FACT SHEET

L-771

CROP FERTILIZATION ON EAST TEXAS SOILS

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This land resource area, Figure 1, includes 16 million acres of forest, pasture and cropland. Elevation ranges from 200 to 700 feet with an annual rainfall from 40 to 56 inches.

Soil Characteristics

Upland soils range from light brown to red. Top soil is usually sandy with sandy loam to clay subsoils. A limited acreage is poorly drained. Because of their sandy texture, the water-holding capacity of these soils is low. However, rainfall is distributed reasonably well throughout the growing season. These soils are relatively easily managed and responsive to good management.

Soil Fertility Levels

Most East Texas soils are acid and low in major plant nutrients. As shown in Table 1, 43 percent of samples tested were low in organic matter; 76 percent low in phosphorus; and 54 percent low in potassium. In addition to low fertility, 56 percent were below pH 6.5. 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 produced.

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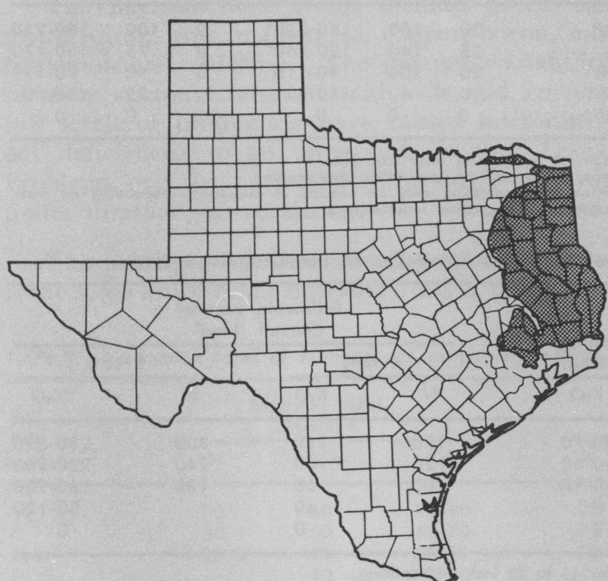

Figure 1. Location of East Texas region

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 12. 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 3 a soil very low (VL) in nitrogen, low (L) in phosphorus and very low (VL) in potassium would show a need for 400-80-300 for 8 tons of Coastal bermudagrass.

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.

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Although a sufficient number of analyses for magnesium are not available to determine the extent of needs, a preliminary appraisal indicates that many of the deep, highly leached, acid sandy soils are low in this nutrient. 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.

Table 1. Percentage distribution at East Texas soils in five ranges for organic matter, phosphorus, potassium and pH.

Soil test level	Percentage of samples at each level: Organic matter	Phosphorus	Potassium	Soil pH range	Percent
VL	10	55	14	Below 5.0	1
L	33	21	40	5.1-5.5	4
M	29	16	30	5.6-6.0	18
H	15	5	9	6.1-6.5	33
VH	13	3	7	Above 6.5	44

Table 2. 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	100	70-90	40	0	40-60
L	30	80	60-80	30	0	30-50
M	30	60	50-70	30	0	0
H		0	0		0	0
VH		0	0		0	0

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

Soil test level	2 tons/A			4 tons/A		
	N[2]	P_2O_5	K_2O	N[2]	P_2O_5	K_2O
VL	80	40	30-50	180	80	90-110
L	60	30	20-40	120	60	70-90
M	40	20	0-30	80	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 3. Application rates of nutrients for three levels of Coastal bermudagrass hay production

Soil test level	Expected yield 6 tons/A			Expected yield 8 tons/A			Expected yield 10 tons/A		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
VL	280	80	180-220	400	100	280-320	550	120	380-420
L	220	60	120-160	320	80	220-260	480	100	320-360
M	180	40	70-90	280	60	160-200	360	80	240-280
H		0	50-70		40	80-120		60	180-220
VH		0	0		0	0		40	80-120

Table 4. Application rates of nutrients for common bermuda grass and related summer grasses maintenance—two grazing intensities[1]

Soil test level	2 tons/A			4 tons/A		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
VL	80	40	30-50	180	60	90-110
L	60	30	20-40	160	40	70-90
M	40	20	0-30	120	20	50-70
H		0	0		0	0-40
VH		0	0		0	0

[1]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 the clover is used.

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	N[3]	P_2O_5	K_2O
VL	30	180	180-220[2]	0	100	180-220
L	25	140	120-160[2]	0	75	130-170
M	20	100	90-110	0	50	80-120
H	0	60	40-80		25	50-70
VH	0	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 5. Application rates of nutrients for crimson clover, vetch or similar legumes in established bermudagrass sods

Soil test level	Crimson Clover Fall planting[1]			Following summer Common (grazing)[2]		Following summer Coastal (hay)[3]: 4 tons		8 tons	
	N	P_2O_5	K_2O	N	K_2O	N	K_2O	N	K_2O
VL	25	150	180-220	120	50-70	150	150	300	280-320
L	20	100	120-160	100	40-60	120	100	240	220-260
M	0	60	80-100	80	30-50	100	60	180	160-200
H		40	60-80		0		40		80-120
VH		0	0		0		0		0

[1]Omit N and use about half the rate of P_2O_5 for vetch and peas. Reduce further for 16 to 20 inch drill spacing.
[2]One a.u./A.
[3]Use 4 tons production for grazing represents about 1 a.u./A.

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

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

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. A satisfactory soil test for available sulfur is not available; the use of sulfur-containing fertilizers should be based on trial plots, observations of deficiency symptoms and plant composition.

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.

Where sulfur is needed, the following rates should be considered:

SOURCE	ANNUAL RATE/A[1]
Sulfate[2]	200 lb. SO_4
Elemental (very fine) sulfur[3]	40 lb. S

[1]Preliminary research data indicate twice these rates can be applied every other year except for ammonium sulfate.

[2]Can be obtained by using fertilizers formulated from ordinary superphosphate, ammonium sulfate or other sources.

[3]Should be applied at least 6 months before period needed by crop.

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; this is to identify and confirm the need, then apply amounts sufficient to meet production requirements.

Table 10. Application rates of nutrients for grain sorghum—three production levels.

Soil test level	Expected yield 3,000 lb./A			Expected yield 4,000 lb./A			Expected yield 5,000 lb./A		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
VL	50	40	30-50	75	50	50-70	100	60	70-90
L	30	30	20-30	55	40	30-50	80	50	50-70
M	0	20	0-20	30	30	20-30	60	40	30-50
H		0	0		20	0-20		30	20-30
VH		0	0		0	0		0	0

Table 11. Application rates of nutrients for alfalfa

Soil test level	New seeding			Annual maintenance		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
VL	30	200	180-220[1]	0	100	180-220[2]
L	25	150	130-170[1]	0	75	130-170[2]
M	20	100	80-120	0	50	80-120
H		50	40-60		25	40-60
VH		0	0		0	0

[1]Half may be applied next spring after seeding.

[2]Apply half after the second harvest.

Table 12. Application rates for soybeans[1]

Soil test level	For the production of from 35 to 40 bu./acre		
	N	P_2O_5	K_2O
VL	0	60	100-140
L	0	40	70-90
M	0	20	30-50
H		0	0
VH		0	0

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

Table 9. Application rates of nutrients for cotton—three production levels.

Soil test level	Expected yield 1 bale/A			Expected yield 1½ bale/A			Expected yield 2 bales/A		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
VL	70	60	70-90	90	80	80-120	120	100	100-140
L	50	50	50-70	70	70	70-90	100	80	80-120
M	30	40	30-50	50	60	50-70	80	70	60-100
H		30	20-30		40	30-50		60	50-70
VH		0	0		0	0		0	0

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 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 nonlegumes are low calcium or low pH crops. An important means of raising the pH of an acid soil is to convert 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. First, does the soil need lime; second, what is the lime requirement; and third, 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 three years.

Soils are limed to raise the pH, if below the desired range, and to keep it 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 amount of clay 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 follows:

Table 13. Rates of limestone

Desired ph range[1]		Rates in tons/A		
High Ca crops	Low Ca crops	Sands	Sandy loams and loams	Clays and clay loams
6.0-6.4	5.8-6.2	1	1	1½
5.6-5.9	5.4-5.7	1	1½	2
5.0-5.5	5.0-5.3	2	3	4

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

Table 14. Ratings for magnesium

Lb/A 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.

Need for Magnesium Limestone

The best basis for deciding whether to use magnesium limestone is from soil test results for magnesium. Dolomitic or magnesium limestone is a mixture of calcium and magnesium carbonates. This liming material brings about a similar change in pH as calcitic limestone and supplies magnesium. It can be used on all soils but is most needed for those soils low in magnesium. If used and high fertilization is followed, sulfur may be needed in the fertilizer.

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