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Texas Agricultural Extension Service

People Helping People

PARTNERS FOR PROFIT... COASTAL BERMUDAGRASS, FERTILIZER AND MANAGEMENT

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INTRODUCTION

Coastal bermudagrass *(Cynodon dactylon)* is a high-yielding, perennial, warm season grass adapted to much of Texas' forage land. It is established on more than 2 million acres and continues to be a popular grass for permanent pastures and hay. Coastal has a deep root system, is drought tolerant and responds to fertilization. It can be harvested as good quality hay or grazed from spring until frost. When fertilized adequately and managed efficiently, Coastal produces three to four times as much forage as similar acreage with inadequate fertilization and management.

This publication illustrates the following points:

- Coastal bermudagrass responds to higher levels of fertilization than most producers apply.
- Increasing the level of fertilization up to a point (limit) can increase the yield and protein content and improve water efficiency.
- The greatest increase in yields results from the initial application of nutrients; higher fertilizer rates provide smaller but important increases up to a level which becomes unprofitable.
- The optimum fertilization rate is influenced by nitrogen cost, hay values and harvest costs.
- Other considerations contribute to a profitable Coastal enterprise, including essential plant nutrients and timely harvest.

This publication does not recommend fertilizer rates on Coastal bermudagrass for any specific area or farm in Texas. Recommendations for fertilizer application are determined best by soil testing.

Coastal bermudagrass producers should evaluate various nitrogen rates on their farm annually and adjust fertilization practices to best suit their soil, climatic conditions and forage needs.

ADEQUATE FERTILIZATION IS IMPORTANT

Because of its high yield potential, Coastal bermudagrass requires large amounts of plant nutrients for optimum production and quality. Most Texas soils where Coastal is planted are low in native fertility, especially nitrogen and phosphorus. In addition, sandy soils usually are medium to low in potassium and may require lime, sulphur and other nutrients (figure 1).

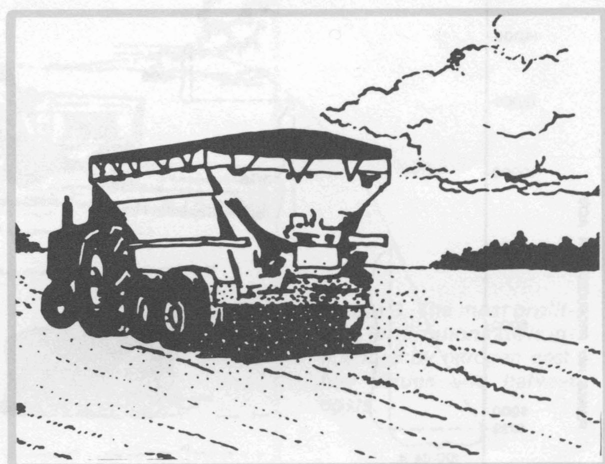

Figure 1. Profitable fertilization rates depend on rainfall, soil conditions, management and economic values.

Nitrogen is a major nutrient for increasing growth and protein content. This is illustrated by many tests and demonstrations during the past years. Nitrogen also improves water use efficiency. A classic example of these benefits is shown in table 1.

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Table 1. Effect of nitrogen on yield, protein content and water use by Coastal bermudagrass[1].

Annual rate of nitrogen	Tons of hay per acre[2]	Percent protein in hay	Pounds of protein per acre	Inches of water per ton hay
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

[1]Texas Agricultural Experiment Station Progress Report 2035
[2]Forage yields in this experiment were produced under irrigation on an air-dry basis. Yields from zero nitrogen application would be considerably lower under nonirrigated conditions.

HOW MUCH NITROGEN SHOULD BE USED?

Several years of research by Texas Agricultural Experiment Station scientists at various locations show that Coastal responds to nitrogen fertilizer at rates much higher than most producers use. Figure 2 illustrates the typical response of Coastal bermudagrass to different rates of nitrogen. Note that 3,739 pounds of forage per acre were produced without applying nitrogen. The first 100 pounds of nitrogen increased the yield per acre by 4,666 pounds, the second 100 pounds increased the yield by 3,136 pounds and the third 100 pounds increased the yield by 1,606 pounds. When the nitrogen rate was increased from 300 to 400 pounds per acre, yield increased only 76 pounds. As higher nitrogen rates were applied, yield increases per unit of additional nitrogen became less. Thus, there is a physical limit and an economic limit for the amount of nitrogen to apply to Coastal bermudagrass. Data from research plots and Extension demonstrations from several years in Central Texas were used to develop this example.

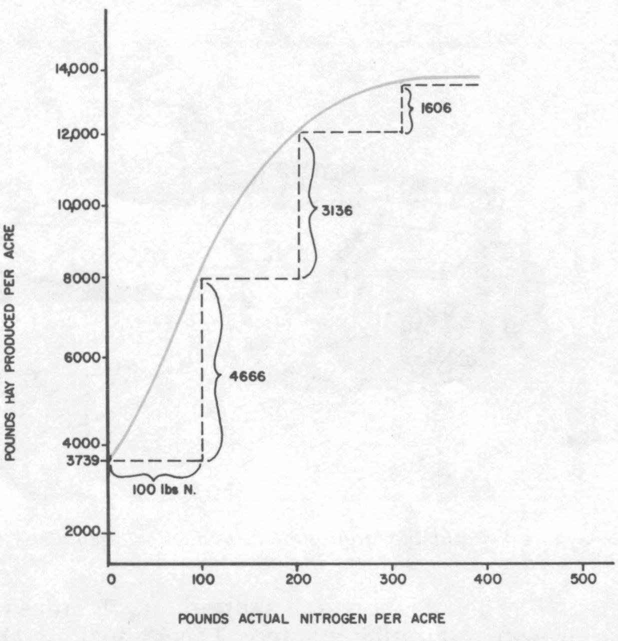

Figure 2. Annual Coastal bermudagrass hay production with different fertilizer rates per acre.

Fertilizer rates in figure 2 and tables 2 and 3 are based on the response of Coastal to nitrogen in *Central Texas on sandy and medium textured soils.* Nitrogen responses usually are less on Blackland and other clay soils when compared to sandy soils. Optimum fertilization rates depend upon rainfall, soil conditions, management and economic values.

Only if nitrogen were free would it be economically feasible to use the nitrogen fertilization rate which would maximize production per acre. Since nitrogen is not free, the most profitable level of fertilizer application depends on the value of the forage produced, the cost of fertilizer and the response of Coastal to fertilizer.

Table 2 provides estimates of the most profitable rates for various hay values and nitrogen costs. Related to figure 2 and the above discussion, generalizations to be drawn from table 2 are:

- With an increase in hay value, apply more nitrogen per acre to achieve maximum net income.
- With no other changes, a decrease in nitrogen costs means that more nitrogen should be applied to realize maximum net income.
- As nitrogen costs increase, apply lower rates, unless the value of the hay also increases.
- When higher protein content of hay is desired, higher nitrogen rates may be justified.

The economic optimum rates of nitrogen fertilization in table 2 apply where the producer has adequate operating capital for purchasing nitrogen. However, many producers are faced with a *limited capital situation* because their lenders limit operating capital or producers are reluctant to borrow sufficient operating capital. Applying less fertilizer than the amount required for maximum net income per acre can still be justified (figure 3).

With limited capital for fertilizer, allocate the fertilizer among all crops in such a way as to realize the highest total return from the available fertilizer. Since the additional return from apply-

Table 2. Most profitable rates of actual nitrogen applied to Coastal bermudagrass, considering various hay values and nitrogen costs.

Hay value dollars per ton (excluding harvest cost)[1]	Most profitable pounds of actual nitrogen applied per acre with nitrogen cost per pound[2]					
	15 cents	20 cents	25 cents	30 cents	35 cents	40 cents
25	277	250	224	198	172	146
30	290	268	246	224	202	181
35	299	280	262	243	224	206
40	306	290	273	257	241	224
45	311	297	282	268	253	239
50	316	303	290	277	263	250

[1]The value does not include hay baling or hauling costs. A producer should use the market value of hay per ton less his hay harvesting costs per ton to decide which hay value to use in the table. (Custom harvesting costs of 65 cents per bale and custom hauling costs of 35 cents per bale convert to about $33 per ton.)

[2]Obtain the cost per pound of nitrogen by dividing the cost per ton of nitrogen fertilizer by the pounds of nitrogen in a ton of fertilizer. For example, ammonium nitrate (33.5-0-0) fertilizer has 670 pounds actual nitrogen per ton. If 33.5-0-0 costs $167 per ton, the cost per pound of actual nitrogen is 25 cents ($167 ÷ 670 = 25 cents).

Table 3. Limited capital situation — most profitable pounds of actual nitrogen applied to Coastal bermudagrass, considering various hay values and nitrogen costs.

Hay value dollars per ton (excluding harvest cost)[1]	Most profitable pounds of actual nitrogen applied per acre with nitrogen cost per pound [1,2]					
	15 cents	20 cents	25 cents	30 cents	35 cents	40 cents
25	198	146	94	41	0	0
30	224	181	137	94	50	6
35	243	206	168	131	94	56
40	257	224	192	159	126	94
45	268	239	210	181	152	123
50	277	250	224	198	172	146

[1]See table 2 for footnotes.

[2]The *specification* that the added return from using the fertilizer be twice the cost of the nitrogen is *arbitary*. For instance, the requirement could be that the added return is to be one and a half times the cost of the nitrogen. In that case, estimate the optimum nitrogen rate from values in tables 2 and 3. Applying this concept to a limited capital situation, the arbitrarily selected value should increase as capital becomes more limited and vice versa. Generalizing, the greater the *specified* added return relative to the cost of nitrogen, the lower the optimum nitrogen fertilization rate.

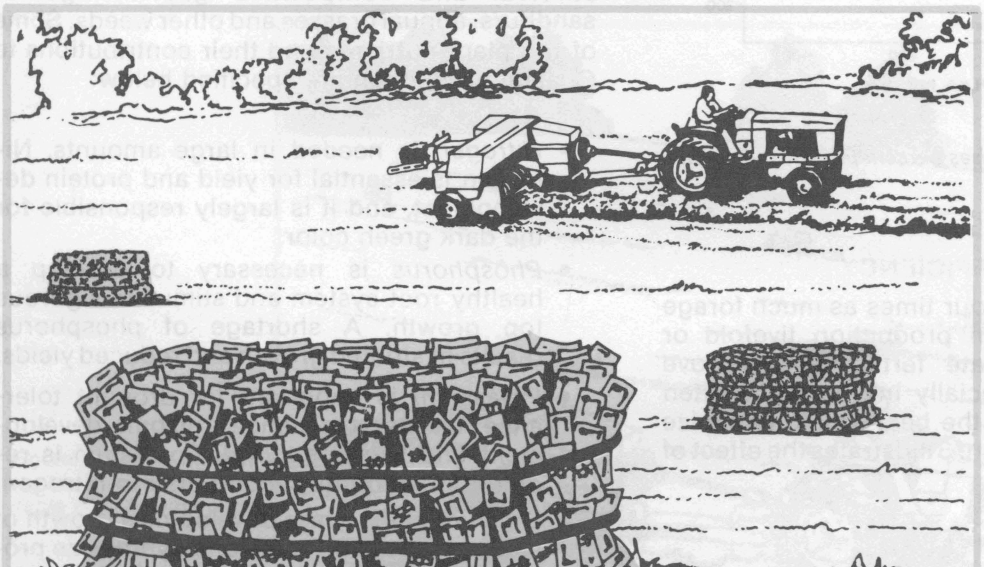

Figure 3. The most profitable fertilization rate is influenced by nitrogen cost, hay values and harvest costs.

ing another unit of fertilizer to other enterprises may be unknown, an alternative approach in allocating a limited resource is to specify a return requirement of twice the cost of the fertilizer. That is, apply fertilizer to that enterprise to the point where the added return from using the fertilizer is twice its cost. This procedure is a reasonable way to deal with the problem of limited capital as well as with uncertain weather and crop yields. See table 3 for the optimum quantities of nitrogen for a *limited capital situation.*

IMPROVED PROTEIN CONTENT

Another benefit from nitrogen fertilization is higher protein content. Figure 4 illustrates the increased protein content of Coastal and the increased amount of crude protein produced per acre when nitrogen rates are increased. A typical response is a fivefold or more increase of crude protein per acre when optimum rates of nitrogen are applied.

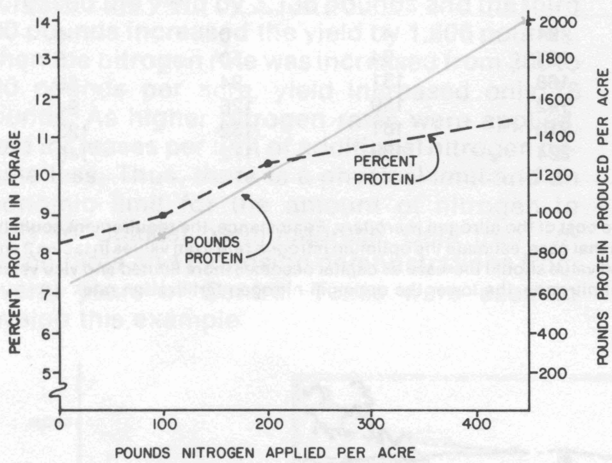

Figure 4. Fertilization increases percent protein and amount of forage protein produced.

IMPROVED WATER EFFICIENCY

Producing three to four times as much forage and increasing protein production fivefold or more through adequate fertilization improve water efficiency. Especially in years of limited rainfall, fertilization is the best way to minimize effects of drought. Figure 5 illustrates the effect of nitrogen on water use.

OTHER NUTRIENTS NEEDED

Although this publication emphasizes the need for nitrogen, Coastal requires other nutrients in large quantities such as phosphorus and potassium.

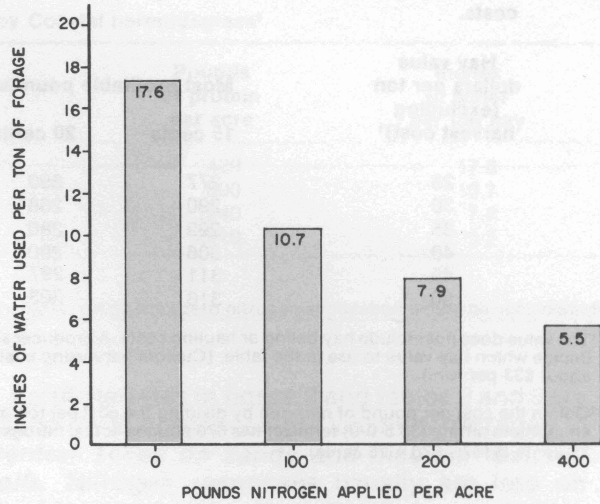

Figure 5. Fertilized Coastal requires less water to produce a ton of forage.

A summary of soil samples tested in the Extension Soil Testing Laboratory for fertilization of Coastal bermudagrass shows that all soils need nitrogen for optimum production and most soils need phosphorus. Deep, sandy soils usually require potassium and sometimes lime and sulphur for high production, especially under high nitrogen fertilization.

High quality Coastal hay removes nitrogen, phosphorus and potash in a ratio of approximately 4-1-3. Phosphorus, potassium, sulphur and other nutrients are essential for maximum quality, vigorous growth, stand maintenance, drought tolerance, rhizome development, winter survival and competitive growth against sandburs, annual grasses and other weeds. Some of the plant nutrients and their contributions to Coastal production are specified below:

- *Nitrogen* is needed in large amounts. Nitrogen is essential for yield and protein development, and it is largely responsible for the dark green color.
- *Phosphorus* is necessary to develop a healthy root system and stimulate vigorous top growth. A shortage of phosphorus results in stunted growth and reduced yields.
- *Potassium* is important for drought tolerance, disease resistance, rhizome development and winter survival. Potassium is required in amounts second only to nitrogen.
- *Calcium* helps grass develop new growth of stems, leaves and roots and synthesize protein. Calcium usually is adequate in clay soils but may be deficient in sandy soils under high production.
- *Magnesium* is needed for chlorophyll forma-

tion and for converting sunlight energy into plant carbohydrates.

- *Sulphur* is a part of the protein molecule and is essential for maximum protein development, growth and color. Sulphur usually is adequate under moderate fertilization levels but may be needed on certain sandy soils.
- *Micronutrients* such as iron, zinc and boron may be needed on certain soils, especially after several years of harvesting high hay yields.

Fertilizer recommendations for specific soil and climatic conditions should be based on a recent soil test.

HARVEST COASTAL WHEN QUALITY IS HIGH

In addition to adequate fertilization, *timely utilization* is essential to recover fertilizer expenditures and obtain maximum performance of animals that consume Coastal hay or pasture. All forage plants begin to lose quality as they mature. Since Coastal grows rapidly, using the forage when it is high quality is a critical management factor.

Young, lush forage is the highest quality. When harvesting for hay, a certain volume must be grown before hay harvest is justified. Cut Coastal hay when plants are 14 to 16 inches tall. Because Coastal has a relatively low moisture content, it cures quickly and is ready for baling before most other forages (figure 6). Figure 7 shows that the percentage of leaves declines as Coastal matures.

For grazing, use Coastal when there is a large proportion of leaves and a small proportion of

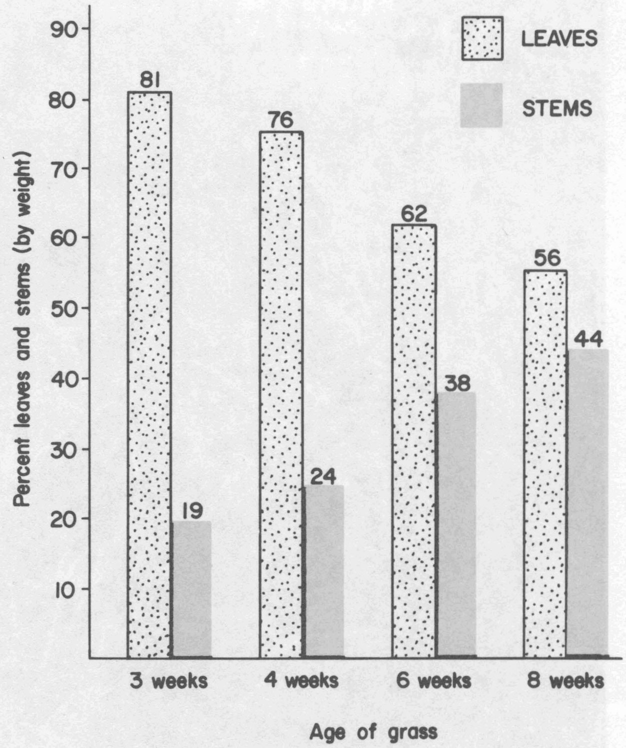

Figure 7. Effect of harvest frequency on the percentage of leaves and stems of Coastal bermudagrass.

stems. Leaves contain three to four times as many nutrients and are much more digestible than stems. Because of the physiological growth habits, young tender Coastal may be only 2 to 4 inches tall when at its maximum quality level. Whenever Coastal reaches 8 or more inches in

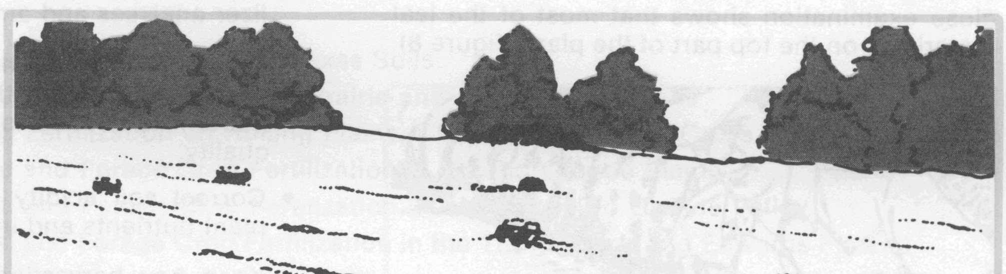

Figure 6. Timely harvesting contributes to a profitable Coastal enterprise.

Figure 8. Leaves contain three to four times as many nutrients as stems and are much more digestible. (Photo courtesy of Dr. Glenn W. Burton, research geneticist, USDA-ARS, Coastal Plains Experiment Station, Tifton, Georgia)

height, the stem material continues to develop, and few, if any, more leaves form. Lower leaves become shaded and eventually fall off the stem; close examination shows that most of the leaf material is on the top part of the plant (figure 8).

Figure 9. Determining protein content of hay samples is essential in managing and using hay supplies.

TIPS FOR HAY PRODUCTION

- Test the soil and use the recommended fertilizer analyses and amounts.
- Determine the amount and quality of hay desired. Remember a threshold level of each nutrient is needed to stimulate growth and quality.
- Correct soil acidity to promote uptake of plant nutrients and increase yields.
- Keep hay harvesting equipment in maximum state of repair to avoid breakdowns and possible damage to hay from rainfall.
- Group Coastal bermudagrass acreage into smaller areas to permit harvesting hay from a small acreage when it is of optimum quality.
- Topdress additional nitrogen immediately after hay is harvested to stimulate further growth.
- Test hay to determine protein content. This information is useful in deciding the most appropriate group of livestock to receive that quality of hay (figures 9 and 10)

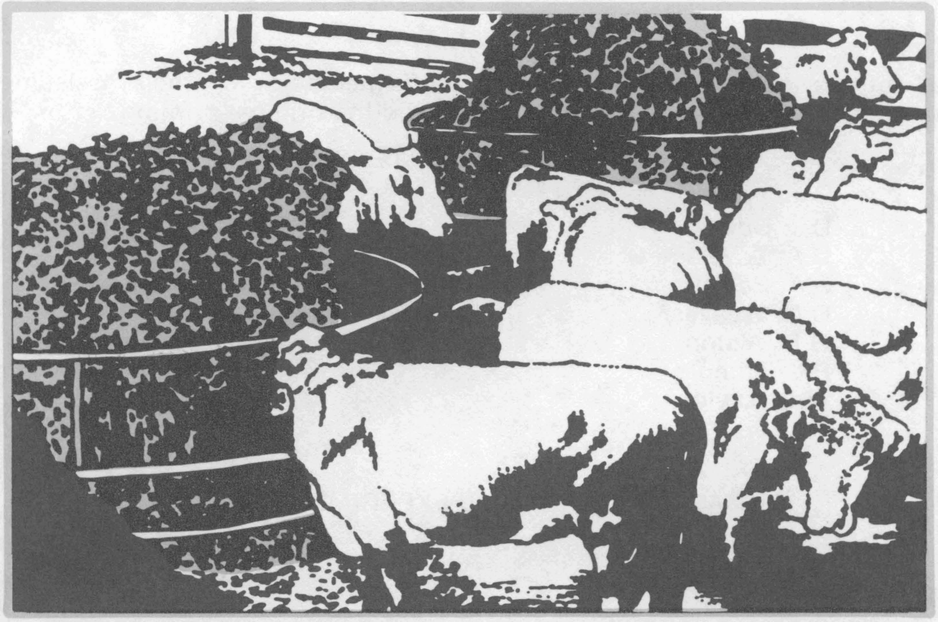

Figure 10. Improved hay protein content results in improved animal performances.

SUGGESTED READING

L-771	Crop Fertilization on East Texas Soils
L-772	Crop Fertilization on Coast Prairie and Coastal Bend Soils
L-983	Crop Fertilization on Rolling Plains, Central Prairies and Cross Timber Soils
L-1411	Field and Forage Crop Fertilization in the Rio Grande Plains
L-1498	Field and Forage Crop Fertilization in the Lower Rio Grande Valley
L-1506	Field and Forage Crop Fertilization in the Trans-Pecos and Edwards Plateau Regions
L-1538	Forage Fertilization on Texas Blackland and Grand Prairie Soils
MP-737	Nitrogen and Crop Production
MP-860	Phosphorus and Crop Production
MP-1007	Potassium and Crop Production
MP-1213	Project Bastrop
B-1171	Hay Harvesting Costs in Texas
B-1243	Forage Results and Potentials in North Central Texas
B-1244	Improving Beef and Forage Profits in Central Texas

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