FACT SHEET

L-1538

FORAGE FERTILIZATION ON TEXAS BLACKLAND AND GRAND PRAIRIE SOILS

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The Blackland and Grand Prairie regions (Figure 1) include 20 million acres of widely varied soils. Most soils are upland, but there are also more than 2 million acres of alluvial soils. Three-fourths of the Grand Prairie and about half the Blackland are rangeland. A limited acreage is used for forage production.

Characteristics of Soils

Most soils are high in clay, and productivity generally is regulated by available moisture. When soils are dry, initial water intake is high. However, the presence of montomorillionitic-type clay results in swelling and closure of pores and cracks and a reduced infiltration rate during swelling.

The mineral and rock deposits from which these soils are formed are generally high in carbonates; therefore, soils have a high base status.

Soil Fertility Status

Forages are generally produced on land that is not well suited for other crops. Hence, low fertility is generally a major problem.

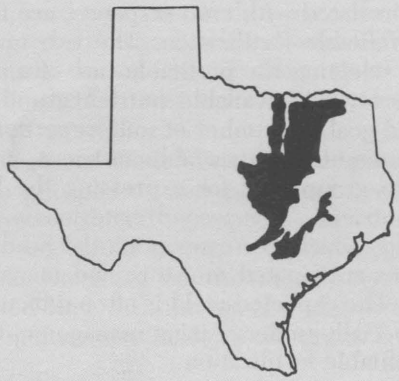

Fig. 1. Location of Blackland and Grand Prairie Regions.

Soil characteristics, past fertilization and cropping practices have resulted in a wide range of fertility levels in these soils. Additions of nitrogen and phosphorus give good responses on much of the cropland. For example, soil test summary data in Table 1 show 70 percent of samples tested to be low or very low in phosphorus. This included a high proportion of samples for row crops, so an even higher percentage would be anticipated for forage crops.

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Collecting Soil Samples

The fertility of a soil can be measured by a soil test provided a representative sample is obtained. It is essential to follow the sampling instructions on information sheets available from the Soil Testing Laboratory. Measuring residual fertilizer, especially top-dressed phosphorus, requires that soil be collected from the top 3 to 4 inches. For small grains, forage sorghums and other crops planted on a prepared seed bed, the residual phosphorus is mixed into the soil and sampling should be from the plowlayer as for row crops.

In using soil test values, consider these points:

1. Have a map with permanent field boundaries and numbers.
2. Establish a plan for sampling all fields at 3- to 4-year intervals or one-third to one-fourth of the fields each year.
3. Keep a record and compare yearly results to determine changes over a period of time.

N, P_2O_5 and K_2O for Major Crops

The wide range in fertility levels throughout Blackland and Grand Prairie soils requires that fertilization practices be adapted to specific conditions. Soil tests, properly calibrated to express available nutrients and correlated with crop response, are the best guide to profitable fertilization. The two important criteria for selecting the profitable rate of a nutrient are: (1) the level of available nutrients; and (2) expected yield goal. A number of soil properties, along with the amount of extractable nutrient, must be evaluated to group soils for expressing the level of available nutrient. The second criterion is the expected yield, which expresses potential productivity and includes anticipated moisture and management conditions. The expected yield is often difficult to estimate, especially under grazing management, but is vital to profitable fertilization.

Rates of N, P_2O_5 and K_2O at varying soil test levels and expected yields for major crops are shown in Tables 2 through 7. Soil test levels used in these tables are based on Texas A&M University procedures 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, using Table 2, a soil low (L) in nitrogen, low (L) in phosphorus and high (H) in potassium would show 140-60-0 for 4 and 5 tons per acre production of forage sorghum. This would require two applications, 80-60-0 at planting and 60-0-0 after the first harvest. In addition to the rate of nitrogen, the source and time of application must be considered.

Sources of Nitrogen Fertilizers

Which source of nitrogen to use is often a difficult decision, especially where the choice of materials is limited and there is a wide price range. However, any comparison should be based on cost per pound of N. The following chart can be used to determine the pounds of N per ton and cost in relation to anhydrous ammonia.

Material	% N	lbs. N/ton	Relative comparison
Anhydrous ammonia	82	1640	100
Urea	45	900	55
Ammonium nitrate	34	680	41
32% N solution	32	640	39
Ammonium sulfate	21	420	26

For example, if anhydrous ammonia costs $200 per ton, an equal value of nitrogen would be $110 for urea, $82 for ammonium nitrate and $52 for ammonium sulfate. This comparison is based strictly on nitrogen content. Handling and transportation costs would vary among materials.

Soil properties, the crop requirement, method of application and time of application should be considered in selecting a nitrogen source. Research data show that low efficiency can result from losses of nitrogen from some fertilizers applied on the surface of alkaline (free calcium carbonate) Blackland and Grand Prairie soils. Under such conditions, it is preferable to apply the fertilizer at least 2 inches in the soil. Chemical reactions which produce ammonia, carbon dioxide and water cause nitrogen loss. Losses are greatest with high soil moisture, high temperature and high calcium carbonate content in the soil. Therefore, considerable variation in losses has been observed due to the combination of conditions that exists in a given field at the time fertilizer is applied.

Time for Nitrogen Application

To insure high yields, adequate amounts of nitrogen must be available throughout the growing season. This nutrient is absorbed and converted to protein and other compounds within a short time. This means that a constant nitrogen supply in the ammonium or nitrate form must be present to meet daily crop requirements. The peak requirement, as well as the total needed for the season, must be satisfied to produce top yields. For these reasons the greatest efficiency from nitrogen fertilization is obtained when it is applied just before it is needed by the crop; however, this is not always the most convenient or economical way.

When considering the best time to apply nitrogen, evaluate the following points:

- Ammonium (ammonia) nitrogen is held by clay particles against leaching.
- Nitrate nitrogen moves with water and can be lost through leaching, especially in coarse-textured soils.
- Some nitrogen can be lost from soil through bacterial denitrification, whereby nitrogen evolves as a gas under anaerobic or water-logged conditions.
- Denitrification increases as temperatures rise, especially above 50 degrees F.

Calcium, Magnesium and Sulfur

Blackland and Grand Prairie soils normally are very high in calcium because of the composition of the parent material. The magnesium levels appear adequate for current production levels. Sulfur, the third secondary nutrient, has been studied less than major nutrients. However, sulfur released from organic matter and that supplied by normal sources of plant nutrients is adequate to prevent widespread deficiencies. Sulfur responses have not been reported for the Blackland and Grand Prairie regions.

Micronutrients

The micronutrient group includes seven elements: iron, zinc, manganese, copper, boron, molybdenum and chlorine. The amounts of these micronutrients in Blackland and Grand Prairie soils appear to be adequate for current levels of production of field crops. However, there are conditions resulting in deficiencies of zinc and/or iron. See Extension leaflets L-721 and L-723, available from county Extension agents, for a more complete discussion of these nutrients.

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

Conversion Factor

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 by .44
From P to P_2O_5 multiply by 2.2
From K_2O to K multiply by .83
From K to K_2O multiply by 1.2

Forage Legumes

With the uncertainty of the supply and the increasing cost of nitrogen, there has been a renewed interest in legumes. However, adapted forage legumes are limited for the Blackland and Grand Prairie regions. Possibilities are as follows:

Legume	Period of growth	Use
Vetch and peas	late winter and spring	grazing
Arrowleaf clover	late winter, spring and early summer	grazing
Sweet clover (annual or bi-annual)	spring and early summer	grazing

Legumes require adequate fertilization, especially with phosphorus. Where less than 80 pounds of P_2O_5 is being applied it is best to drill the fertilizer in a band near the seed. A major factor limiting legume production on Blackland soils is often a lack of phosphorus during the seedling stage. Legumes planted in the fall must make sufficient early growth for winter survival.

For legumes seeded in a summer perennial grass sod, the phosphorus and potassium needed for the forage system should be applied when the legume is seeded. Additional nitrogen topdressing would be needed for the grass, but the rate and time of application would vary with the amount of growth from the legume and the use made of the grass.

Table 1. Percentage distribution of Blackland and Grand Prairie soils in five ranges for organic matter, phosphorus, potassium and pH.

Soil test level*	Percentage of samples at each level			Soil pH range	Percent
	Organic matter	Phosphorus	Potassium		
VL	7	50	4	below 6.0	9
L	19	20	15	6.1-6.5	16
M	22	17	22	6.6-7.3	19
H	22	8	21	7.4-7.8	19
VH	30	5	38	above 7.8	37

*Soil test summary data from Texas Agricultural Extension Service Soil Testing Laboratories.

Table 2. Application rates of nutrients for forage (Sudan types) sorghum — three production levels.

Soil test level	Expected yield 2 to 3 tons/A. (1 cutting)			Expected yield 4 to 5 tons/A. (2 cuttings)			Expected yield 6 to 7 tons/A. (3 to 4 cuttings)		
	N[1]	P_2O_5	K_2O	N[1]	P_2O_5	K_2O	N[1]	P_2O_5	K_2O
VL	80	40	30.40	160	80	60-80	240	100	80-100
L	60	30	20.30	140	60	40-60	220	80	60-80
M	40	0	0	120	40	30-40	200	60	40-60
H	0	0	0	0	0	0	0	40	30-40
VH	0	0	0	0	0	0	0	0	0

[1]Rates of N above 40 pounds should be divided into a preplant application and one or more topdressings after each harvest, except the last.

Table 3. Application rates of nutrients for the production of coastal bermudagrass — three production levels (no legumes).

Soil test level	Light to moderate grazing[1]			Intensive grazing[1]			Expected yield 6 tons hay/A.		
	N[2]	P_2O_5	K_2O	N[2]	P_2O_5	K_2O	N[2]	P_2O_5	K_2O
VL	100	50	90-100	200	80	100-120	300	100	160-200
L	80	40	50-60	180	60	80-100	240	80	120-160
M	60	30	30-40	160	40	60-80	200	40	90-120
H	0	0	0	0	0	30-60	0	30	60-90
VH	0	0	0	0	0	0	0	0	0

[1]Reduce rates by 50 percent for common bermudagrass.

[2]Rates of N above 60 to 80 pounds should be divided with a portion in the spring (omit with a legume) and after each harvest, except the last.

Table 4. Application rates of nutrients for Fescue or Harding grass.

Soil test level	Fall application			Winter and spring applications
	N	P_2O_5	K_2O	
VL	60	60	100-120	Topdress 50 to 60 lbs. of N per acre in mid-winter and in early spring for additional production.
L	50	40	80-100	
M	0	30	40-80	
H	0	20	0	
VH	0	0	0	

Table 5. Application rates of nutrients for love grass.

Soil test level	Spring			Late summer
	N	P_2O_5	K_2O	
VL	60	40	30-40	Topdress 40 to 50 lbs. of N per acre.
L	50	30	20-30	
M	0	20	20	
H	0	0	0	
VH	0	0	0	

Table 6. Application rates of nutrients for small grains for grazing — two grazing intensities.

Soil test level	1 a.u./2A.			1 a.u./A.		
	N[1]	P_2O_5	K_2O	N[1]	P_2O_5	K_2O
VL	60	40	30-40	140	80	60-80
L	40	30	20-30	120	60	40-60
M	0	0	0	100	40	30-40
H	0	0	0	0	0	0
VH	0	0	0	0	0	0

[1]Apply all of the P_2O_5 and K_2O and up to 40 pounds of the N at or before planting. Topdress the remainder of the N in late winter.

Table 7. Application rates of nutrients for kleingrass — (no legume).

Soil test level	One application			Season total		
	N[1]	P_2O_5	K_2O	N[1]	P_2O_5	K_2O
VL	100	40	50-60	200	60	60-80
L	60	30	30-40	160	40	40-60
M	0	0	0	100	30	30-40
H	0	0	0	0	0	0
VH	0	0	0	0	0	0

[1]For continuous grazing during favorable seasons. Rates of N above 40 pounds should be divided with a portion in the early spring (omit with a good legume) and after each grazing period, except the last.

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