should be used for Group 1 and 2 soils.
502–*For watermelons and cantaloupes, the recommended nitrogen rate is 120 pounds per acre when grown with plastic mulch and drip irrigation. See the fertigation schedule below for amounts to apply pre-planting and delivery rate of nitrogen and potassium. The rate should be decreased to 100 pounds of nitrogen per acre when grown under plastic mulch or on open ground with overhead irrigation. When grown on open ground with no irrigation the recommended nitrogen rate is 80 pounds per acre. 103–Applying 0.5 to 1.0 pound per acre of boron as a foliar spray prior to bloom may help fruit set.
100–*For cucurbits, grown on bare ground, one-half of the fertilizer recommendation should be applied before planting and the balance at layby.
102–*Placement of fertilizer for cantaloupes, cucumbers and watermelons is very important because they are susceptible to fertilizer injury. Broadcast application followed by thorough mixing with the soil and split applications are good practices. Part of the nitrogen, 20 to 35 pounds per acre, should be applied as a sidedress.
502–**Fertigation schedule for watermelons and cantaloupes**: Apply 30 percent of your total nitrogen, all of the phosphorus, 30 percent of your total potassium prior to planting. Apply the following amounts of nitrogen and potassium (K_2O) each day in irrigation water or the totaled daily amounts per week.

Growth Stage	pounds N and K_2O per day
Planting to flowering	1.0
Flowering to fruit set	1.5
Fruit set to ripe start	2.0
Ripe start to harvest	1.5
Maintenance	1.0

Beets (060), **Broccoli** (061), **Cabbage** (062), **Carrots** (063), **Cauliflower** (079), **Eggplant** (065), **Pole Beans** (070), **Spinach** (071) **or Greens** (072)

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	120-240-200	120-240-150	120-240-100	120-240-40
Low	120-200-200	120-200-150	120-200-100	120-200-40
Medium	120-150-200	120-150-150	120-150-100	120-150-40
High	120-100-200	120-100-150	120-100-100	120-100-40
Very High	120- 0-200	120- 0-150	120- 0-100	120- 0-40

168–Boron is very important for beets, broccoli, cabbage, cauliflower and greens and should be applied with broadcast fertilizer or as a foliar spray (no more than 0.2 pound per acre of boron per spraying). When applied with broadcast fertilizer, 1 pound of elemental boron should be sufficient.

166–If broccoli, cabbage, or greens are directly seeded, a starter fertilizer that supplies 20 to 40 pounds of nitrogen per acre, depending on row spacing, would be very beneficial. Fertilizer should be banded 2 inches to the side and 2 inches below the seed.

167–Broccoli, cabbage or greens are also very susceptible to magnesium deficiency when the pH or magnesium levels are low.

169–For cabbage and eggplant, about one-third to one-half of the fertilizer should be applied in the row seven days before transplanting. The balance fertilizer should be applied in one or two subsequent applications.

104–For pole beans, one-half of the recommended fertilizer should be banded 3 inches to the side and slightly below the seed. The remaining fertilizer should be broadcast. If all of the fertilizer is broadcast, increase the rate by one-third to one-half. 170–Also, when pole beans are grown in average soils, application of 25 pounds of nitrogen per acre as a sidedress at the time of first cultivation and again as late as possible before stringing is strongly recommended. If heavy leaching rain occurs, additional nitrogen should be applied. Total nitrogen applied may be increased from the recommended 120 pounds per acre to 140 pounds depending on the conditions.

Collards (064)**, Onions** (068) **or Peppers** (069)

Soil Groups 1, 2, 3 or 4			Desired pH 5.8-6.5	
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	*-240-200	*-240-150	*-240-100	*-240-40
Low	*-200-200	*-200-150	*-200-100	*-200-40
Medium	*-150-200	*-150-150	*-150-100	*-150-40
High	*-100-200	*-100-150	*-100-100	*-100-40
Very High	*- 0-200	*- 0-150	*- 0-100	*- 0-40

*Nitrogen rates recommended for the above crops differ based on the soil group and irrigation practice. Both phosphorus and potassium should be applied at the rates indicated above.

505–*For collards, a rate of 160 pounds of nitrogen per acre is recommended when grown in Soil Groups 1 and 2 with overhead irrigation. An application rate of 140 pounds of nitrogen per acre is recommended when grown in Soil Groups 1 and 2 with no irrigation. When collards are grown in Soil Groups 3 and 4, nitrogen should be applied at 120 pounds per acre.

506–*For onions, recommended nitrogen application rates are 120 pounds of nitrogen per acre when grown in Soil Groups 3 and 4 and 150 pounds of nitrogen per acre when grown in Soil Groups 1 and 2 under irrigation.

507, 169–*For peppers, three different rates of nitrogen application are recommended. A rate of 120 pounds of nitrogen per acre should be applied when grown in Soil Groups 1 and 2 on open bare ground beds. A rate of 140 pounds of nitrogen per acre should be used when irrigated on all Soil Groups. When grown under plastic mulch and drip irrigation in all soil groups, a rate of 160 pounds of nitrogen per acre should be used. About one-third to one-half of the fertilizer should be applied in the row seven days before the transplanting. The balance should be applied in one or two subsequent applications.

166–If collards and onions are directly seeded, a starter fertilizer that would supply 20 to 40 pounds of nitrogen per acre, depending on row spacing, would be very beneficial. Fertilizer should be banded 2 inches to the side and 2 inches below the seed.

168–Also, boron is very important for collards and onions and should be applied with broadcast fertilizer or as a foliar spray tank (no more than 0.2 pound per acre of boron per spraying). When broadcast with fertilizer, one pound of elemental boron should be sufficient.

167Collards are very susceptible to magnesium deficiency when the pH or magnesium level is low.

106–When collards are grown with a long growing season or when the growth is slow, sidedressing with nitrogen and potash after a multiple harvest is recommended. Also, a 1-0-1 ratio fertilizer at a rate to supply 50 pounds of nitrogen per acre should be used. This supplemental fertilizer is often required in addition to the basic fertilizer rates given in the table. The need for supplemental fertilizer is determined by the change of foliage color.

Crop Code No. 067

Green Onions

Soil Groups 1 or 2			Desired pH 5.8-6.5	
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	*-200-200	*-200-130	*-200-80	*-200-40
Low	*-150-200	*-150-130	*-150-80	*-150-40
Medium	*-100-200	*-100-130	*-100-80	*-100-40
High	*- 50-200	*- 50-130	*- 50-80	*- 50-40
Very High	*- 0-200	*- 0-130	*- 0-80	*- 0-40

508, 509–*Nitrogen recommendations differ based on the soil group. If green onions are grown in Soil Groups 3 or 4, use 140 pounds of nitrogen per acre and for Soil Groups 1 and 2, use 160 pounds of nitrogen per acre.
149, 150–Use 40 pounds of nitrogen per acre as a starter fertilizer banded 2 inches to the side and 2 inches below the seed. When irrigated, or if rainfall is above average, the nitrogen rate should be increased by 50 pounds per acre.
168–Boron is very important to this crop and should be applied with broadcast fertilizer or as a foliar spray. Boron at a rate of 1 pound per acre as a broadcast fertilizer or 0.2 pound per acre as a foliar spray should be sufficient.

Crop Code No. 095

Irish Potatoes

Soil Groups 1, 2, 3 or 4			Desired pH 5.8-6.5	
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	150-220-180	150-220-150	150-220-100	150-220-40
Low	150-200-180	150-200-150	150-200-100	150-200-40
Medium	150-100-180	150-100-150	150-100-100	150-100-40
High	150-100-180	150-100-150	150- 100-100	150- 100-40
Very High	150- 60-180	150- 60-150	150- 60-100	150- 60-40

107–Maintain soil pH between 5.0 and 5.5 if scab-susceptible varieties are grown.

Crop Code No. 073

Blackeyed Peas and Southern Peas

Soil Groups 1, 2, 3 or 4			Desired pH 5.8-6.5	
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	30-120-120	30-120-100	30-120-50	30-120-0
Low	30- 80-120	30- 80-100	30- 80-50	30- 80-0
Medium	30- 50-120	30- 50-100	30- 50-50	30- 50-0
High	30- 0-120	30- 0-100	30- 0-50	30- 0-0
Very High	30- 0-120	30- 0-100	30- 0-50	30- 0-0

151–Research has shown that cowpea strains of Bradyrhizobium, formerly called Rhizobium, are effective in nitrogen fixation for Southern peas. Use a commercial peat-based inoculum specifically for cowpeas. Nitrogen fertilizer is not needed if seed are inoculated. Also, high rates of nitrogen will depress effectiveness of natural or applied inoculum.

Crop Code No. 075

Sweet Corn

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	150-150-120	150-150-90	150-150-60	150-150-0
Low	150-120-120	150-100-90	150-100-60	150-100-0
Medium	150- 60-120	150- 60-90	150- 60-60	150- 60-0
High	150- 0-120	150- 0-90	150- 0-60	150- 0-0
Very High	150- 0-120	150- 0-90	150- 0-60	150- 0-0

110–Approximately three-fourths of the total nitrogen should be applied as a sidedressing. A small, late application of 20 pounds of nitrogen per acre may be needed to maintain a green ear flag leaf. A starter fertilizer providing 30 pounds of nitrogen per acre of nitrogen should be banded 2 inches to the side and 2 inches below the seed. A small amount of phosphorus should be included when planted into a cold soil. 18–On sandy and coarse loamy soils, apply 3 to 5 pounds per acre of zinc when the soil pH is above 6.5 or when zinc deficiency has been previously diagnosed. Plant tissue testing is the best way to determine when zinc should be included in the fertilizer program. 9–Also, fertilizer applied to sandy and coarse loamy soils should contain sufficient sulfur to provide 10 pounds per acre of sulfur. A 500-pounds-per-acre rate is equivalent to 3.5 pounds per 100 feet of row if row spacing is 36 inches.

Crop Code No. 076

Sweet Potatoes

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	90-180-180	90-180-120	90-180-80	90-180-40
Low	90-160-180	90-160-120	90-160-80	90-160-40
Medium	90-120-180	90-120-120	90-120-80	90-120-40
High	90- 80-180	90- 80-120	90- 80-80	90- 80-40
Very High	90- 0-180	90- 0-120	90- 0-80	90- 0-40

108–Broadcast one-third of the fertilizer before bedding, band one-third at planting, and apply the remaining one-third 30 days after planting. The fertilizer should contain adequate boron to supply a total of one pound of boron per acre. No more than one-half of the potassium should be provided as a chloride (muriate of potash). 13–Apply 5 to 15 pounds of manganese per acre with the fertilizer when the soil pH is above 6.2 and manganese deficiency has been observed in the field in previous years. The problem with manganese usually occurs on the following soil series: Coosaw, Ocilla, Pelham, Williman, Chewacla, Lynchburg, Yemassee, Myatt, Ogeechee, Rains, Wadmalaw, Wehadkee, or Yonges. If manganese deficiency symptoms occur and are confirmed by a plant analysis, manganese may be applied as a foliar spray either singularly or mixed with a pesticide. Make one or two applications of 1 or 2 pounds of elemental manganese per acre.

Crop Code No. 078

Tomatoes (Coastal Plains)

Soil Groups 1, 2 or 3				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	*-275-250	*-275-200	*-275-125	*-275-100
Low	*-250-250	*-250-200	*-250-125	*-250-100
Medium	*-170-250	*-170-200	*-170-125	*-170-100
High	*-140-250	*-140-200	*-140-125	*-140-100
Very High	*-100-250	*-100-200	*-100-125	*-100-100

510–*The nitrogen rate should be 140 pounds of nitrogen per acre for light textured soils and 160 pounds of nitrogen per acre for clayey soils.
111–Broadcast and plow down all of the phosphorus and potash and 50 pounds of nitrogen per acre if the tomatoes are not mulched. Sidedress the remainder of the nitrogen. When sidedressing nitrogen on sandy and coarse loamy soils, include an amount of K_2O equal to the nitrogen. 510–If plastic mulch and drip irrigation are used, apply at least 25 percent of the nitrogen and potassium and all of the phosphorus preplant. The remainder of nitrogen and potassium can be applied through the drip tube.
111–Fertilizer should provide no less than 0.3 or more than 1 pound per acre of boron. If boron is not in the fertilizer, it may be provided by a foliar spray at first bloom. In such cases, make two applications at two-week intervals at a rate of 0.2 pound per acre of actual boron.
75–When tomatoes are grown in Soil Groups 1, 2 or 3, magnesium is LOW to MEDIUM, and lime is not recommended, include 15 to 20 pounds per acre of magnesium with the fertilizer. Use of dolomitic limestone when lime is recommended should maintain calcium and magnesium at the desired levels.

Crop Code No. 077

Tomatoes (Piedmont)

Soil Groups 1, 2 or 3				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	*-850-400	*-850-300	*-850-250	*-850-200
Low	*-700-400	*-700-300	*-700-250	*-700-200
Medium	*-500-400	*-500-300	*-500-250	*-500-200
High	*-300-400	*-300-300	*-300-250	*-300-200
Very High	*-200-400	*-200-300	*-200-250	*-200-200

512–*Recommended nitrogen application rates range from 180 to 200 pounds per acre. The lower amount will be adequate in most cases. Use the higher rate for clayey soils.
114–Apply 40 to 50 pounds of the nitrogen, phosphorus, and potassium as a starter fertilizer in the row. Broadcast 100 pounds of the nitrogen, the remainder of the phosphate, and up to 300 pounds per acre of the potash and plow down before planting. If more than 300 pounds of potash is required, apply the remainder when sidedressing with nitrogen. Sandy spots will require additional sidedressing. One-half of the potassium should be in the sulfate form. Nitrogen sidedressing should be applied as two applications of 50 pounds per acre, one immediately after the first cluster is set (about three weeks), and again three weeks later. If drip irrigation is used up to 60 percent of the nitrogen and potassium can be applied through the drip tubing. The total nitrogen should be 180 to 200 pounds per acre.

Boron should be applied at a rate of 2 pounds per acre broadcast with other fertilizer. Foliar sprays of 0.2 pound per acre may be added with fungicide treatments.

Crop Code No. 080 or 081

Apples (080) **or Pears** (081)

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	* -90-90	* -90-45	* -90-0	* -90-0
Low	* -60-90	* -60-45	* -60-0	* -60-0
Medium	* -0-90	* -0-45	* -0-0	* -0-0
High	* -0-90	* -0-45	* -0-0	* -0-0
Very High	* -0-90	* -0-45	* -0-0	* -0-0

211–**Recommended nitrogen rate for both **apples** and **pears** ranges from **30 to 80 pounds per acre**.* The following details apply to both apples and pears unless stated otherwise. The nitrogen rate needs to be varied depending on the age and size of the trees. Adjust the nitrogen rate to give the desired fruit color and 12 to 18 inches of growth annually. Nitrogen supplied in an ammonium form is preferentially adsorbed over the nitrate form, but it competes with calcium for uptake. To overcome this, calcium nitrate can be used as a source of both calcium and nitrogen.

If fertilizer does not provide boron, it may be applied as a spray at petal fall and first cover. Use a concentration of 1 pound of Solubor per 100 gallons. For a single tree, apply 5 tablespoons of borax or 2.5 tablespoons of Solubor.

Use 3 pounds of calcium nitrate per 100 gallons of spray at petal fall, first cover and third cover. The same rate should be used for two cover sprays that precede the final harvest spray.

213–For apples, zinc deficiency can be corrected by application of 0.3 pound of zinc per tree; zinc deficiency can be prevented by application of 0.15 pounds of zinc per tree. Zinc application is not normally needed for pears.

A soil test combined with plant tissue testing is the best way to ensure adequate nutrient management. The results will serve as a basis for adjustment of fertilizer treatments in the following year.

Above recommendations can be converted to per tree rate by dividing the per-acre rates by 100.

Crop Code No. 082

Blueberries (Mature Plants)

Soil Groups 1, 2, 3 or 4				Desired pH 5.0-5.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	40-80-80	40-80-40	40-80-20	40-80-0
Low	40-40-80	40-40-40	40-40-20	40-40-0
Medium	40-40-80	40-40-40	40-40-20	40-40-0
High	40 -0-80	40 -0-40	40 -0-20	40 -0-0
Very High	40 -0-80	40 -0-40	40 -0-20	40 -0-0

270–Best results are obtained when blueberries are planted on recently cleared land that has not been limed. Lime should not be applied on established stands except in special cases and then only after consultation with the county Extension agent. Fertilizer should not be applied at transplanting. Use liberal quantities of peat moss or rotted sawdust when setting plants. For mature plants, one-half of the recommended fertilizer should be applied before bloom. Apply the balance six to eight weeks later. Topdress an additional 20 pounds of nitrogen per acre after harvest and up to mid-July. Acid-forming fertilizers that do not contain chlorides are recommended. Use ammonium sulfate or ammonium nitrate as nitrogen sources. Caution: Too much fertilizer in one application without adequate water may damage plants.

275–Soil pH should be maintained below 6.0. Materials to correct this problem should be applied upon consultation with your county Extension agent. Iron and magnesium deficiencies are common with blueberries. Use the plant tissue testing service to determine if this is a problem.

To convert per-acre rates to per-plant rate, divide the acre rate by 605. Each plant requires an area 12 feet long and 6 feet wide.

Crop Code No. 084

Grapes (Bunch or Muscadine)

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	60-120-100	60-120-80	60-120-60	60-120-45
Low	60- 60-100	60- 60-80	60- 60-60	60- 60-45
Medium	60- 30-100	60- 30-80	60- 30-60	60- 30-45
High	60 -0-100	60 -0-80	60 -0-60	60 -0-45
Very High	60 -0-100	60 -0-80	60 -0-60	60 -0-45

260–Apply fertilizer in February. Applications on sandy soils, however, should be divided, with the first application in February and the second when cane growth is about 6 inches long. Nitrogen rate may be varied between 40 and 80 pounds per acre, depending on age and size of the vines. Use the lower rate for older vines or when pruning weight is greater than 2 pounds per plant. Use the higher rate for younger vines and lighter pruning weights.

Add 0.6 pound per acre of boron or apply Solubor in two cover sprays using a concentration of 1 pound of Solubor per 10 gallons of water.

To convert per-acre to per-vine rates, divide by 544 for bunch grapes and 270 for Muscadine grapes.

Crop Code No. 085, 086 or 087

Nectarines (085)**, Peaches** (086) **or Plums** (087)

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	*-120-100	*-120-50	*-120-30	*-120-0
Low	*-100-100	*-100-50	*-100-30	*-100-0
Medium	*- 50-100	*- 50-50	*- 50-30	*- 50-0
High	* -0-100	* -0-50	* -0-30	* -0-0
Very High	* -0-100	* -0-50	* -0-30	* -0-0

220–*The recommended rate of nitrogen application is 40 to 80 pounds of nitrogen per acre. Nitrogen should be adjusted to provide annual terminal twig growth of 12 to 18 inches. This can normally be attained by varying rates in the above range, depending on age and vigor of trees. If it appears that the nitrogen supply has been exhausted when harvest is completed, apply an additional 10 to 15 pounds of nitrogen per acre as a sidedressing using calcium nitrate. Nitrogen application should be split with the second application made after fruit set is determined. Apply fertilizer four to six weeks before anticipated bloom.

224–Peach orchards should receive one-half pound per acre of boron every two to four years or an annual application of 0.2 pound of boron. For plums and nectarines, boron application is not usually needed.

To correct zinc deficiency, apply a foliar spray of chelated zinc as the label directs or apply a spray containing 3 ounces of zinc sulfate per 100 gallons of water three times at three-week intervals. If a fungicide containing zinc is used, additional zinc will not be needed.

226–A soil test combined with plant tissue testing is the best way to ensure adequate nutrient management, and this test should be done at the same time every year, usually after harvest but before September. The results will serve as a basis for adjustment of fertilizer treatments in the following year.

Crop Code No. 088

Pecans

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	100-120-120	100-120-80	100-120-0	100-120-0
Low	100- 80-120	100- 80-80	100- 80-0	100- 80-0
Medium	100- 40-120	100- 40-80	100- 40-0	100- 40-0
High	100 -0-120	100 -0-80	100 -0-0	100 -0-0
Very High	100 -0-120	100 -0-80	100 -0-0	100 -0-0

200–If individual trees are fertilized, reduce the amount according to the area encompassed. Apply near the drip line for young trees and broadcast for older trees. Trees older than 20 years should receive 6 to 8 pounds of nitrogen per tree broadcast in February or 100 pounds per acre. Younger trees should receive 0.5 pound of nitrogen per year of age. Additional nitrogen may be applied in late May depending on nut set and if heavy leaching rains have occurred. Excessive growth and no crop usually indicate that too much nitrogen has been used. Reduce the amount of nitrogen if new terminal growth of limbs exceeds 12 to 18 inches per year. Young nonbearing trees should receive 1/2 pound of zinc sulfate per year of age. When rosette is noticeable on older trees, apply 5 to 10 pounds of zinc sulfate per tree. A soil test combined with plant tissue testing in late July is the best way to ensure adequate nutrient management. The results will serve as a basis for adjustment of fertilizer treatments in the following year.

Crop Code No. 074

Strawberries

Soil Groups 1, 2, 3 or 4				Desired pH 6.0-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	*-120-180	*-120-120	*-120-60	*-120-0
Low	*-100-180	*-100-120	*-100-60	*-100-0
Medium	*- 80-180	*- 80-120	*- 80-60	*- 80-0
High	*- 60-180	*- 60-120	*- 60-60	*- 60-0
Very High	*- 0-180	*- 0-120	*- 0-60	*- 0-0

Plasticulture

251–*Fall fertilization:* Fertilizer and lime should be broadcast and shallowly incorporated into the soil prior to bedding and laying plastic mulch. Apply 60 pounds of actual nitrogen in any form desired (however, do not use sulfur-coated urea or other slow release materials) and all of the phosphorus and potash. Recent work has shown significant yield response to the addition of 60 pounds P_2O_5 pre-plant in the fall even on soil testing Very High in phosphorus. No response has been noted to drip-applied P in the spring. Also, no response has been noted to additions of K_2O greater than 120 pounds per acre with plasticulture even on sites testing in the low range.

Spring fertilization: Apply 30 to 60 pounds of nitrogen per acre through the drip system at no more than 1 pound of nitrogen per acre per day based on petiole nitrate analysis. The start and frequency of these applications is determined by twice monthly analysis of strawberry petioles. Petiole analysis should begin shortly before major bloom occurs. Also, leaf tissue analysis can be used to gauge other nutrient needs. Your local Extension agent can provide guidance and bags for these analyses. No benefit has been observed from application of phosphorus or potassium in the spring.

For further information contact your local county agent.

Dryland

Apply nitrogen at a total rate of 120 pounds per acre in split applications. Broadcast one-third of the nitrogen, all the phosphate and potash, and any lime recommended prior to setting plants and work into the soil. For spring planting, apply one-third of the nitrogen 30 days after planting. For fall planting, apply one-third of the nitrogen 90 days before ripening. Split the balance of the nitrogen between August and September. On sandy soils, sidedress with 15 to 30 pounds of nitrogen per acre in January. The nitrogen rate should be increased to 180 pounds per acre for Coastal Plain soils. Too much nitrogen or nitrogen applied too close to harvest will cause excessive vegetative growth and soft berries. Keep nitrogen at least 4 inches from young plants to avoid injury.

For established plantings, apply one-third of the fertilizer in September, one-third at about 90 days before ripening, and the remainder after harvesting. When renovating, apply all of any lime recommended, phosphate, potash and one-half of the nitrogen in late August or September.

A 500-pounds-per-acre rate is equivalent to 3.5 pounds per 100 feet of row if row spacing is 36 inches.

Crop Code No. 108

Annual Flowers or Roses

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	120-120-120	120-120-120	120-120-60	120-120-0
Low	120-120-120	120-120-120	120-120-60	120-120-0
Medium	120-120-120	120-120-120	120-120-60	120-120-0
High	120- 60-120	120- 60-120	120- 60-60	120- 60-0
Very High	120- 0-120	120- 0-120	120- 0-60	120- 0-0

323–Fertilizer should be uniformly spread over the area and soaked into the soil. If applied before planting, mix in the top 6 inches.

Crop Code No. 117, 110 or 109

Shrubs (117); **Perennial Flowers** (110); **or**
Azaleas, Camellias and Rhododendron (109)

Soil Groups 1, 2, 3 or 4				Desired pH 5.0-6.0 for Azaleas, Rhododendron, and Camellias pH 5.8-6.5 for others
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	120-120-120	120-120-120	120-120-60	120-120-0
Low	120-120-120	120-120-120	120-120-60	120-120-0
Medium	120-120-120	120-120-120	120-120-60	120-120-0
High	120- 60-120	120- 60-120	120- 60-60	120- 60-0
Very High	120- 0-120	120- 0-120	120- 0-60	120- 0-0

325-328–For azaleas, camellias and rhododendron, maintenance of desired pH is critical. We strongly suggest that a second soil sample be taken and checked for soil pH before any measures to correct soil pH are taken. Aluminum sulfate can be used to lower the pH to the desired level in the event the soil pH is too high (see Table 5). Consult your county agent before treating any large area.

315–Iron deficiency can occur in acid-loving plants if the soil pH is above 6.0. If plants show iron deficiency symptoms (yellowing between green veins on upper leaves), apply chelated iron, following directions on
the label.

Crop Code No. 092

Christmas Trees

Soil Groups 1, 2, 3 or 4				Desired pH 5.5-6.0
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	*-150-150	*-150-150	*-150-0	*-150-0
Low	*-150-150	*-150-150	*-150-0	*-150-0
Medium	*- 75-150	* - 75-150	* - 75-0	* - 75-0
High	* - 0-150	* - 0-150	* - 0-0	* - 0-0
Very High	* - 0-150	* - 0-150	* - 0-0	* - 0-0

354–*Nitrogen application rate varies with tree age. For establishment, after planting, apply 50 lb N/acre as a split application with 25 lb applied before growth starts (usually in March) and 25 lb applied in May. Apply six inches from the stem. For the second year, apply 75 lb N/acre as a split application with 40 lb applied before growth starts (usually in March) and 35 lb applied in May. Apply at the outer reach of the limbs. For trees three years old and older, apply 100 lb N/acre at the outer reach of the limbs of each tree before growth starts. 355–For established trees, potassium recommendations of greater than 100 lb/acre should be split with half applied during the early spring and the other half in the fall. Availability of potassium may be reduced if gypsum is applied at the same time. Can be broadcast over the field or banded at the tree drip line. Broadcasting should not result in fertilizer lodging in tree branches and needles.
356– For new plantings, all recommended phosphorus and potassium fertilizers, and lime and gypsum should be incorporated thoroughly into the top 6 to 8 inches of soil prior to planting. 357–For established trees, phosphorus recommendations can be broadcast across the planting area. If broadcast fertilizer materials lodge within tree branches and needles, trees will be burned and may suffer unacceptable damage.
358–An adequate calcium level is needed to prevent premature needle drop. The soil test level for calcium should be equal to about 55 percent of the cation exchange capacity (55% base saturation with calcium). Ordinarily, calcium supply is maintained through liming, but when no lime is recommended and the available calcium is less than 800 lb/acre, sufficient gypsum should be applied to raise the percent calcium saturation to the recommended level. If gypsum is to be applied prior to planting, it should be incorporated. For established trees, gypsum may be broadcast or banded. Consult Information Leaflet No. 69 or your County Extension Agent to determine the correct amount of gypsum to apply.

Crop Code No. 040 or 041

Golf Fairway (041) **or Athletic Field** (040)

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	120-120-80	120-120-60	120-120-0	120-120-0
Low	120- 80-80	120- 80-60	120- 80-0	120- 80-0
Medium	120- 40-80	120- 40-60	120- 40-0	120- 40-0
High	120- 40-80	120- 40-60	120- 40-0	120- 40-0
Very High	120- 0-80	120- 0-60	120- 0-0	120- 0-0

440–Apply one-half of the nitrogen with phosphate and potash in the spring and the remaining nitrogen as needed in late summer.

Crop Code No. 042

Bentgrass Golf Green

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	300-200-200	300-200-100	300-200-60	300-200-0
Low	300-200-200	300-200-100	300-200-60	300-200-0
Medium	300-100-200	300-100-100	300-100-60	300-100-0
High	300- 0-200	300- 0-100	300- 0-60	300- 0-0
Very High	300- 0-200	300- 0-100	300- 0-60	300- 0-0

560–Nitrogen application should be alternated with application of complete fertilizers and modified to maintain desired growth and color. Bentgrass should be fertilized in fall, winter and very early spring months (September through February) and only sparingly in the summer.

Crop Code No. 043

Bermudagrass Golf Green or Tee

Soil Groups 1, 2, 3, or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	400-200-200	400-200-100	400-200-60	400-200-0
Low	400-200-200	400-200-100	400-200-60	400-200-0
Medium	400-100-200	400-100-100	400-100-60	400-100-0
High	400- 0-200	400- 0-100	400- 0-60	400- 0-0
Very High	400- 0-200	400- 0-100	400- 0-60	400- 0-0

561–Nitrogen applications should be alternated with application of other complete fertilizers and should be modified to maintain desired growth and color. Fertilizers should be applied in spring, summer, and early fall months.

Crop Code No. 107 and 106

Centipedegrass (107) and Carpetgrass (106)
for Soil Groups 1 and 2

Soil Groups 1 or 2				Desired pH 5.5-6.0
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	40-10-20	40-10-20	40-10-0	40-10-0
Low	40-10-20	40-10-20	40-10-0	40-10-0
Medium	40- 0-20	40- 0-20	40- 0-0	40- 0-0
High	40- 0-20	40- 0-20	40- 0-0	40- 0-0
Very High	40- 0-20	40- 0-20	40- 0-0	40- 0-0

562–Slow-release nitrogen fertilizers should be applied in the spring. Spring applications should be made when the grass has fully greened. Centipedegrass should not be over fertilized or fertilized after August 15. Iron can be added to centipedegrass to achieve better color without growth, as per label directions of a commercial chelate.

Crop Code No. 107 and 106

Centipedegrass (107) and Carpetgrass (106)
for Soil Groups 3 and 4

Soil Groups 3 or 4			Desired pH 5.5-6.0	
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	20-10-20	20-10-20	20-10-0	20-10-0
Low	20-10-20	20-10-20	20-10-0	20-10-0
Medium	20- 0-20	20- 0-20	20 -0-0	20- 0-0
High	20- 0-20	20- 0-20	20 -0-0	20- 0-0
Very High	20- 0-20	20- 0-20	20 -0-0	20- 0-0

562–Slow-release nitrogen fertilizers should be applied in the spring. Spring applications should be made when the grass has fully greened. Centipedegrass should not be over fertilized or fertilized after August 15. Iron can be added to centipedegrass to achieve better color without growth, as per label directions of a commercial chelate.

Crop Code No. 105

St. Augustinegrass (105)

Soil Groups 1, 2, 3, or 4			Desired pH 5.8-6.5	
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	80-10-20	80-10-20	80-10-0	80-10-0
Low	80-10-20	80-10-20	80-10-0	80-10-0
Medium	80- 0-20	80- 0-20	80- 0-0	80- 0-0
High	80- 0-20	80- 0-20	80- 0-0	80- 0-0
Very High	80- 0-20	80- 0-20	80- 0-0	80- 0-0

562–Slow-release nitrogen fertilizers should be applied in the spring. Spring applications should be made when the grass has fully greened.

Crop Code No. 112

Cool-Season Turf Grass

Soil Groups 1, 2, 3 or 4			Desired pH 5.8-6.5	
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	160-80-80	160-80-80	160-80-40	160-80-0
Low	160-80-80	160-80-80	160-80-40	160-80-0
Medium	160-40-80	160-40-80	160-40-40	160-40-0
High	160- 0-80	160- 0-80	160- 0-40	160- 0-0
Very High	160- 0-80	160 -0-80	160- 0-40	160- 0-0

401–The nitrogen should be split into three applications as follows: one-fourth in September, one-half in November and one-fourth in January.

Crop Code No. 113

Turf Establishment

Soil Groups 1, 2, 3 or 4	Desired pH 5.5-6.0 for centipedegrass and carpetgrass and 5.8-6.5 for other grasses			
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	120-120-120	120-120-60	120-120-40	120-120-0
Low	120-100-120	120-100-60	120-100-40	120-100-0
Medium	120- 60-120	120- 60-60	120- 60-40	120- 60-0
High	120- 0-120	120- 0-60	120- 0-40	120- 0-0
Very High	120- 0-120	120- 0-60	120- 0-40	120- 0-0

402–Apply all of the phosphorus and one-third of the nitrogen and potassium and incorporate into the soil before planting. The remainder of the nitrogen and potassium should be applied in two separate applications 4 to 6 and 8 to 12 weeks after planting when grass is established.

Crop Code No. 045

Roadside Turf Establishment

Soil Groups 1, 2, 3 or 4	Desired pH 5.8-6.5			
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	120-160-160	120-160-80	120-160-40	120-160-0
Low	120-160-160	120-160-80	120-160-40	120-160-0
Medium	120- 80-160	120- 80-80	120- 80-40	120- 80-0
High	120- 40-160	120- 40-80	120- 40-40	120- 40-0
Very High	120- 0-160	120- 0-80	120- 0-40	120- 0-0

400–Prior to planting, mix the recommended amount of lime, phosphate, potash and one-half of the nitrogen into the surface soil. Apply the other one-half of the nitrogen when plants are well established, normally after four to six weeks.

Crop Code No. 114

Zoysiagrass and Bermudagrass

Soil Groups 1, 2, 3 or 4	Desired pH 5.8-6.5			
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	80-80-80	80-80-80	80-80-40	80-80-0
Low	80-80-80	80-80-80	80-80-40	80-80-0
Medium	80-40-80	80-40-80	80-40-40	80-40-0
High	80- 0-80	80- 0-80	80- 0-40	80- 0-0
Very High	80- 0-80	80- 0-80	80- 0-40	80- 0-0

404–One-half of the fertilizer should be applied in the spring after total green-up and the remainder in midsummer.

Crop Code No. 046

Roadside Turf Maintenance

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	80-80-80	80-80-40	80-80-0	80-80-0
Low	80-80-80	80-80-40	80-80-0	80-80-0
Medium	80-40-80	80-40-40	80-40-0	80-40-0
High	80- 0-80	80- 0-40	80- 0-0	80- 0-0
Very High	80- 0-80	80- 0-40	80- 0-0	80- 0-0

513–All the fertilizer should be applied in spring and should be broadcast. Repeat applications should be made in midsummer.

Crop Code No. 013

Kiwi Fruit

Soil Groups 1 or 2				Desired pH 6.0-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	150-75-175	150-75-130	150-75-60	150-75-0
Low	150-65-175	150-65-130	150-65-60	150-65-0
Medium	150-50-175	150-50-130	150-50-60	150-50-0
High	150- 0-175	150- 0-130	150- 0-60	150- 0-0
Very High	150- 0-175	150- 0-130	150- 0-60	150- 0-0

340–Kiwi fruits are best grown in well-drained soils in the lower Coastal Plains (Soil Groups 1 and 2). Preplant soil analysis should be conducted several months before planting. For spring planting, lime should be applied in the fall and the entire preplant fertilizer should be applied during late winter based on soil test results. A soil test for pH and a proper leaf tissue sample is the best guide to ensure that adequate nutrients are applied. Any alterations to the recommendations should be based on such testing and in consultation with the county agent. Incorporation of about $1^1/_2$ pounds of organic fertilizer (bone meal, tankage, peat moss or cotton seeds) in each plant hole before planting may prove beneficial. Care should be taken to incorporate these fully to prevent any root damage.

Since the recommendations are for mature plants to young vines during the first three years, nitrogenous fertilizer should be split as follows:

Year 1: 1 ounce urea over 2 square yards, three to four times from April to August.

Year 2: 4 ounces urea over 5 square yards, in March; follow with 2 ounces urea three times from April to August.

Year 3: 8 ounces urea over 5 square yards, in March; follow with 4 ounces urea three times from April to August.

Foliar applications of liquid fertilizers may be made four to six times at a rate of 2 pounds per acre in the early season (3:1:1 ratio fertilizer with micronutrients) or in late season (2:1:4 ratio fertilizer). These can be applied along with tank-mixed pesticide sprays.

Kiwi fruit is sensitive to boron. The rate should not exceed 0.5 pound per acre of actual boron per year. Excess boron can be especially toxic to young vines.

Fertilizer applications after the third year should be broadcast over the entire area in the spring.

Crop Code No. 101

Grasses for Wildlife

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	100-100-80	100-100-40	100-100-0	100-100-0
Low	100- 80-80	100- 80-40	100- 80-0	100- 80-0
Medium	100- 40-80	100- 40-40	100- 40-0	100- 40-0
High	100- 0-80	100- 0-40	100- 0-0	100- 0-0
Very High	100- 0-80	100- 0-40	100- 0-0	100- 0-0

514–Apply nitrogen in two to three split applications throughout the growing season. 517–Potassium, when recommended at 100 pounds per acre, should be split into two applications, particularly on sandy soils.

Crop Code No. 102

Legumes for Wildlife

Soil Groups 1, 2, 3 or 4				Desired pH 6.0-6.8
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	0-120-100	0-120-40	0-120-0	0-120-0
Low	0- 80-100	0- 80-40	0- 80-0	0- 80-0
Medium	0- 40-100	0- 40-40	0- 40-0	0- 40-0
High	0- 0-100	0- 0-40	0- 0-0	0- 0-0
Very High	0- 0-100	0- 0-40	0- 0-0	0- 0-0

518–Maintaining soil pH within the desired range is critical for most legumes. 515–Lime should be applied three to six months before seeding for best results.
517–Potassium, when recommended at 100 pounds per acre or more, should be split into two applications, particularly on sandy soils.

Crop Code No. 103

Grass/Legume Mixtures for Wildlife

Soil Groups 1, 2, 3 or 4				Desired pH 6.0-6.8
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Pounds of N-P_2O_5-K_2O per Acre			
Very Low	30-120-100	30-120-60	30-120-0	30-120-0
Low	30- 80-100	30- 80-60	30- 80-0	30- 80-0
Medium	30- 60-100	30- 60-60	30- 60-0	30- 60-0
High	30- 0-100	30- 0-60	30- 0-0	30- 0-0
Very High	30- 0-100	30- 0-60	30- 0-0	30- 0-0

518–Maintaining soil pH within the desired range is critical for most legumes. 516–Since nitrogen promotes grass growth over legume growth, high rates of nitrogen should not be used in a grass/legume mix.
517–Potassium, when recommended at 100 pounds per acre or more, should be split into two applications, particularly on sandy soils.

NUTRIENT MANAGEMENT PRACTICES FOR HOME GARDENS AND OTHER SMALL AREAS

All of the recommendations given in the previous sections for agronomic and horticultural crops are given on an acre basis. Because smaller areas are generally involved around the home landscape and garden, this section provides recommended amounts of nitrogen, phosphorus, and potassium based on the more commonly formulated fertilizers available in garden supply stores and nurseries. Because the formulations are not likely to match exactly the recommendations for primary nutrients, the recommendations approximate the amounts that are appropriate based on use of formulated fertilizers. For growers who prefer to be more precise and use primary fertilizer materials such as ammonium nitrate, superphosphate, and muriate of potash, the per-acre amounts given in the previous sections may be converted to a 1,000 square-foot area by dividing the values by 43.6. For example, 100 pounds per acre is equivalent to 2.3 pounds per 1,000 square feet.

The following examples illustrate the conversion of per acre rates for nitrogen, phosphate, and potash to rates per 1,000 and 100 square feet using ammonium nitrate, triple super phosphate, and muriate of potash as single-nutrient sources. For example, ammonium nitrate applied at rates of 294 pounds per acre or 6.8 pounds per 1,000 square feet both provides nitrogen application rates of 100 pounds per acre.

Amounts of single-nutrient fertilizers needed to provide 100 pounds per acre of N, P_2O_5 or K_20 for one acre and smaller areas

Fertilizer Material	Nutrient Form	Area			
		Acre *pounds*	1,000 square feet *pounds*	100 square feet	
				cups	*ounces*
ammonium nitrate (34-0-0)	nitrogen, N	294	6.8	1.4	11
triple superphosphate (0-48-0)	phosphate, P_2O_5	208	4.8	1.0	7
muriate of potash (0-0-60)	potash, K_2O	167	3.8	0.8	6

Amounts of fertilizer are based on bulk densities of approximately 1.0 and the following formulations: ammonium nitrate, 34-0-0; triple superphosphate, 0-48-0; muriate of potash, 0-0-60. Slight differences in formulation or concentration may be encountered between fertilizers prepared by different manufacturers.

NOTE: *The fertilizer formulations given below are only suggestions. A cost effective choice should be made between the fertilizer formulations given below and any other equivalent grades available in the market. Consult your local County Extension Agent for information on other blends and equivalent grades for substitutions.*

Crop Code No. 049

Greenhouse Crops, Inorganic Soils

Soil Material and Soil Mixtures				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Per 100 square feet			
Very Low	4 lb 8-8-8 (1 lb 8-8-8)*	4 lb 8-8-8 (1 lb 8-8-8)*	4 lb 8-8-8 + 2-1/2 lb 0-20-0 (1/4 cup 34-0-0)*	5 lb 0-20-0 (1/2 cup 34-0-0)*
Low	4 lb 8-8-8 (1 lb 8-8-8)*	4 lb 8-8-8 (1 lb 8-8-8)*	4 lb 8-8-8 + 2-1/2 lb 0-20-0 (1/4 cup 34-0-0)*	5 lb 0-20-0 (1/2 cup 34-0-0)*
Medium	4 lb 8-8-8 (1 lb 8-8-8)*	4 lb 8-8-8 (1 lb 8-8-8)*	4 lb 8-8-8 (1/4 cup 34-0-0)*	2-1/2 lb 0-20-0 (1/4 cup 34-0-0)*
High	4 lb 8-8-8 (1/2 cup 15-0-15)*	4 lb 8-8-8 (1/4 cup 34-0-0)*	4 lb 8-8-8 (1/4 cup 34-0-0)*	2-1/2 lb 0-20-0 (1/4 cup 34-0-0)*
Very High	(1 cup 15-0-15)*	(Alternate: 1 cup 15-0-15 and 1/2 cup 34-0-0)*	(Alternate: 1 cup 15-0-15 and 1/2 cup 34-0-0)*	(1/4 cup 34-0-0)*

The above rates are recommended for areas of 100 square feet or 2 cubic yards.

*Formulations in parentheses, or their equivalents, should be applied as directed every two weeks in 25 gallons of water.

To correct acidity, apply dolomitic limestone as recommended. One ton per acre is 5 pounds per 2 cubic yards or 100 square feet.

Other fertilizer grades or materials that supply equivalent amounts of plant nutrients may be used with equal results. If you need assistance in calculating amounts of other materials to use, contact your county agent or fertilizer supplier.

Crop Code No. 017

Annual Flowers and Roses

316-322–Apply the following amounts of fertilizer per 100 square feet in spring when growth begins and repeat monthly, except as noted. Repeat all the doses at monthly intervals until August 1, unless specified otherwise.

Fertilizer should be spread uniformly over the area and soaked into the soil. If applied before planting, fertilizers should be mixed in the top 6 inches. 307–Any single application of nitrogen should not exceed 0.1 pound of water-soluble nitrogen per 100 square feet.

300–As a precaution against fertilizer burn, water the plants before the fertilizer is applied and immediately after the fertilizer is applied. No more than 0.4 to 0.6 pound of actual nitrogen per 100 square feet should be applied each year for annuals. Slow-release fertilizers for annual bedding plants should be applied once before planting and again in mid-season, if necessary, as determined by growth and over-all appearance.

Soil Groups 3 or 4	Desired pH 6.5-7.0			
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Per 100 square feet			
Very Low	2 cups 10-10-10	2 cups 10-10-10	2 cups 10-10-10	0.5 cup 34-0-0[a] 2.5 cups 0-20-0[b]
Low	2 cups 10-10-10	2 cups 10-10-10	2 cups 10-10-10	0.5 cup 34-0-0[a] 2.5 cups 0-20-0[b]
Medium	2 cups 10-10-10	2 cups 10-10-10	2 cups 10-10-10	0.5 cup 34-0-0[a] 2.5 cups 0-20-0[b]
High	1 cup 10-10-10 1 cup 15-0-15	1 cup 10-10-10 0.5 cup 34-0-0	1 cup 10-10-10 0.5 cup 34-0-0	0.5 cup 34-0-0[a]
Very High	1 cup 15-0-15 0.5 cup 34-0-0	1 cup 15-0-15 0.5 cup 34-0-0	1 cup 15-0-15 0.5 cup 34-0-0	0.5 cup 34-0-0[a]

[a] Make ammonium nitrate application when spring growth begins and repeat monthly until August 1; do not apply after August 1.

[b] Apply 0-20-0 once in spring; do not repeat application.

Shrubs (15), Perennial Flowers (16), Azaleas (096), Rhododendron (096) or Camellias (096)

301-306–Apply the following amounts of fertilizer per 100 square feet in early spring and repeat in summer, except in those cases noted in which a different fertilizer is used for the second application. When shrubs or perennials are planted, apply 4 cups of 0-20-0 per 100 square feet if phosphorus test is very low, low, or medium. 307–Any single application of nitrogen should not exceed 0.1 pound of nitrogen per 100 square feet. 300–As a precaution against fertilizer injury, water the plants before and immediately after the fertilizer is applied.
308–In case of shrubs, azaleas, rhododendron and camellias, uniformly spread fertilizer over the area beginning 6 inches from the trunk and extending well beyond the drip line or outermost branches. It is not necessary to remove the mulch before application of fertilizer. Brush or rinse fertilizer from the leaves and stems.

Soil Group 1, 2, 3 or 4

Desired pH 5.0-6.0 for azaleas, rhododendron, and camellias
pH 5.8-6.5 for all others

Phosphorus	Potassium			
	Low	Medium	High	Very High
	Per 100 square feet			
Very Low	3 cups 10-10-10	3 cups 10-10-10	3 cups 10-10-10	1 cup 34-0-0
Low	3 cups 10-10-10	3 cups 10-10-10	3 cups 10-10-10	1 cup 34-0-0
Medium	3 cups 10-10-10	3 cups 10-10-10	3 cups 10-10-10	1 cup 34-0-0
High	3 cups 10-10-10	3 cups 10-10-10	3 cups 10-10-10	1 cup 34-0-0
2nd application:	*2 cups 15-0-15*	*2 cups 15-0-15*	*2 cups 15-0-15*	
Very High	2 cups 15-0-15	2 cups 15-0-15	1 cup 34-0-0	1 cup 34-0-0

Special instructions for azaleas, rhododendron and camellias: Since these are acid-loving plants, the desired soil pH is 5.0-6.0 and any increase in soil pH above 6.0 may be too high. In order to lower the pH to the desired range, the following rates of aluminum sulfate may be made:

Soil pH	Aluminum sulfate, lbs/10 square feet
6.0 - 6.5	1.5
6.5 - 7.0	2.1
7.0 - 7.5	2.7
More than 7.5	3.3

310-313–Before attempting to lower the soil pH, we suggest that a second soil sample be taken and analyzed to confirm the soil pH. The recommended rate should be increased by one-half for clayey soil and reduced by one-third for sandy soil. Only one-seventh of the recommended rate should be used if elemental sulfur is to be applied to lower the pH. 315–If the plants showed an iron deficiency (yellowing between green veins on upper, younger leaves) chelated iron should be applied as directed on the label.

Crop Code No. 090

Home Garden Fertilization, Inorganic Sources

Amounts of formulated fertilizer to be applied per 1,000 square feet of soil or per 300 feet of row.
118–One pint of fertilizer is equal to approximately 1 pound.

Soil Groups 1, 2, 3 or 4			Desired pH 5.8-6.5	
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Per 1,000 square feet			
Very Low	10 lb 10-10-10 18 lb 0-20-0 2.5 lb 0-0-60 *15 lb 10-10-10	10 lb 10-10-10 18 lb 0-20-0 *15 lb 10-10-10	10 lb 10-10-10 25 lb 0-20-0 *5 lb 34-0-0	3 lb 34-0-0 30 lb 0-20-0 *5 lb 34-0-0
Low	10 lb 10-10-10 8 lb 0-20-0 2.5 lb 0-0-60 *15 lb 10-10-10	10 lb 10-10-10 8 lb 0-20-0 *15 lb 10-10-10	10 lb 10-10-10 15 lb 0-20-0 *5 lb 34-0-0	3 lb 34-0-0 20 lb 0-20-0 *5 lb 34-0-0
Medium	10 lb 10-10-10 2.5 lb 0-0-60 *15 lb 10-10-10	10 lb 10-10-10 *15 lb 10-10-10	10 lb 10-10-10 8 lb 0-20-0 *5 lb 34-0-0	3 lb 34-0-0 13 lb 0-20-0 *5 lb 34-0-0
High	10 lb 10-10-10 5 lb 0-0-60 *5 lb 34-0-0	10 lb 10-10-10 2.5 lb 0-0-60 *5 lb 34-0-0	10 lb 10-10-10 *5 lb 34-0-0	3 lb 34-0-0 5 lb 0-20-0 *5 lb 34-0-0
Very High	3 lb 34-0-0 7 lb 0-0-60 *5 lb 34-0-0	3 lb 34-0-0 4 lb 0-0-60 *5 lb 34-0-0	3 lb 34-0-0 2 lb 0-0-60 *5 lb 34-0-0	3 lb 34-0-0 *5 lb 34-0-0

171-190–* Sidedress this portion of the fertilizer three weeks after planting.

Crop Code No. 091

Home Garden Fertilization, Organic Sources

500–For optimum growth of garden plants, maintenance of a high level of all the plant nutrients in the soil is desirable and can be accomplished by additions of compost, manure and lawn clippings throughout the year. If any of the plant nutrients indicated on the soil test report fall into the medium or low category, the following materials may be added per 100 square feet to bring the nutrients back up to a high level.

Phosphorus: 10 pounds of bone meal or rock phosphate.
Potassium: 10 pounds of granite dust or green sand. Wood ash is high in potassium but should be used sparingly only on acid soils (pH less than 6.0) due to its potential to make the soil too alkaline.
Magnesium: If limestone is recommended due to low pH, use dolomitic limestone which contains magnesium. If limestone is not recommended, add 10 pounds of Epsom salts.
Calcium: If limestone is recommended and applied, that will correct low calcium levels. If limestone is not recommended, add 10 pounds of gypsum.
Nitrogen: If a nitrogen-rich material such as compost or green manure (especially from legumes) has been incorporated in the garden soil within a few weeks before planting, little or no further nitrogen will be required. Otherwise, incorporate in the rows any one of the following materials before planting: 5 pounds of blood meal; 5 pounds of fish meal; 10 pounds of soybean seed meal; 10 pounds of cotton seed meal; or 15 to 25 pounds of poultry manure.

Crop Code No. 089

Home Orchards

230-238–Amounts of formulated fertilizer to be applied per 1,000 square feet or per 300 feet of row of soil before planting. One pound of nitrogen can be supplied through 3 pounds 34-0-0, 5 pounds ammonium sulfate, or 6 pounds of calcium nitrate.

Soil Groups 1, 2, 3 or 4			Desired pH 5.8-6.5	
Phosphorus	Potassium			
	Low	Medium	High	Very High
		Per 1,000 square feet		
Very Low	16 lb 0-14-14	8 lb 0-14-14 6 lb 0-20-0	12 lb 0-20-0	12 lb 0-20-0
Low	16 lb 0-14-14	8 lb 0-14-14 6 lb 0-20-0	12 lb 0-20-0	12 lb 0-20-0
Medium	8 lb 0-14-14 2 lb 0-0-60	8 lb 0-14-14	6 lb 0-20-0	6 lb 0-20-0
High	4 lb 0-0-60	2 lb 0-0-60	No P & K	No P & K
Very High	4 lb 0-0-60	2 lb 0-0-60	No P & K	No P & K

239–In addition to the above, nitrogen should be applied at the following recommended rates:

Crop	N recommendation lb/tree or plant/year of age	Maximum not to exceed lb N/tree
Peaches	0.16	1.0
Plums	0.16	0.8
Pecans	0.16	0.5
Pears	0.06	0.56
Apples	0.08	0.56
Figs or Grapes	0.04	0.56
Blueberries*	0.02*	0.14

*For blueberries, split the nitrogen application into two equal amounts: first in February and second in June, after harvest. Since more acid soils are required for blueberries than most other crops, acid-forming fertilizers free of chlorides should be used. Lime should not be used, unless recommended by soil testing. Too much fertilizer in one application without irrigation should be avoided.

Strawberries, per 100 feet of row: 0.3 lb. in October and repeat 90 days before ripening and again after harvest.

Blackberries: 1.0-1.3 lbs in February and 0.5-0.7 lb after harvest.

Crop Code No. 018

Ornamental or Shade Trees

330-333–Lay out a rectangular area to be fertilized around the tree so that the entire branch spread will be included. Determine the area of the rectangle and apply at rates indicated below for every 1,000 square feet in early spring (from March to May before or during bud-break) and in the fall (a few weeks before the expected first freeze in October or November) to encourage growth and if turf grass is not present in the area fertilized. Do not exceed 1 pound of quick-release actual nitrogen per 1,000 square feet in the presence of turf grass.
334–If grass, ivy or other plants under the trees are fertilized, it will not be necessary to add fertilizer for the tree.

When no P & K is recommended, 15 pounds 34-0-0 may be applied.

Soil Groups 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
		Per 1,000 square feet		
Very Low	50 lb 10-10-10	50 lb 10-10-10 18 lb 0-20-0	50 lb 10-10-10 18 lb 0-20-0	50 lb 10-10-10 18 lb 0-20-0
Low	50 lb 10-10-10	50 lb 10-10-10 18 lb 0-20-0	50 lb 10-10-10 18 lb 0-20-0	50 lb 10-10-10 18 lb 0-20-0
Medium	31 lb 16-4-8	No P or K	No P or K	No P or K
High	31 lb 16-4-8	No P or K	No P or K	No P or K
Very High	31 lb 16-4-8	No P or K	No P or K	No P or K

Crop Code No. 111

Bentgrass Golf Green

451-460– The following recommendations reflect the amounts of formulated fertilizer to be applied for a 1,000-square-foot area in the fall. When P_20_5 and K_20 are recommended, use 16-4-8 or other equivalent grades. Nitrogen application should be alternated with application of complete fertilizers and modified to maintain desired growth and color. 1 lb Nitrogen may be supplied as 3 pounds of ammonium nitrate (34-0-0) or 6 pounds calcium nitrate (15.5-0-0) (or equivalent) when nitrogen is supplied alone. When P_2O_5 and K_2O are recommended, use 15-0-15, 16-4-8, or other equivalent grades. Fertilize bentgrass in fall, winter and very early spring months (September through February) as indicted below. Supplement with additional nitrogen as needed in fall and winter.

Soil Group 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
		Per 1,000 square feet		
Very Low	10 lb 10-10-10 Repeat four times at monthly intervals	12 lb 0-20-0 (fall only); 10 lb 10-10-10 in fall and repeat in winter	12 lb 0-20-0 in fall and repeat in winter. 6 lb 15-0-15 in fall and repeat monthly three more times	12 lb 0-20-0 in fall and repeat in winter
Low	10 lb 10-10-10 Repeat four times at monthly intervals	12 lb 0-20-0 (fall only); 10 lb 10-10-10 in fall and repeat in winter	12 lb 0-20-0 in fall and repeat in winter. 6 lb 15-0-15 in fall and repeat monthly three more times	12 lb 0-20-0 in fall and repeat in winter
Medium	6 lb 16-4-8 in the fall and repeat monthly through winter and early spring	10 lb 10-10-10 in fall and repeat in winter	6 lb 0-20-0 in fall and repeat in winter	6 lb 0-20-0 in fall and repeat in winter
High	6 lb 15-0-15 in the fall and repeat monthly 3 more times	6 lb 15-0-15 in the fall and repeat monthly 3 more times	8 lb 15-0-15 in fall and repeat in winter	1 lb N, as needed for color and vigor
Very High	6 lb 15-0-15 in the fall and repeat monthly 3 more times	6 lb 15-0-15 in the fall and repeat monthly 3 more times	8 lb 15-0-15 in fall and repeat in winter	1 lb N, as needed for color and vigor

Crop Code No. 118

Bermudagrass Golf Green or Tee

441-449–Apply the following amounts of fertilizer formulation per 1,000 square feet in spring. Application of super phosphate is generally recommended in the spring to build up soil phosphorus level when the soil tests very low or low for phosphorus.
450– 1 lb Nitrogen may be supplied as 3 pounds of ammonium nitrate (34-0-0) or 6 pounds calcium nitrate (15.5-0-0) (or equivalent) when nitrogen is supplied alone. Nitrogen application should be alternated with application of complete fertilizers and modified to maintain desired growth and color. Fertilize bermudagrass in spring, summer, and early fall.

Soil Group 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Per 1,000 square feet			
Very Low	10 lb 10-10-10 Repeat four times at two-month intervals.	12 lb 0-20-0 (spring only); 10 lb 10-10-10 in the spring and repeat in the fall.	12 lb 0-20-0 in the spring and repeat in the fall.	12 lb 0-20-0 in the spring and repeat in the fall.
Low	10 lb 10-10-10 Repeat four times at two-month intervals.	12 lb 0-20-0 (spring only); 10 lb 10-10-10 in the spring and repeat in the fall.	12 lb 0-20-0 in the spring and repeat in the fall.	12 lb 0-20-0 in the spring and repeat in the fall.
Medium	6 lb 16-4-8 Repeat monthly through fall.	10 lb 10-10-10 Repeat in the fall.	6 lb 0-20-0 Repeat late summer or fall.	6 lb 0-20-0 Repeat late summer or fall.
High	6 lb 15-0-15 Repeat four times at two-month intervals.	6 lb 15-0-15 Repeat four times at two-month intervals.	8 lb 15-0-15 Repeat late summer or fall.	1 lb N for color and vigor.
Very High	6 lb 15-0-15 Repeat four times at two-month intervals.	6 lb 15-0-15 Repeat four times at two-month intervals.	8 lb 15-0-15 Repeat late summer or fall.	1 lb N for color and vigor.

Centipedegrass (094)

432-439–Amounts of formulated fertilizer to be applied per 1,000 square feet. Total nitrogen should not exceed 1 pound per 1,000 square feet during the growing season. When only nitrogen is being applied, ammonium sulfate (21-0-0) at 2¼ pounds per 1,000 square feet or ammonium nitrate (34-0-0) at 1½ pounds per 1,000 square feet should be used.

Spring applications should be made when the grass has fully greened. Centipedegrass should not be over-fertilized or fertilized after August 15.

Sulfate of potash or muriate of potash can be added at 5 pounds per 1,000 square feet in late summer or early fall to harden the turf, or anytime to overcome magnesium or potassium deficiencies.

403–Iron can be added to centipedegrass to achieve a better color without growth. Iron sulfate at a rate of 2 ounces per 1,000 square feet or any other commercial iron chelate can be applied as per the label directions.

for Soil Groups 1 and 2

Soil Group 1 or 2				Desired pH 5.5-6.0
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Per 1,000 square feet			
Very Low	3 lb 16-4-8 in spring and again in midsummer.	3 lb 16-4-8 in spring and again in midsummer.	1 lb 0-20-0 and 1-2 lb 34-0-0 in spring and again in midsummer.	1 lb 0-20-0 and 1-2 lb 34-0-0 in spring and again in midsummer.
Low	3 lb 15-0-15 in spring and again in midsummer.	3 lb 15-0-15 in spring and again in midsummer.	1-2 lb 34-0-0 in spring and again in midsummer.	1-2 lb 34-0-0 in spring and again in midsummer.
Medium	3 lb 15-0-15 in spring and again in midsummer.	3 lb 15-0-15 in spring and again in midsummer.	1-2 lb 34-0-0 in spring and again in midsummer.	1-2 lb 34-0-0 in spring and again in midsummer.
High	3 lb 15-0-15 in spring and again in midsummer.	3 lb 15-0-15 in spring and again in midsummer.	1-2 lb 34-0-0 in spring and again in midsummer.	1-2 lb 34-0-0 in spring and again in midsummer.
Very High	3 lb 15-0-15 in spring and again in midsummer..	3 lb 15-0-15 in spring and again in midsummer.	1-2 lb 34-0-0 in spring and again in midsummer.	1-2 lb 34-0-0 in spring and again in midsummer.

for Soil Groups 3 and 4

NOTE: The recommended amounts may be split into two or more applications.

Soil Group 3 or 4				Desired pH 5.5-6.0
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Per 1,000 square feet			
Very Low	3-4 lb 16-4-8	3-4 lb 16-4-8	1 lb 0-20-0 and 1-2 lb 34-0-0	1 lb 0-20-0 and 1-2 lb 34-0-0
Low	3-4 lb 15-0-15	3-4 lb 15-0-15	1-2 lb 34-0-0	1-2 lb 34-0-0
Medium	3-4 lb 15-0-15	3-4 lb 15-0-15	1-2 lb 34-0-0	1-2 lb 34-0-0
High	3-4 lb 15-0-15	3-4 lb 15-0-15	1-2 lb 34-0-0	1-2 lb 34-0-0
Very High	3-4 lb 15-0-15	3-4 lb 15-0-15	1-2 lb 34-0-0	1-2 lb 34-0-0

Carpetgrass (093)

432-439–Amounts of formulated fertilizer to be applied per 1,000 square feet. Total nitrogen should not exceed 1 pound per 1,000 square feet during the growing season. When only nitrogen is being applied, ammonium sulfate (21-0-0) at $2^{1}/_{4}$ pounds per 1,000 square feet or ammonium nitrate (34-0-0) at $1^{1}/_{2}$ pounds per 1,000 square feet should be used.

Spring applications should be made when the grass has fully greened.

Sulfate of potash or muriate of potash can be added at 5 pounds per 1,000 square feet in late summer or early fall to harden the turf, or anytime to overcome magnesium or potassium deficiencies.

for Soil Groups 1 and 2

Soil Group 1 or 2				Desired pH 5.5-6.0
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Per 1,000 square feet			
Very Low	3 lb 16-4-8 in spring and again in midsummer.	3 lb 16-4-8 in spring and again in midsummer.	1 lb 0-20-0 and 1-2 lb 34-0-0 in spring and again in midsummer.	1 lb 0-20-0 and 1-2 lb 34-0-0 in spring and again in midsummer.
Low	3 lb 16-4-8 in spring and again in midsummer.	3 lb 16-4-8 in spring and again in midsummer.	1 lb 0-20-0 and 1-2 lb 34-0-0 in spring and again in midsummer.	1 lb 0-20-0 and 1-2 lb 34-0-0 in spring and again in midsummer.
Medium	3 lb 15-0-15 in spring and again in midsummer.	3 lb 15-0-15 in spring and again in midsummer.	1-2 lb 34-0-0 in spring and again in midsummer.	1-2 lb 34-0-0 in spring and again in midsummer.
High	3 lb 15-0-15 in spring and again in midsummer.	3 lb 15-0-15 in spring and again in midsummer.	1-2 lb 34-0-0 in spring and again in midsummer.	1-2 lb 34-0-0 in spring and again in midsummer.
Very High	3 lb 15-0-15 in spring and again in midsummer.	3 lb 15-0-15 in spring and again in midsummer.	1-2 lb 34-0-0 in spring and again in midsummer.	1-2 lb 34-0-0 in spring and again in midsummer.

for Soil Groups 3 and 4; NOTE: The recommended amounts may be split into two or more applications.

Soil Group 3 or 4				Desired pH 5.5-6.0
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Per 1,000 square feet			
Very Low	3-4 lb 16-4-8	3-4 lb 16-4-8	1 lb 0-20-0 + 1-2 lb 34-0-0	1 lb 0-20-0 + 1-2 lb 34-0-0
Low	3-4 lb 16-4-8	3-4 lb 16-4-8	1 lb 0-20-0 + 1-2 lb 34-0-0	1 lb 0-20-0 + 1-2 lb 34-0-0
Medium	3-4 lb 15-0-15	3-4 lb 15-0-15	1-2 lb 34-0-0	1-2 lb 34-0-0
High	3-4 lb 15-0-15	3-4 lb 15-0-15	1-2 lb 34-0-0	1-2 lb 34-0-0
Very High	3-4 lb 15-0-15	3-4 lb 15-0-15	1-2 lb 34-0-0	1-2 lb 34-0-0

St. Augustinegrass (119)

390-393–Amounts of formulated fertilizer to be applied per 1,000 square feet. When only nitrogen is being applied, ammonium sulfate (21-0-0) at 2¼ pounds per 1,000 square feet or ammonium nitrate (34-0-0) at 1½ pounds per 1,000 square feet should be used.

Spring applications should be made when the grass has fully greened.

Sulfate of potash or muriate of potash can be added at 5 pounds per 1,000 square feet in late summer or early fall to harden the turf, or anytime to overcome magnesium or potassium deficiencies.

Soil Groups 1, 2, 3, or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Per 1,000 square feet			
Very Low	6 lb 16-4-8 once in spring and once in midsummer.	6 lb 16-4-8 once in spring and once in midsummer.	1 lb 0-20-0 and 2-3 lb 34-0-0 once in spring and once in midsummer.	1 lb 0-20-0 and 2-3 lb 34-0-0 once in spring and once in midsummer.
Low	6 lb 16-4-8 once in spring and once in midsummer.	6 lb 16-4-8 once in spring and once in midsummer.	1 lb 0-20-0 and 2-3 lb 34-0-0 once in spring and once in midsummer.	1 lb 0-20-0 and 2-3 lb 34-0-0 once in spring and once in midsummer.
Medium	6 lb 15-0-15 once in spring and once in midsummer.	6 lb 15-0-15 once in spring and once in midsummer.	2-3 lb 34-0-0 once in spring and once in midsummer.	2-3 lb 34-0-0 once in spring and once in midsummer.
High	6 lb 15-0-15 once in spring and once in midsummer.	6 lb 15-0-15 once in spring and once in midsummer.	2-3 lb 34-0-0 once in spring and once in midsummer.	2-3 lb 34-0-0 once in spring and once in midsummer.
Very High	6 lb 15-0-15 once in spring and once in midsummer.	6 lb 15-0-15 once in spring and once in midsummer.	2-3 lb 34-0-0 once in spring and once in midsummer.	2-3 lb 34-0-0 once in spring and once in midsummer.

Crop Code No. 044

Cool-Season Turf Grass Maintenance

407, 408, 418-424–Amounts of formulated fertilizer to be applied per 1,000 square feet of soil. For more growth or better color, 1 pound of nitrogen should be applied as ammonium nitrate or calcium nitrate in late January or early February.

Soil Group 1, 2, 3 or 4	Desired pH 5.8-6.5			
Phosphorus	Potassium			
	Low	Medium	High	Very High
Very Low	Sept: 9 lb 10-10-10 Nov: 9 lb 10-10-10 and 3 lb 34-0-0	Sept: 9 lb 10-10-10 Nov: 9 lb 10-10-10 and 3 lb 34-0-0	Sept: 9 lb 10-10-10 Nov: 2 lb 0-46-0 and 6 lb 34-0-0	Sept: 4 lb 0-46-0 and 3 lb 34-0-0 Nov: 5 lb 34-0-0
Low	Sept: 9 lb 10-10-10 Nov: 9 lb 10-10-10 and 3 lb 34-0-0	Sept: 9 lb 10-10-10 Nov: 9 lb 10-10-10 and 3 lb 34-0-0	Sept: 9 lb 10-10-10 Nov: 5 lb 0-20-0 and 6 lb 34-0-0	Sept: 4 lb 0-46-0 and 3 lb 34-0-0 Nov: 5 lb 34-0-0
Medium	Sept: 9 lb 10-10-10 and 2 lb 0-0-60 Nov: 6 lb 34-0-0	Sept: 9 lb 10-10-10 and 2 lb 0-0-60 Nov: 6 lb 34-0-0	Sept: 9 lb 10-10-10 Nov: 6 lb 34-0-0	Sept: 2 lb 0-46-0 and 3 lb 34-0-0 Nov: 5 lb 34-0-0
High	Sept: 3 lb 34-0-0 Nov: 12 lb 15-0-15	Sept: 3 lb 34-0-0 Nov: 12 lb 15-0-15	Sept: 3 lb 34-0-0 Nov: 6 lb 15-0-15 and 3 lb 34-0-0	Sept: 3 lb 34-0-0 Nov: 5 lb 34-0-0
Very High	Sept: 3 lb 34-0-0 Nov: 12 lb 15-0-15	Sept: 3 lb 34-0-0 Nov: 12 lb 15-0-15	Sept: 3 lb 34-0-0 Nov: 6 lb 15-0-15 and 3 lb 34-0-0	Sept: 3 lb 34-0-0 Nov: 5 lb 34-0-0

Crop Code No. 048

Zoysiagrass and Bermudagrass

425-430–The following amounts of fertilizer should be applied per 1,000 square feet of soil beginning after total green-up in the spring and again in midsummer.

Soil Group 1, 2, 3 or 4				Desired pH 5.8-6.5
Phosphorus	Potassium			
	Low	Medium	High	Very High
	Per 1,000 square feet			
Very Low	6 lb 16-4-8 and 4 lb 0-46-0 in spring; repeat 6 lb 16-4-8 in midsummer	6 lb 16-4-8 and 4 lb 0-46-0 in spring; repeat 6 lb 16-4-8 in midsummer	3 lb 34-0-0 and 4 lb 0-46-0 in spring; repeat 3 lb 34-0-0 in midsummer	3 lb 34-0-0 and 4 lb 0-46-0 in spring; repeat 3 lb 34-0-0 in midsummer
Low	6 lb 16-4-8 and 4 lb 0-46-0 in spring; repeat 6 lb 16-4-8 in midsummer	6 lb 16-4-8 and 4 lb 0-46-0 in spring; repeat 6 lb 16-4-8 in midsummer	3 lb 34-0-0 and 4 lb 0-46-0 in spring; repeat 3 lb 34-0-0 in midsummer	3 lb 34-0-0 and 4 lb 0-46-0 in spring; repeat 3 lb 34-0-0 in midsummer
Medium	6 lb 16-4-8 and 2 lb 0-46-0 in spring; repeat 6 lb 16-4-8 in midsummer	6 lb 16-4-8 and 2 lb 0-46-0 in spring; repeat 6 lb 16-4-8 in midsummer	3 lb 34-0-0 and 2 lb 0-46-0 in spring; repeat 3 lb 34-0-0 in midsummer	3 lb 34-0-0 and 2 lb 0-46-0 in spring; repeat 3 lb 34-0-0 in midsummer
High	6 lb 16-4-8 and 2 lb 0-46-0 in spring; repeat 6 lb 16-4-8 in midsummer	6 lb 16-4-8 and 2 lb 0-46-0 in spring; repeat 6 lb 16-4-8 in midsummer	3 lb 34-0-0 in spring; repeat in midsummer	3 lb 34-0-0 in spring; repeat in midsummer
Very High	6 lb 16-4-8 in spring; repeat in midsummer	6 lb 16-4-8 in spring; repeat in midsummer	3 lb 34-0-0 in spring; repeat in midsummer	3 lb 34-0-0 in spring; repeat in midsummer

Turf Establishment

409-417– Amounts of fertilizer to be incorporated into the soil per 1,000 square feet **before planting** grass.

Soil Group 1, 2, 3 or

Desired pH 5.5-6.0 for centipedegrass and carpetgrass,
5.8-6.5 for St. Augustinegrass and others

Phosphorus	Potassium			
	Low	Medium	High	Very High
	Per 1,000 square feet			
Very Low	20 lb 10-10-10	15 lb 10-10-10	12 lb 0-20-0 1 lb N	12 lb 0-20-0 1 lb N
Low	20 lb 10-10-10	15 lb 10-10-10	12 lb 0-20-0 1 lb N	12 lb 0-20-0 1 lb N
Medium	15 lb 10-10-10	15 lb 10-10-10	8 lb 0-20-0 1 lb N	8 lb 0-20-0 1 lb N
High	7 lb 15-0-15	7 lb 15-0-15	1 lb N	1 lb N
Very High	7 lb 15-0-15	7 lb 15-0-15	1 lb N	1 lb N

Amounts of formulated fertilizer to be applied **after establishment** of grass per 1,000 square feet.

Phosphorus	Potassium			
	Low	Medium	High	Very High
	Per 1,000 square feet			
Very Low	10 lb 10-10-10 after 4-6 weeks	10 lb 10-10-10 after 4-6 weeks	1 lb N after 4-6 weeks and 8-12 weeks	1 lb N after 4-6 weeks and 8-12 weeks
Low	10 lb 10-10-10 after 4-6 weeks	10 lb 10-10-10 after 4-6 weeks	1 lb N after 4-6 weeks and 8-12 weeks	1 lb N after 4-6 weeks and 8-12 weeks
Medium	7 lb 15-0-15 after 4-6 weeks and 8-12 weeks	1 lb N after 4-6 weeks and 8-12 weeks	1 lb N after 4-6 weeks and 8-12 weeks	1 lb N after 4-6 weeks and 8-12 weeks
High	7 lb 15-0-15 after 4-6 weeks and 8-12 weeks	1 lb N after 4-6 weeks and 8-12 weeks	1 lb N after 4-6 weeks and 8-12 weeks	1 lb N after 4-6 weeks and 8-12 weeks
Very High	7 lb 15-0-15 after 4-6 weeks and 8-12 weeks	1 lb N after 4-6 weeks and 8-12 weeks	1 lb N after 4-6 weeks and 8-12 weeks	1 lb N after 4-6 weeks and 8-12 weeks

APPENDIX

Laws and Regulations on Fertilizer and Agricultural Lime

The South Carolina Fertilizer Law (46-25 of 1976 Code of Laws) provides for the registration, correct labeling, inspection and analysis of fertilizers sold or offered for sale in South Carolina. The South Carolina Agricultural Liming Materials Act (Jan. 1, 1976) provides for the classification and labeling in terms of fineness, calcium carbonate equivalent (neutralizing value), and calcium and magnesium contents. Farmers should select agricultural liming materials on the basis of calcium carbonate equivalent, fineness and price. Dolomitic limestone should be selected when magnesium is needed. Refer to the website maintained by the Fertilizer Inspection Program at Clemson University http://fscs.clemson.edu/ins.htm for more specific information.

Agricultural limestone is used to neutralize soil acidity (raise soil pH) and to supply calcium and magnesium. The buffer pH and soil pH indicate the amount of lime needed to raise the pH to the desired range. A soil test is the only good measure to determine if lime is needed and if so, what source should be used.

Conversion Factors for Various Chemical Compounds Associated with Liming

$CaCO_3$	X	0.56	=	CaO	$MgCO_3$	X	0.48	=	MgO
$CaCO_3$	X	0.40	=	Ca	$MgCO_3$	X	0.29	=	Mg
CaO	X	0.71	=	Ca	MgO	X	0.60	=	Mg
CaO	X	1.78	=	$CaCO_3$	MgO	X	2.09	=	$MgCO_3$
Ca	X	1.40	=	CaO	Mg	X	1.66	=	MgO
Ca	X	2.50	=	$CaCO_3$	Mg	X	3.48	=	$MgCO_3$
$CaCO_3$	X	0.84	=	$MgCO_3$	$MgCO_3$	X	1.19	=	$CaCO_3$
$CaCO_3$	X	0.74	=	$Ca(OH)_2$					
$Ca(OH)_2$	X	1.35	=	$CaCO_3$					

For example, 100 pounds of $CaCO_3$ (calcium carbonate) has the same acid neutralizing power as 56 pounds of CaO (calcium oxide): 100 X 0.56 = 56.

Conversion Factors Related to Phosphorus and Potassium

Professional societies and scientific publications have adopted a uniform policy of expressing phosphorus and potassium on the elemental basis. Phosphorus is expressed as P instead of as P_2O_5, the oxide, and potassium is expressed as K instead of as K_2O, its oxide form. The Clemson Soil Laboratory reports available phosphorus and potassium on this elemental basis, as do most soil-testing laboratories. Phosphorus and potassium in fertilizer is expressed on the oxide basis, as concentrations of P_2O_5, and K_2O. For example, a formulation of 5-10-15 on a fertilizer bag would indicate that the material is 5 percent N (nitrogen), 10 percent P_2O_5 and 15 percent K_2O. The following conversion factors should be used to convert from one unit to another.

P_2O_5	X	0.44	=	P	P	X	2.29	=	P_2O_5
K_2O	X	0.83	=	K	K	X	1.205	=	K_2O

Examples: 60 lb K_2O X 0.83 = 49.8 lb K and 44 lb P X 2.28 = 100 lb P_2O_5

Calculations for CEC, Exchangeable Acidity and % Base Saturation of a Soil

1. Total CEC is calculated using the following formulas:

H. meq/100 gm of soil = 8 * (8.00 – measured buffer pH)
K, meq/100 gm of soil = lb/acre of extracted K ÷ 782
Mg, meq/100 gm of soil = lb/acre of extracted Mg ÷ 240
Ca, meq/100 gm of soil = lb/acre of extracted Ca ÷ 400
Na, meq/100 gm of soil = lb/acre of extracted Na ÷ 460
Total CEC of the soil = Sum of the results for above 5 cations (meq/100 gm soil).
Note: Extractable Na (lb/acre) is not printed on the Soil Analysis Report

Example:

SOIL ANALYSIS REPORT

Lab No.	Sample No.	Soil Code	Soil pH	Buffer pH	Soil Test Results (lb/A) P	K	Ca	Mg
1116	45	3	6.0	7.70	92 H	180 H-	732 M+	98 H

CEC (Meq/100 Gm Soil)	Acidity	% Base Saturation Ca	Mg	K	Na	Total
4.90	2.40	37.3	8.4	4.7	0.6	51.0

Cation	Calculation		Exchangeable, meq/100 gm of soil
H	= 8 * (8.00 – 7.70)	=	2.40 (Exchangeable Acidity)
K	= 180 ÷ 782	=	0.23
Ca	= 732 ÷ 400	=	1.83
Mg	= 98 ÷ 240	=	0.41
*Na	= 14 ÷ 460	=	0.03
Total CEC		=	4.90

**Amount of extractable Na is not given on the report; however it is measured and used in the calculations as shown above, which would be 14 pounds per acre in this example.*

2. Percent Base Saturation is determined by dividing the sum of K, Ca, Mg and Na (basic cations) by the Total CEC and multiplying by 100. For the above example, % Base Saturation can be calculated as follows:

Cation	Exchange Bases (meq/100 gm soil)	% Saturation	
K	0.23	100 x 0.23/4.90 =	4.7
Ca	1.83	100 x 1.83/4.90 =	37.3
Mg	0.41	100 x 0.41/4.90 =	8.4
Na	0.03	100 x 0.03/4.90 =	0.6
Total bases	2.50	% Base saturation =	51.0 (total of K, Ca, Mg, and Na)

Micronutrient Sources

Material	Micronutrient Content
Boron (B)	%B
Borax fine granular	11.3
Fertilizer borate	14.3
Fertilizer borate (concentrate)	22.2
Solubor	20.5
Manganese (Mn)	% Mn
Manganese sulfate	20-25
Manganese oxide	26-65
Tecmangam	20
Manganese chelate	6-10
Manganese frits	3-6
Zinc (Zn)	% Zn
Zinc sulfate	35
Zinc oxide	70-80
Zinc chelate	10
Zinc frits	4-7
Iron (Fe)	% Fe
Iron sulfate	20
Iron chelate	6-12
Iron frits	14
Copper (Cu)	% Cu
Copper sulfate	25
Copper oxide	50-75
Copper sulfate (tri-basic)	54
Molybdenum (Mo)	% Mo
Sodium molybdate	30-41
Molybdic oxide	47

Liming Materials

Materials	Name	Neutralizing Value
CaO	Calcium oxide or burned quick lime	179
$Ca(OH)_2$	Calcium hydroxide, slake lime, hydrated lime or builders lime	135
$CaMg(CO_3)_2$	Dolomitic lime	85-109
$CaCO_3$	Calcitic lime	85-100
CaO + Impurities*	Basic slag (depending on source)	25-70

*May contain magnesium, manganese, iron and phosphorus

Analysis of Some Materials that Supply Calcium, Magnesium and Sulfur

Material	Average Percent					
	N	P_2O_5	K_2O	Ca	Mg	S
Magnesium Sulfate (Epsom salts)					9.7	13
Calcium Sulfate (Gypsum)				22.3		17
Sulfate of Potash-Magnesia			18-22		11.2	22.7
Superphosphate (Normal)		18-20		20.4		12-14
Superphosphate (Concentrated)		30-50		16.0		1.4
Ammonium Sulfate	21					21-23
Potassium Sulfate			48-51			17-18
Elemental Sulfur						50-99
Ammonium Phosphate	11	48				2.2
Ammonium Phosphate (Sulfate)	16	20				15.4
Manganese Sulfate						14-17
Ammonium thiosulfate	12					26
Calcium Nitrate	15.5			20		
Nitrogen Solution (25-S)	25					3.5
Nitrogen Solution (28-S)	28					3.5

Conversion of Pounds Per Acre to Smaller Areas

Lime or Fertilizer	Pounds per 100 sq ft	Pounds per 1000 sq ft	Pounds per 100 ft of Row
lb per acre			**3-foot width**
400	1.0	10	3.0
600	1.5	15	4.5
800	2.0	20	6.0
1,000	2.5	25	7.5
1,200	3.0	30	9.5
1,400	3.5	35	10.5
1,600	4.0	40	12.0
1,800	4.5	45	13.5
1,900	5.0	50	15.0

1 acre = 43,560 square feet
1 pint = approximately one pound of fertilizer

CROP CODE INDEX, NUMERICAL

Code	*Crop*
000	No recommendations given; for diagnostic purposes and pine trees
001	Cotton
004	Soybeans
005	Annual Legume on summer grass pasture
006	Annual Legume on winter grass pasture
007	Annual Legumes (arrowleaf, yuchi, crimson, etc.)
008	Peanut
010	Lespedeza, Common
011	Lespedeza, Sericea
013	Kiwi
014	Pumpkins
015	Shrubs*
016	Perennial Flowers*
017	Annual flowers*
017	Roses*
018	Trees, Ornamental and Shade*
019	Soybeans with sorghum for silage
020	Corn, grain
021	Corn (in rotation before peanuts or soybeans
022	Corn - Irrigated
023	Corn for Silage
024	Grain Sorghum for Silage
025	Grain Sorghum for Grain
026	Sweet Sorghum
027	Sugarcane
028	Sunflowers
029	Small Grain, for grain
030	Small Grain (in rotation before peanuts or soybeans)
031	Fescue, Cool Season Perennial Pasture
032	Orchardgrass, Cool-Season Perennial Pasture
033	Bahiagrass Pasture
034	Bermudagrass Pasture
035	Bermudagrass, Establishing
036	Bahiagrass for Hay
036	Bermuda for Hay (and coastal bermuda)
037	Grass-Clover Pasture (cool season perennial grass)
038	Temporary Annual Grazing, Winter
039	Temporary Annual Grazing, Summer
040	Athletic Fields
041	Golf Fairway
042	Bentgrass Golf Green
043	Bermudagrass Golf Green/Tee
044	Cool-Season Grass Maintenance*
045	Roadside Turf Establishment
046	Roadside Turf Maintenance
047	Turf Establishment*
048	Zoysiagrass and Other Warm Season Turf Grass Maintenance*
049	Greenhouse Crops, Inorganic Soils
050	Alfalfa
051	Asparagus, Establishing
052	Cantaloupes
053	Cucumbers
054	Lettuce
055	Lima Beans
056	Okra
057	Snapbeans
058	Squash
059	Watermelons
060	Beets
061	Broccoli
062	Cabbage
063	Carrots
064	Collards
065	Eggplant
066	Asparagus, Maintenance
067	Onions, Green (Soil Code 1 or 2)
068	Onions
069	Pepper
070	Pole Beans
071	Spinach
072	Greens
073	Blackeyed Peas
073	Southern Peas
074	Strawberries
075	Sweet Corn
076	Sweet Potatoes
077	Tomatoes (Piedmont)
078	Tomatoes (Coastal Plains)
079	Cauliflower
080	Apples
081	Pears
082	Blueberries
084	Grapes (Bunch or Muscadine)
085	Nectarines
086	Peaches
087	Plums
088	Pecans

* Indicates recommendations are for small areas rather than on an acre basis

Code	***Crop***
089	Home Orchards*
090	Home Garden* -includes inorganic fertilization
091	Home Garden* -includes organic fertilization
092	Christmas Trees
093	Carpetgrass*
094	Centipedegrass*
095	Irish Potatoes
096	Azaleas*
096	Camellias*
096	Rhododendron*
097	Tobacco, Low Profile
098	Tobacco Bed
099	Tobacco
101	Grasses for Wildlife
102	Legumes for Wildlife
103	Grass/Legume Mixture for Wildlife
104	Canola
105	St. Augustinegrass
106	Carpetgrass
107	Centipedegrass
108	Annual Flowers
108	Roses
109	Azaleas
109	Camellias
109	Rhododendron
110	Perennial Flowers
111	Bentgrass Golf Green*
112	Cool-Season Turf Grass Maintenance
113	Turf Establishment
114	Zoysiagrass and Other Warm-Season Turf Grass Maintenance
117	Shrubs
118	Bermudagrass Golf Green or Tee*
119	St. Augustinegrass*

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CROP CODE INDEX, ALPHABETICAL

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Crop	***Code***	***Page***
St. Augustinegrass	105	53
St. Augustinegrass*	119	68
Strawberries	74	49
Sugarcane	27	35
Sunflowers	28	35
Sweet Corn	75	45
Sweet Potatoes	76	45
Sweet Sorghum	26	35
Temporary Annual Grazing, Winter or Summer	39	38
Tobacco	99	39
Tobacco Bed	98	39
Tomatoes (Coastal Plains)	78	46
Tomatoes (Piedmont)	77	46
Trees, Ornamental and Shade*	18	63
Turf Establishment	113	54
Turf Establishment*	47	71
Watermelons	59	41
Zoysiagrass	114	54
Zoysiagrass*	48	70

* Indicates recommendations are for small areas rather than on an acre basis