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Crop Nutrient Needs in South and Southwest Texas

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Crop fertilization is not an exact science. The soil is a dynamic, changing, and complex mixture of organic matter, minerals, insects, nematodes, bacteria, fungi, water, and gasses. Any change in one or more of these factors can change the availability of nutrients to plants. Much is known about how soils and soil nutrients respond to these changes, but no one can predict precisely which changes will occur. Fertility recommendations for essential plant nutrients are based on "averages" from field and laboratory tests and on what "usually" works best under "normal" conditions. Special circumstances call for specific suggestions.

The primary limiting factor for crop production in Texas is the availability of water. As water evaporates from a plant's leaves, the roots replace the water with soil moisture. As the roots absorb water from the soil, they also absorb nutrients that are dissolved in the water. The more water the roots absorb, the greater their nutrient uptake. In dry soil, nutrient uptake is limited, even if the nutrients are present. Yield goals should be based on average yields on a farm, historical rainfall information, or expected water applied through irrigation. Typically, nitrogen fertilization is most important, since nitrogen is often depleted from the soil each year through crop uptake, leaching losses, or denitrification (loss to the atmosphere).

Fertilizer use efficiency—the conversion of nutrients into crop yields—also changes with yield. Low yields require fewer nutrients per pound of production than high yields. As the maximum yield for a crop in an area is reached, the plant does not use nutrients as efficiently; so more nutrients are required to produce each additional pound of yield. Thus, fertility recommendations per unit of crop produced will be greater at maximum yields than at lower yields. For example, corn requires 1.2 pounds of nitrogen per bushel when yields exceed 150 bushels; 1.1 pounds per bushel for yields of 100 to 150 bushels; and 1 pound per bushel for yields less than 100 bushels per acre. Adjusting fertilizer rates based on realistic yield goals is essential to maintain environmental quality and to obtain maximum economic returns.

Soil testing should be the basis for any fertility program on any crop. Before buying fertilizer, producers should have the soil analyzed to determine which nutrients are present in adequate amounts, and which are lacking for the crop they intend to grow. The following charts provide information on when nutrients are absorbed and the approximate amounts of nutrients needed by field crops grown in South and Southwest Texas. They are not intended to

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serve as recommendations on the amounts of fertilizer to apply, but can be used as a guide to estimate proper application rates for crop production at different yield levels.

Corn

Corn has a high demand for nutrients because of its high yield potential and the amount of dry matter produced. Corn yields are greatest in regions with cool night-time temperatures; for this reason, yields are limited in Southwest Texas. With the best adapted varieties and 30 inches of growing-season water, corn yields average 150 bushels per acre. With less water, yields are reduced in proportion to the water available. Fertilizer cannot replace water in enhancing yields. However, if water is available, adequate fertilizer will allow the plant to reach its full yield potential.

The standard nitrogen recommendation for corn is 1.1 pounds of nitrogen for each bushel produced. For example, if corn is producing 120 bushels per acre, 132 pounds per acre of nitrogen are needed. Other nutrients should be applied based on a soil test. Table 1 shows approximate amounts of the major nutrients needed based on the growth stage of the crop. Table 2 shows the approximate amounts of secondary and micronutrients required to produce a corn yield of 180 bushels per acre. Table 3 is the amount of nutrients removed in the grain and returned to the soil in the stover. (The data in Tables 1, 2, and 3 were adapted from the Phosphate and Potash Institute.)

Table 1. Approximate Nutrient Requirements for Corn Based on Stage of Growth for a Yield of 180 Bushels per Acre.

Growth Stage	Days After Planting	Nitrogen lb./A	% of Total	P_2O_5 lb./A	% of Total	K_2O lb./A	% of Total
Early	0 - 25	19	8	4	4	22	9
Rapid Growth	25 - 50	84	35	27	27	104	44
Silk	50 - 75	75	31	36	36	72	31
Grain	75 - 100	48	20	25	25	36	14
Mature	100 - 125	14	6	8	8	6	2
Totals	Harvest	240		100		240	

Table 2. Approximate Total Pounds per Acre of Secondary and Micronutrients Required for a Yield of 180 Bushels per Acre of Corn.

Sulfur	Magnesium	Calcium	Iron	Zinc	Manganese	Boron	Copper
30	50	40	3	0.5	0.5	0.1	0.2

Table 3. Distribution of Nutrients Removed in Corn Grain and Stover.

Crop Dry Matter	Dry Matter Distribution	Nitrogen lb./A	% of Total	P_2O_5 lb./A	% of Total	K_2O lb./A	% of Total
Grain 180 bu/A	52%	170	71	70	70	48	20
Stover 8,000 lbs	48%	70	29	30	30	192	80

Grain Sorghum

Grain sorghum is better-adapted to limited-moisture growing conditions and can produce good yields under less than optimum conditions. For a grain yield of 7,500 pounds per acre, sorghum needs approximately 25 inches of water during the growing season. The nitrogen fertilizer recommendation in South Texas is 2 pounds of nitrogen for each 100 pounds per acre of grain yield. Estimated nutrient requirements for grain sorghum based on stage of growth are presented in Table 4. Tables 5 and 6 give secondary and micronutrient requirements and nutrient distribution between grain and stover, respectively.

Table 4. Approximate Nutrient Requirements for Grain Sorghum Based on Stage of Growth for a Yield of 7,500 Pounds per Acre.*

Growth Stage	Days After Planting	Nitrogen lb./A	% of Total	P_2O_5 lb./A	% of Total	K_2O lb./A	% of Total
Seedling	0 - 20	9	5	2	3	18	7
Rapid Growth	21 - 40	61	33	18	23	103	40
Early Bloom	41 - 60	60	32	28	33	85	33
Grain Fill	61 - 85	27	15	21	26	39	15
Maturity	86 - 95	28	15	11	14	13	5
Totals	Harvest	185		80		285	

Table 5. Approximate Total Pounds per Acre of Secondary and Micronutrients Required for a Grain Sorghum Yield of 7,500 Pounds per Acre.*

Sulfur	Magnesium	Calcium	Iron	Zinc	Manganese	Boron	Copper
21	17	20	2.5	0.21	0.17	0.1	0.3

*Source: Kansas State University

Table 6. Distribution of Nutrients Removed in Sorghum Grain and Stover.*

Crop Dry Matter	Dry Matter Distribution	Nitrogen lb./A	% of Total	P_2O_5 lb./A	% of Total	K_2O lb./A	% of Total
Grain 7,500 lb.	56%	107	58	28	35	28	10
Stover 5,280 lb.	44%	78	42	52	65	230	80

*Source: Kansas State University

Cotton

Because cotton is a perennial tree under its native environmental conditions (rather than an annual plant) and sets fruit throughout its growth cycle, fertility management is critical. It is important to remember that more fertilizer does not always equal more yield. Too much fertilizer or application at the wrong time may even reduce yields. Other publications discuss fertility management of cotton in greater detail. Table 7 lists cotton nutrient requirements based on growth stage, while Table 8 estimates requirements for secondary nutrients and micronutrients. Table 9 details nutrient distribution in cotton seed and stalks.

Table 7. Approximate Nutrient Requirements Based on Stage of Growth to Produce 1,000 Pounds of Lint per Acre.

Growth Stage	Days After Planting	Nitrogen lb./A	% of Total	P_2O_5 lb./A	% of Total	K_2O lb./A	% of Total
Emergence - Seedling	0 - 15	10	8	2	3	7	6
Seedling - Early Square	15 - 35	20	14	5	8	30	25
Early Square - Early Boll	36 - 70	56	42	23	38	46	38
Early Boll - Maturity	71 - 120	48	36	31	51	37	31
Totals	Harvest	134		61		120	

Table 8. Approximate Total Pounds per Acre of Secondary and Micronutrients Required for a Lint Yield of 1,000 Pounds per Acre.

Sulfur	Magnesium	Calcium	Iron	Zinc	Manganese	Boron	Copper
20	23	26	0.14	0.12	0.2	0.5	0.3

Table 9. Distribution of Nutrients Removed in Cotton Seed and Stalks.*

Dry Matter	Nitrogen lb./A	% of Total	P_2O_5 lb./A	% of Total	K_2O lb./A	% of Total
Seed 3,000 lb./A	80	53	20	69	25	28
Stalks 3,928 lb./A	70	47	9	31	59	72

*Seed and stalk totals taken from separate studies.

Wheat

Like other grains, wheat responds to greater water and fertility with higher yield. For best utilization, timing of nitrogen applications should be split with approximately 40 percent applied preplant and 60 percent after the first of January. In South Texas, the standard recommendation is 1.5 pounds of nitrogen per bushel per acre for **ungrazed wheat**; or 2 pounds of nitrogen per bushel **for grazing + grain**. Tables 10, 11, and 12 detail wheat without requirements and distribution at harvest between grain and straw.

Table 10. Approximate Amount of Nutrients Required to Produce 60 Bushels per Acre of Wheat.

Growth Stage	Days After Planting	Nitrogen lb./A	% of Total	P_2O_5 lb./A	% of Total	K_2O lb./A	% of Total
Tillering	0 - 30	25	24	7	15	11	14
Rapid Growth	30 - 74	46	44	23	50	57	75
Bloom - Milk	75 - 93	29	32	16	35	32	11
Mature	93 - 114	0		0		0	
Totals	Harvest	105		46		76	

Table 11. Approximate Total Pounds per Acre of Secondary and Micronutrients Required for a Yield of 60 Bushels per Acre.

Sulfur	Magnesium	Calcium	Iron	Zinc	Manganese	Boron	Copper
13	14	11	2.4	0.29	0.38	0.08	0.07

*Source: New Mexico State University

Table 12. Distribution of Nutrients Removed in Wheat Seed and Straw.

Crop Dry Matter	Dry Matter Distribution	Nitrogen lb./A	% of Total	P_2O_5 lb./A	% of Total	K_2O lb./A	% of Total
Grain 60 bu	79%	75	71	38	83	23	30
Straw 5,000 lb.	21%	30	29	8	17	53	70

Warm-Season Perennial Grasses

For grasses, like other crops, water is the primary limiting factor for plant growth. However, grasses become more water-efficient as the fertility level increases. Research in Southwest Texas showed that almost 17.5 inches of water was needed to produce a ton of forage without fertilizer, while only 5 inches of water per ton was required by forage under well-fertilized conditions. As a general rule, warm-season grasses require about 50 pounds of nitrogen, 15 pounds of phosphorus, and 42 pounds of potassium per ton of dry matter produced. If the forage is cut for hay, the demand for nutrients is higher, because the nutrients are removed from the field in the forage. If the forage is grazed, the primary nutrient of concern is nitrogen. Table 13 indicates the nutrients needed to produce 5 tons of hay dry matter per acre.

Soil Testing and Fertilizer Recommendations

Fertilizer recommendations are based on the type of crop grown and the yield goal. For example, if a soil test showed the following levels of nutrients in ppm, N - 1, P - 22, and K - 125, then fertilizer would be recommended at the rates given in Table 14.

The nutrient requirements of a given crop depend largely on the yield. For simplicity, fertilizer requirements are often expressed as pounds of nutrients per unit of yield. Below are the general guidelines for nitrogen fertilizer.

Crop	Nitrogen Fertilization Rate
Corn	1.1 lb./bu.
Sorghum	2 lb./cwt.
Cotton	10 lb./100 lb. of lint
Ungrazed Wheat	1.5 lb./bu.
Grazed Wheat	2 lb./bu.
Warm-Season Grasses	50 lb./ton

Summary

We do not fertilize plants. Instead, we apply fertilizer (minerals) to the soil and hope that the plant roots are in the vicinity of the nutrient and that there is sufficient moisture to enable the nutrient to be absorbed by roots. Many factors affect the uptake of nutrients, including soil temperature, organic matter content, soil moisture, soil pH, compaction, microorganisms, root diseases, and the type of crop planted. Careful attention to soil testing, placement, and timing will result in greater response to the nutrients supplied and greater potential profitability.

Table 13. Approximate Amounts of Nutrients Required to Produce 5 Tons of Hay Dry Matter per Acre.

Bermudagrass	Nitrogen lb./A	$P_2 0_5$ lb./A	$K_2 0$ lb./A	S lb./A	Magnesium lb./A
5 Tons/Acre	250	75	210	25	15

Table 14. Recommended Fertilizer Application Rates by Crop According to Soil Test Results.

Crop	Yield Goal/A	Soil test N - ppm	Soil test P - ppm	Soil test K - ppm	Fertilizer Rates/A		
					N	$P_2 0_5$	$K_2 0$
Corn	110 bu.	1	22	125	120	50	0
Sorghum	5,000 lb.	1	22	125	100	35	0
Cotton	2 bales	1	22	125	00	50	0
Wheat	60 bu.	1	22	125			
Grazed only					120	40	0
Grain only					90	25	0
Grazed & Grain					120	40	0
Bermudagrass	5 tons	1	22	125	250	75	50

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