Forage Fertilization

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Water and nutrient supply are the two most important factors in forage crop growth. Most soils in Texas only have enough nutrients to produce 1 to 2 tons of forage. Under good moisture conditions, proper fertilization can more than double yields.

Tons Forage Per Year, Potential*		
Rainfall (inches)	**Without Fertilizer**	**Adequate Fertilizer**
30	1.0-1.5	5-7
35	1.5-2.0	7-8
40	2.0	8-10
45	2.5	10
*Assumes drainage, soil depth and other conditions satisfactory for grass growth.		

There are 20 nutrient elements which are essential for plant growth. A deficiency of any one of these can limit plant growth. Most Texas soils contain adequate amounts of many of these nutrients. The 8 most commonly deficient nutrients are:

Major Nutrients	Secondary Nutrients	Minor Nutrients
Nitrogen (N)	Sulfur (S)	Zinc (Zn)
Phosphorus (P_2O_5)	Magnesium (Mg)	Boron (B)
Potassium (K_2O)	Calcium (Ca)	

With adequate water, the nutrient supply determines not only the quantity of forage produced, but also the quality or feed value of the forage. Nitrogen promotes leafy growth of grasses and increases forage protein content. It also greatly increases water use efficiency.

Effect of Nitrogen on Yield, Protein Content & Water Use				
Rate of N (lbs/A)	**Hay (Ton/A)**	**Crude Protein**		**Inches H_2O/Ton of Hay**
		%	**lbs/A**	
0	2.67	8.0	420	17.6
100	4.38	9.1	800	10.7
200	5.93	10.5	1240	7.9

400	8.59	11.7	2010	5.5

Most soils are deficient in nitrogen and many also are deficient in either phosphorus, potassium or both. Some soils also may become deficient in one or more other essential nutrients depending on soil chemical properties and past use. Proper fertilization to supply these essential nutrients is critical to achieve optimum crop yields and quality.

Balancing N with P & K To Optimize Bermudagrass Hay Yields

N-P_2O_5-K_2O (lbs/A)	Three Year Average Yields (T/A)
300-0-0	3.75
300-100-0	5.78
300-0-300	5.93
300-100-300	7.51

How Much Fertilizer To Use

The amount of fertilizer needed per acre depends on the nutrient status of the soil; the desired production level (tons/acre, stocking rate) and whether the pasture will be used for hay, grazing or both. If soils contain naturally sufficient or adequate carryover levels of some nutrients, the fertilizer rate can be reduced accordingly.

A regular soil testing program is the only way to predict what amount and type of fertilizer (nitrogen:phosphorus: potassium) is needed. Soil tests should be obtained every second or third year and fertilization should be based on the results.

In grazing systems, only small amounts of the nutrients contained in the forage that a cow eats are removed as part of the animal=s body. Most are recycled in urine and/or feces back to the soil. Thus, once the nutrient status of the soils is brought up to a high level, additional fertilizer will not be required often. However, because nitrogen can volatilize from these waste products, it must still be routinely supplied.

In hay production, nutrients taken up by the crop are harvested and removed from the field. These nutrients must be replaced by fertilization to sustain crop growth.

Fertilizer Nutrients Removed By Different Forage Management Systems

Nutrient	Grazing (500 lbs beef/acre)	Hay (6 tons/acre)
	Pounds Removed Per Acre	
Nitrogen	18	300
Phosphorus	9	60
Potassium	1	240

Fertilizer Selection and Use

Research in Texas has shown that most warm-season grasses, like bermudagrass, require 50 pounds of nitrogen, 14 pounds of phosphate and 42 pounds of potassium per ton of forage. Thus, for soils testing LOW in each of these nutrients, a fertilizer with a nutrient ratio of 4-1-3 is appropriate. However, some soils and management systems will not require a full recommendation each year. Soil testing can be used to determine the proper fertilizer type and rate of application.

To apply the recommended amount of fertilizer, dealers must blend either a dry or liquid fertilizer to get the correct amounts of nutrients. Dealers blend single or mixed grade nitrogen, phosphorus or potassium fertilizers to obtain the proper ratios.

Major Fertilizer Materials Used For Blending In Texas

	Grade		
	% Nitrogen (N)	**% Phosphorus (P_2O_5)**	**% Potassium (K_2O)**
Ammonium nitrate	33	0	0
Urea	46	0	0
Ammonium sulfate	21	0	0
Diammonium phosphate	18	46	0
Monoammonium phosphate	11	48	0
Normal superphosphate	0	20	0
Concentrated superphosphate	0	46	0
Potassium nitrate	13	0	44
Potassium chloride	0	0	60
Potassium sulfate	0	0	50

Some fertilizer dealers do not have the ability to blend and thus sell commonly available mixed fertilizers. These can be compared with the soil test to determine which one most closely meets the need of a particular field and cropping system.

Commonly Available Mixed Fertilizers In Texas

Grade N-P_2O_5-K_2O (%)	**Ratio**
10-20-10	1-2-1
13-13-13	1-1-1
20-10-10	2-1-1
16-6-12	4-1.5-3
20-5-5	4-1-1

Nitrogen Sources

Nitrogen is the single most commonly deficient nutrient in most crops and the one required in the greatest amounts. Also, because of its chemical nature, nitrogen can be lost by leaching or volatilization. Thus, proper selection and use of nitrogen fertilizer is important to ensure efficient use and good crop yields. Several sources of nitrogen fertilizer are commonly available and growers often must make decisions about which one to select.

Nitrogen Fertilizer Sources and Characteristics

Source	% N
Ammonium sulfate	21
Urea ammonium nitrate (32 Solution)	32
Ammonium nitrate	33
Urea	46
Anhydrous ammonia	82

Two forms of nitrogen, urea and ammonium sulfate, are most subject to loss by volatilization. However, this is only a concern when these fertilizers are applied to the surface of a moist soil and then subjected to drying conditions. Ammonium sulfate is only subject to this type of loss when the soil is alkaline (high pH) and calcareous (high carbonate level). Most importantly, the effective use of both of these fertilizers can be obtained when they are applied to a dry soil and then washed in by rainfall or irrigation.

In hay production systems, multiple applications of nitrogen fertilizer are commonly made to produce several cuttings. When purchasing fertilizer, cost comparisons should be made based on the cost per pound of nutrient, NOT the cost per ton of fertilizer. This is important since as shown above, different nitrogen sources have different nutrient concentrations. An example of such a comparison is shown below:

Example: Urea (46%) 2000 x 0.46 = 920 pounds of N per ton of fertilizer
$240 / 920 = $0.26 per pound of Nitrogen

Fertilizer Cost Comparison

Fertilizer (% nitrogen)	Cost Per Ton (estimated)	Pounds of N Per Ton (2000 X %N)	Cost Per lb. N ($)
Ammonium sulfate* (21%)	$155	420	$0.37
Urea ammonium nitrate (32%)	$160	640	$0.25
Ammonium nitrate (33%)	$200	660	$0.30
Urea (46%)	$240	920	$0.27
Anhydrous ammonia (82%)	$300	1640	$0.18

*In this example, keep in mind that if sulfur also is needed the value of that nutrient must be considered in determining the total fertilizer value.