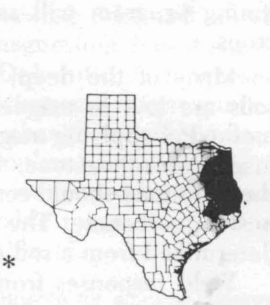
FACT SHEET

CROP FERTILIZATON ON EAST TEXAS SOILS



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Most East Texas soils are acid and low in major plant nutrients. As shown in Table 1, 79 percent of samples tested were low in phosphorus, and 61 percent were low in potassium. In addition to low fertility, 42 percent were below pH 6.0. Returns for money invested in limestone and fertilizer depend on cropping and management systems. Much East Texas land is used for pasture. Thus higher fertilization generally means higher per acre production which requires better grazing management to utilize the additional forage.

Source of Nitrogen

Differences between sources of nitrogen have generally been small. However, with the high and varying cost per pound of N, efficiency becomes more important and small differences must be recognized. The time and method of application can affect the results from any given source of N.

Applying nitrogen just prior to the period of peak requirement has generally been most efficient. Except for the problem of applying high rates of limestone on the surface along with ammonium nitrogen, concern about losses from topdressed nitrogen has centered around urea. Urea, with nitrogen in the NH_2 form, is hydrolized (adds water) with the help of the enzyme urease to form ammonia (NH_3) and other compounds according to the following reaction:

$$\underset{\text{Urea}}{(NH_2)_2C=O} + \underset{\text{water}}{3H_2O} \xrightarrow{\text{urease}} \underset{\text{ammonia}}{2NH_3} + 2H_2O + \underset{\text{carbon dioxide}}{CO_2}$$

If the reaction takes place in the soil, the ammonium becomes attached to the clay. However, on the surface some can escape to the air as ammonia gas. The reaction is affected by environmental conditions including temperature and moisture. Where the temperature is above 70 degrees F, the losses can be substantial. If rain or irrigation water dissolves and carries the urea into the soil no loss is expected.

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Research indicates that urea can be expected to be about 80 percent as effective as other common nitrogen sources applied to East Texas soils during the hot summer. Suggestions and limitations regarding methods for applying some sources of N are as follows:

1. Urea or mixtures containing urea should be put in the soil.

2. Concentrated nitrogen solutions should not be sprayed on vegetation. Dribbling on the soil surface is preferred.

3. Where surface applications of lime have been made within 6 months prior to fertilization, the nitrogen material (especially urea and ammonium sulfate) should be put in the soil.

4. Urea is less acidifying than other ammonium sources.

N, P_2O_5 and K_2O for Major Crops

The wide range in soil fertility levels of East Texas soils calls for management practices and fertilization adapted to specific production requirements. Soil tests, properly calibrated to express available nutrients and correlated with crop response, are the best guide to profitable fertilization. Two important criteria needed for selecting the profitable rate of a nutrient are: (1) the level of available nutrient in the soil, and (2) the expected yield or production goal.

Many soil properties, as well as the amount of extractable nutrients, must be evaluated in grouping soils as a means of expressing the level of available nutrients. The expected yield expresses potential productivity to include anticipated moisture and management conditions.

Suggested rates of N, P_2O_5 and K_2O for varying soil test levels and expected crop yields are shown in Tables 2 through 10. These levels are based on Texas A&M University soil testing methods and calibrations. To use these tables, determine the soil test level in the left column and read across to the expected yield column for the rate of nutrient. For example, in Table 4 a soil very low (VL) in nitrogen, low (L) in phosphorus and very low (VL) in potassium

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would need 400-80-200 to yield 8 tons of Coastal bermudagrass per acre.

Calcium, Magnesium and Sulfur

In East Texas a high proportion of the soils are low in calcium, especially if not limed. However, a good liming program will supply adequate calcium for crops.

Many of the deep, highly leached, acid, sandy soils are low in magnesium. The most economical method of applying magnesium is through the use of magnesium limestone. For soils low in magnesium, the limestone should contain at least 10 percent magnesium carbonate. The need for magnesium can be determined from a soil test.

Yield responses from applications of sulfur have been obtained on some East Texas soils. This has occurred with Coastal bermudagrass grown on deep sandy soils under high nitrogen fertilization with adequate phosphorus and potassium. Many mixed fertilizers are formulated from materials containing sulfur. This is one of the most economical methods of sulfur fertilization.

Sulfur deficiency causes plants to lack chlorophyll and appear light green. This can be confused with nitrogen deficiency. Sulfur fertilization should not be considered unless the supply of nitrogen is adequate.

On deep sandy soils where more than 300 pounds of actual nitrogen is used for Coastal bermudagrass, the following sources and rates should be considered:

Source	Annual rate lb./acre
Ammonium sulfate*	150
Calcium sulfate (gypsum)	200
Elemental sulfur (very fine)	30**

*Will also supply 31 pounds of N.

**Enough can be applied in a single application to last 2 to 3 years. However, high rates produce more acidity. 1 pound of sulfur neutralizes 3 pounds of calcium carbonate.

Soil Testing

Soil test summary data reported in Table 1 were obtained from topsoil samples and do not indicate the nutrient content of subsoils. The fact that research data from the Texas A&M University Research and Extension Center at Overton show low responses to P and K fertilization indicates that subsoils make a significant contribution to the nutrient requirement of deep rooted crops such as Coastal bermudagrass. Fertility levels of subsoils must receive more consideration in soil sampling and fertilization.

Soil tests provide the best method for evaluating fertility levels of soils. Obtaining the greatest benefit from soil tests involves the following:

1. *Good samples.* Composite samples to represent the plowlayer for cultivated fields and top 3 to 4 inches for perennial sods.

2. *Regular sampling plan.* Each field should be sampled at 2- to 4-year intervals, depending on the cropping system. Sampling ¼ to ½ of the farm each fall or winter is a good plan.

3. *Map and record.* A farm map with permanent field numbers serves as a permanent record to compare results from previous samples.

4. *Use results.* Be able to translate soil test results and suggested rates of plant nutrients and limestone into a profitable soil fertility program.

Micronutrients

The micronutrient group includes seven elements — iron, zinc, manganese, copper, boron, molybdenum and chlorine. The greater availability of most micronutrients in acid soils and current low levels of production have caused micronutrient deficiencies to go unnoticed in East Texas. Problems may be encountered in small areas or under unusual soil conditions.

The principle involved in using micronutrients is the same as for other nutrients — to identify and confirm the need, then apply amounts sufficient to meet production requirements.

Conversion Factors

Fertilizers are labeled as percent P_2O_5 and K_2O and soil test values are reported in these terms. However, plant analyses results usually are reported as percentages of the element. For this reason, the following factors are presented for use in converting from one form to the other.

From P_2O_5	to P	multiply P_2O_5	by .44
From P	to P_2O_5	multiply P	by 2.3
From K_2O	to K	multiply K_2O	by .83
From K	to K_2O	multiply K	by 1.2

Liming Acid Soils

The soil pH should be known before liming acid soils. In addition to pH, the cropping system and soil properties are considered in determining application rate.

The desirable pH to maintain in a soil is determined by the crops to be grown. Legumes are classified as high calcium or high pH crops and most non-legumes are low calcium or low pH crops.

Grain sorghum appears to be less tolerant to acidity than corn and grasses. An important means of raising the pH of an acid soil is to apply lime which converts aluminum and manganese to less soluble compounds. For desirable pH ranges for specific crops see L-164, *Soil Reaction (pH) Ranges*, available from the county Extension agents.

Rates and Types of Limestone. Once the soil pH is obtained from a reliable soil test and the desirable range determined for the crops being grown, three questions need answers. Does the soil need lime? What is the lime requirement? Should magnesium limestone be used? Lime requirement is defined as the amount of limestone needed to bring the pH into the desired range and/or maintain it for at least 3 years.

Soils are limed to raise the pH and to keep them in this range for 3 to 5 years. Therefore, conditions that contribute to the development of acidity are considered in determining the lime requirement. Probably the most common contribution to the rapid development of acidity is the application of high rates of ammonium nitrogen. When ammonium is oxidized to nitrate by nitrifying bacteria, hydrogen is activated to produce acidity. Therefore, for each 100 pounds (N) of ammonium nitrogen to be applied, the lime requirement should increase about 300 pounds per acre. For example, the lime requirement for Coastal bermudagrass, to be fertilized with 300 pounds of N annually from ammonium nitrate (150 pounds of ammonium N), would be increased about 1,250 pounds or ½ ton during a 3-year period.

The major soil property influencing the lime requirement is the clay content, expressed as soil texture. Clay contributes to the cation exchange capacity which determines the amounts of calcium and magnesium required to raise the pH. A general lime requirement guide is presented in Table 11.

Need for Magnesium Limestone. The best basis for deciding whether to use magnesium limestone is a soil test for magnesium. Dolomitic or magnesium limestone is a mixture of calcium and magnesium carbonates. It brings about a change in pH similar to calcitic limestone, and it supplies magnesium. It can be used on all soils but is most needed for those soils low in magnesium. Extractable magnesium and soil test ratings are shown in Table 12.

Table 1. Percentage distribution of East Texas soils in five ranges for phosphorus, potassium, magnesium and pH.

	Percent of samples at each level				
Soil test level	Phosphorus	Potassium	Magnesium	Soil pH range	Percent
VL	58	14	—	Below 5.0	3
L	21	47	18	5.1 - 5.5	12
M	14	22	53	5.6 - 6.0	27
H	5	14	29	6.1 - 6.5	30
VH	2	3	—	Above 6.5	28

Table 2. Application rates of nutrients for summer perennial grass grazing (bermuda, bahia, etc.).*

Soil test level	4 tons/acre (¾ to 1 a.u.)		
	N	P_2O_5	K_2O
VL	160	60	80-100
L	120	40	50-90
M	80	20	0-60
H	—	0	0
VH	—	0	0

*If a legume such as crimson is planted, apply P_2O_5 and K_2O in the fall and delay nitrogen until that furnished by clover is used.

Table 3. Application rates of nutrients for establishing Coastal bermudagrass.

Soil test level	At sprigging			First summer		
	N*	P_2O_5	K_2O	N	P_2O_5	K_2O
VL	40	80	70-90	40	0	40-60
L	30	60	60-80	30	0	30-50
M	30	40	50-70	30	0	0
H	—	0	0	—	0	0
VH	—	0	0	—	0	0

*May want to delay until growth begins.

Table 4. Application rates of nutrients for three levels of Coastal bermudagrass (bahia or common bermudagrass) hay production.*

Soil test level	Expected yield 6 tons/acre (three cuttings)			Expected yield 8 tons/acre (four cuttings)			Expected yield 10 tons/acre (five cuttings)		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
VL	280	80	140-200	400	100	180-240	540	120	220-280
L	220	60	80-130	340	80	140-180	480	100	180-220
M	160	40	50-70	280	60	100-140	400	80	140-180
H	—	0	0	—	40	60-100	—	60	80-120
VH	—	0	0	—	0	0	—	40	0-80

*Would be similar for other perennial grasses.

Table 5. Application rates of nutrients for Arrowleaf or crimson clover or for similar legumes in established bermudagrass sods.

Soil test level	Clover fall planting[1]			Following summer			
				Grazing[2]	Hay[3]		
					4 tons	6 tons	
	N	P_2O_5	K_2O	N	N	N	K_2O
VL	0	80	120	120	120	160	60
L	0	60	100	80	80	120	40
M	0	40	60	40	40	80	0
H	—	40	0	—	—	—	0
VH	—	0	0	—	—	—	0

[1]Omit N and use about 2/3 the rate of P_2O_5 for vetch and peas. Reduce further for 16- to 20-inch drill spacing.
[2]1 a.u./acre
[3]4 tons — two cuttings, 6 tons — three cuttings.

Table 6. Application rates of nutrients for ryegrass, oats and similar winter grasses (no legume).[1]

Soil test level	Spring production			Fall, winter and spring production		
	N[2]	P_2O_5	K_2O	N[2]	P_2O_5	K_2O
VL	100	40	40-60	220	80	90-110
L	80	30	30-40	160	60	70-90
M	60	20	0-30	120	40	50-70
H	—	0	0	—	30	0
VH	—	0	0	—	0	0

[1]Grazing period about 6 months.
[2]Divide N into 2 or 3 applications.

Table 7. Application rates of nutrients for seeding and maintenance of S_1 Louisiana white clover-grass pasture.

Soil test level	At or before planting			Grazing maintenance[1]		
	N	P_2O_5	K_2O[2]	N[3]	P_2O_5	K_2O[2]
VL	0	120	120-180	0	80	120-180
L	0	100	100-120	0	60	100-120
M	0	80	80-100	0	40	80-100
H	—	60	40-80	—	0	40-80
VH	—	0	0	—	0	0

[1]Annual topdressing after first year.
[2]May apply half the next spring after seeding.
[3]Nitrogen topdressing may be needed in midseason depending on management and grazing requirements.

Table 8. Application rates of nutrients for three levels of corn production.

Soil test level	60 to 75 bu./acre			75 to 100 bu./acre			100 to 125 bu./acre		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
VL	80	40	50-70	100	60	70-90	140	80	80-120
L	60	30	30-50	80	50	50-70	120	60	70-80
M	40	20	0-20	60	40	30-50	100	40	50-70
H	—	0	0	0	0	0	—	30	30-50
VH	—	0	0	0	0	0	—	0	0

Table 9. Application rates of nutrients for three levels of grain sorghum production.

Soil test level	Expected yield 4,000 lbs./acre			Expected yield 5,000 lbs./acre		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
VL	75	50	50-70	100	60	70-90
L	55	40	30-50	80	50	50-70
M	30	30	20-30	60	40	30-50
H	—	0	0-20	—	30	20-30
VH	—	0	0	—	0	0

Table 10. Application rates for soybeans.*

Soil test level	For the production of from 35 to 40 bu./acre		
	N	P_2O_5	K_2O
VL	0	60	60
L	0	40	40
M	0	20	20
H	0	0	0
VH	0	0	0

*Inoculated soybeans can get nitrogen from the atmosphere. However, on new fields where soybeans have never been grown, up to 20 to 30 lbs. of nitrogen per acre may be included in the fertilizer application to supply nitrogen until good inoculation is attained.

Table 11. Rates of limestone.

Desired pH range*		Rates in tons/acre		
High Ca crops	Low Ca crops	Sands	Sandy loams and loams	Clays and clay loams
6.0-6.4	5.6-5.9	1	1	1½
5.6-5.9	5.3-5.5	1	1½	2
5.3-5.5	5.2 & below	2	2½	3
5.2 & below	—	2½	3	4

*High-calcium crops are legumes and legume-grass mixtures. The pH levels under low-calcium crops are for grasses and row crops.

Table 12. Ratings for magnesium.

Lb./acre Magnesium[1]	Soil test rating
0-75	Low[2]
75-250	Medium
above 250	High

[1]Refers to the soil testing methods and calibrations used by Texas A&M University.
[2]Limestone containing at least 10% magnesium carbonate should be used for soils low in this nutrient.

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