FACT SHEET

L-1506

FIELD AND FORAGE CROP FERTILIZATION IN THE TRANS-PECOS AND EDWARDS PLATEAU REGIONS

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The Trans-Pecos is an important agricultural region of about 18 million acres, while the Edwards Plateau, less important agriculturally, includes about 24 million acres. A large part of both regions is in rangeland, brush and rough, unproductive land.

Cropping and Soil Conditions

Only about 5 percent of the Trans-Pecos Region is used for crops. Cotton, alfalfa, grain sorghum and vegetables are the major crops grown. Irrigation management, salinity, and low nitrogen and phosphorus are major soils problems.

An estimated 2 percent of the land in the Edwards Plateau is used for cultivated crops. The main crops are small grains, grain sorghum and forage grasses. Shallow soils, low moisture, and low nitrogen and phosphorus are the major soils problems in this region.

Soil Fertility Levels

Soil characteristics, past fertilization and cropping have contributed to a wide range in nutrient levels in soils throughout these regions. Soil test summary data is available for some counties and is useful for identifying general fertility problems that need emphasis in Extension educational programs.

Table 1 contains the normal soil nutrient levels and pH ranges found in these two regions. Nitrogen levels, not shown, are generally low except after a fallow period following a legume, or under high nitrogen fertilization.

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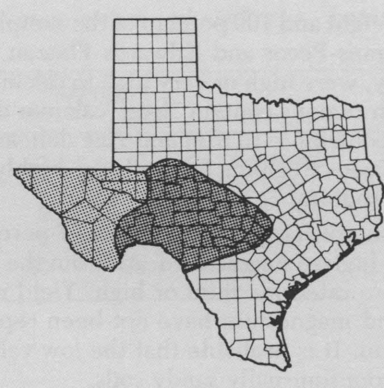

Figure 1. The Edwards Plateau (darker) and Trans-Pecos (lighter) Regions.

Phosphorus is the second most commonly deficient nutrient. Values in Table 1 show 32 and 36 percent of the samples from the Trans-Pecos and Edwards Plateau, respectively, to be low in phosphorus, while 61 and 46 percent were high. The latter values are especially important because they indicate that little or no phosphorus would be needed for crop production. Seventy-six and 100 percent of samples tested were high in potassium in the Trans-Pecos and Edwards Plateau, respectively.

Rates of N, P_2O_5 and K_2O

The wide range in rainfall, soil fertility levels and cultural and irrigation management practices results in a range in rates of nutrients needed for profitable production. Soil tests, calibrated to express available nutrients and correlated with crop response, are the

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best guide for crop fertilization. Two important criteria for selecting the profitable rate of each nutrient are (1) the level of available nutrient in the soil and (2) the expected or potential production.

Rates of N, P_2O_5 and K_2O at varying soil test levels and expected yields for major crops are presented in Tables 2 through 7. The soil test levels are based on Texas A&M University methods and calibrations. Unless a relationship has been estabished with other methods, use of the suggested rates is not valid.

An estimate of the expected yield should be based on past experience, anticipated rainfall and irrigation, management, cultural practices and other factors that affect yields. The expected yield should reflect the best judgement of the producer and his advisors about the potential for the production system.

To use the tables, select the soil test level from the column on the left and read across to the expected yield column to determine the rate of the nutrient in question. For example, in Table 2, a soil low (L) in nitrogen, medium (M) in phosphorus and very high (VH) in potassium would have a 30-0-0 and 90-30-0 suggested for 3,000 and 6,000 pounds of grain sorghum respectively.

Calcium, Magnesium and Sulfur

Eighty-eight and 100 percent of the samples tested from the Trans-Pecos and Edwards Plateau Regions, respectively, were high or very high in calcium. Some soils in both regions contain "free" calcium carbonate which can contribute to iron and zinc deficiencies. In the Trans-Pecos Region a few soils are highly alkaline because of sodium.

Of the samples from Trans-Pecos 97 percent were medium or high in magnesium. All from the Edwards Plateau were rated medium or high. Yield responses from applied magnesium have not been reported for either region. It is probable that the low values were obtained from unusually sandy soils.

Sulfur in soils of these regions has not been studied extensively, but available data do not indicate it to be a problem. Because of the relatively low production under dryland conditions and the fact that most irrigation water contains some sulfate, the need for sulfur fertilization is not evident.

Micronutrients

The high alkalinity of soils in these regions causes some micronutrient deficiencies, principally of iron and zinc.

Iron chlorosis is sometimes observed in irregular patterns in fields of oats, grain sorghum and other crops. More information about iron chlorosis is provided in L-723, *Identifying and Correcting Iron Deficiency in Field Crops* (Texas Agricultural Extension Service).

Zinc deficiency is common on pecan trees and has been found on cotton growing in high phosphorus soils in Midland County. For more information, refer to L-721, *Zinc Deficiency and Fertilization* (Texas Agricultural Extension Service). Although few isolated deficiencies have been confirmed, the extent of micronutrient problems in the Trans-Pecos and Edwards Plateau Regions is not well defined.

Conversion Factors

Fertilizers containing phosphorus and potassium 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

Salinity and Sodium

A substantial proportion of acreage in the Trans-Pecos Region is affected by soluble salts (salinity) or sodium, possibly both. However, such problems in the Edwards Plateau Region are limited to relatively small areas. In discussing salinity problems, a distinction should be made between a salt-affected (salinity or saline) and sodium-affected soils.

A salt-affected soil is one that contains enough water soluble salt to reduce the growth of plants. Improvement generally requires the use of excess irrigation water to leach the salt below the plant root zone. Soil salinity tests can be obtained from the Extension Soil and Water Testing Laboratory at Texas A&M University. For sampling instructions, obtain a copy of D-616 from your county Extension office.

A sodium-affected soil is high enough in sodium to cause dispersion of the clay, compaction, poor aeration and other undesirable physical conditions of the soil. Improvement requires the replacement of sodium by calcium, usually added in the form of gypsum, followed by leaching to remove the sodium. In some calcareous soils, elemental sulfur or sulfuric acid can accomplish the same purpose by chemically converting calcium carbonate to gypsum. More time is required for improvement from sulfur due to the rate of the chemical reactions in the soil. However, sulfuric acid reacts rapidly and requires rapid leaching to remove sodium and excess salt.

Before investing in reclamation practices for either salt-affected or sodium-affected soils, a thorough study should be made of the problem and its causes.

Concern About Nutrient Losses

The objective of fertilization is to apply nutrients to deficient soils for the purpose of growing plants. The rate, method and time of application should ensure that the nutrients are used efficiently, since economic loss results from improper fertilization.

Nutrients are lost or removed in four general ways: (1) erosion or movement of soil particles; (2) leaching of soluble nutrients; (3) denitrification or volatilization of nitrogen; and (4) crop removal. Therefore, good soil management and cultural practices should be followed to minimize erosion losses. In addition, nitrogen rates as well as time and method of application should be compatible with soil conditions and the period of crop need.

Recent studies of nitrogen application in calcareous soils (those with free calcium carbonate) show that the chemical composition of the nitrogen fertilizer, temperature, moisture, method of application and soil texture all affect the amount and rate of ammonia loss. Losses from ammonium sulfate and diammonium phosphate can be especially large and rapid.

Since losses involve chemical reactions, the rate of loss generally increases with temperature. Soil moisture or water has a significant effect on losses. Using enough water to dissolve and carry surface-applied nitrogen fertilizers into the soil greatly reduces volatilization losses that result from the formation of ammonium carbonate through the following reactions:

(1) $(NH_2)_2CO + H_2O \longrightarrow (NH_4)_2CO_3$
urea, water → ammonium carbonate

(2) $(NH_4)_2SO_4 + CaCO_3 \longrightarrow (NH_4)_2CO_3 + CaSO_4$
ammonium sulfate, calcium carbonate → ammonium carbonate, calcium sulfate

(3) $(NH_4)_2CO_3 \longrightarrow 2NH_3\uparrow + H_2CO_3$
ammonium carbonate → ammonia, carbonic acid

When these reactions take place on the surface of the soil, ammonia gas (NH_3) can escape into the atmosphere. When in the soil, ammonia becomes attached to the negative charges on clay particles as illustrated in reactions 4 and 5.

(4) $2\ NH_3 + 2\ H_2O \longrightarrow 2\ NH_4OH$
ammonia, water → ammonium hydroxide

(5) $2\ NH_4OH + \left[^{=}\ \text{clay}\right] \longrightarrow Ca(OH)_2 + \left.\begin{matrix} NH_4 \\ NH_4 \end{matrix}\right[\begin{matrix} - \\ - \end{matrix}\ \text{clay}$
ammonium hydroxide, calcium clay → calcium hydroxide, ammonium clay

Light-textured or sandy soils do not hold the ammonium as well as sandy loam, loams and clay soils.

Because of these reactions the method of application is an important factor affecting nitrogen losses. Based on experimental data, methods of applying nitrogen fertilizers, other than anhydrous ammonia, in order of decreasing effectiveness are as follows:

Banded
Surface applied and disked immediately
Surface applied and irrigated immediately
Applied in irrigation water
Surface applied with no incorporation.

Surface applications on a calcareous soil without immediate incorporation *should be avoided.*

*Table 1. Percentage distribution of soils in ranges for calcium, magnesium, phosphorus, potassium and pH in the Trans-Pecos (TP) and Edwards Plateau (EP).**

Soil test levels	Calcium TP	Calcium EP	Magnesium TP	Magnesium EP	Phosphorus TP	Phosphorus EP	Potassium TP	Potassium EP	Ranges	pH TP	pH EP
VL	0	0	—	—	22	18	2	0	Below 5.0	2	0
L	7	0	3	0	10	18	13	0	5.1 - 5.5	5	1
M	5	0	9	6	7	18	9	0	5.6 - 6.0	6	0
H	12	2	88	94	20	31	16	4	6.1 - 6.5	10	0
VH	76	98	—	—	41	15	60	96	Above 6.5	77	99

*130 samples for TP, 136 for EP.

Table 2. Application rates of nutrients for grain sorghum.

Soil test level	Expected yield 3,000 lbs./acre*			Expected yield 4,000 lbs./acre			Expected yield 6,000 lbs./acre		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
VL	40	30	30	60	40	40	120	60	60
L	30	20	20	40	30	30	90	40	40
M	0	0	0	30	20	20	60	30	30
H	0	0	0	0	0	0	0	30	30
VH	0	0	0	0	0	0	0	0	0

*Dryland; remainder under full or partial irrigation.

Table 3. Application rates of nutrients for cotton.

Soil test level	Expected yield ½ bale/acre*			Expected yield 1 bale/acre			Expected yield 1½ bale/acre		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
VL	30	30	30	50	50	50	70	70	70
L	20	20	20	40	40	40	60	60	60
M	0	0	0	30	30	30	40	40	40
H	0	0	0	0	0	0	0	30	30
VH	0	0	0	0	0	0	0	0	0

*Dryland; remainder under full or partial irrigation.

Table 4. Application rates of nutrients for irrigated alfalfa.

Soil test level	N	P_2O_5	K_2O
VL	0	160	*
L	0	120	120 - 160
M	0	80	80 - 120
H	0	60	60 - 80
VH	0	0	0

*Extremely deficient soils are not well suited for high production of alfalfa.

Table 5. Application rates of nutrients for wheat.

Soil test level	Expected yield 30 bu./acre			Expected yield 40 bu./acre			Expected yield 50 bu./acre		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
VL	40	30	30	80	40	40	100	50	50
L	30	20	20	60	30	30	80	40	40
M	0	0	0	40	20	20	60	30	30
H	0	0	0	0	0	0	0	0	0
VH	0	0	0	0	0	0	0	0	0

Table 6. Application rates of nutrients for small grain grazing.

Soil test level	Dryland			Irrigated		
	N	P_2O_5	K_2O	N*	P_2O_5	K_2O
VL	60	30	30	160	80	80
L	40	20	20	140	60	60
M	0	0	0	120	40	40
H	0	0	0	0	0	0
VH	0	0	0	0	0	0

*Split into at least two applications.

Table 7. Application rates of nutrients for perennial summer grasses.

Soil test level	Expected yield 3 to 4 tons			Expected yield 5 to 6 tons			Expected yield 6 to 8 tons		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
VL	120	60	60	200	80	120	300	100	160
L	100	40	40	160	60	100	260	80	140
M	0	0	0	120	40	80	220	60	100
H	0	0	0	0	0	0	0	40	80
VH	0	0	0	0	0	0	0	0	0

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