may be necessary to control (clip or spray) broadleaf weeds and annual grasses to reduce their competition for sunlight and nutrients before this application of nitrogen. Wait until the desirable grass begins to cover before applying the second application of nitrogen. When the grass is completely covered and haying operations are to begin, fertilize as indicated in the sections on hay fertilization.

Summary

A proper fertilization program can produce high yields of bermuda or bahiagrass hay with good quality. For best results, hay should be cut every 30 days (assuming adequate rainfall) and fertilized adequately. The recommended amount of fertilizer should be split into 3 - 4 applications beginning at green up and continuing through the last harvest.

A good fertilization program for bermuda or bahiagrass hay is expensive and requires good management but the results can be yields of 6 - 8 tons of hay per acre with a protein content of 12 percent to 14 percent.

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Authors

Eddie R. Funderburg, Specialist (Agronmy)
Edward K. Twidwell, Specialist (Agronomy)

Visit our website: www.agctr.lsu.edu

Louisiana State University Agricultural Center,
William B. Richardson, Chancellor
Louisiana Cooperative Extension Service,
Jack L. Bagent, Vice Chancellor and Director

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Fertilizing Summer Hay Fields

LSU AgCenter
Research & Extension

Fertilizing Summer Hay Fields

for High Yields, Quality and Profits

Fertilizer costs account for a high percentage of the inputs associated with hay production. A properly fertilized hay field will result in high yields, good quality and good cattle performance. Poorly fertilized hay will be of poor quality, yield poorly and cause cattle to be unthrifty even if they eat large amounts of hay.

The keys to fertilizing hay are to use the right nutrients with the right source at the proper rate at the right time. If these things are done, and if it rains at the right time, very good yields of high quality hay will result.

Nutrients Usually Needed

High-yielding hay removes large amounts of nutrients. The most common nutrients used in fertilizers for hay production are nitrogen (N), phosphorus (P), potassium (K) and sulfur (S). Table 1 shows the amount of nutrients removed in one ton of hybrid bermudagrass, bahiagrass and dallisgrass hay.

Table 1. Nutrient removal in hay.

	----------lbs/ton of hay----------		
Nutrient	**Hybrid Bermuda**	**Bahia**	**Dallisgrass**
N	46	43	45
P_2O_5	12	12	12
K_2O	50	35	50
S	6	6	6

Source: Potash and Phosphate Institute

The amount of nitrogen to be applied is determined by the yield goal, the forage species and whether the forage will be used for grazing or hay. The amounts of phosphate (P_2O_5) and potash (K_2O) needed are determined by soil test results and will be discussed in detail following the section on nitrogen fertilization.

Soil Testing

Soil testing is strongly encouraged to determine lime and fertilizer needs. A good soil testing program can identify problem areas in fields, save money on unnecessary fertilizer use and improve yields through increased fertilizer use.

A soil testing program is only as good as the sample collected. It is recommended to break large fields into 10 to 15 acre blocks. Soil test each smaller field. From each testing site, collect soil from 10 to 15 places in a field at random from a depth of 0 to 6 inches. Place this soil in a clean, plastic bucket. Thoroughly mix the soil and remove about 1 pint for analysis. Your county agent can provide information sheets and soil sample boxes.

pH and Liming

Bermudagrass and bahiagrass are tolerant of acid soils. They rarely respond to lime applications until the soil pH reaches very low levels. Louisiana research has shown that Coastal bermudagrass failed to respond to lime applications when the soil pH was 4.9. Many other research studies support this work. But, if clovers or ryegrass are to be planted in the field, the soil pH should be 5.5 or higher.

Nitrogen (N) Rates

Nitrogen is the element which is usually most limiting in hay production. It is an important constituent of protein. Proper rates of nitrogen increase growth rate and photosynthesis.

Nitrogen deficiencies are characterized by a light green color and poor growth. If grass does not "green up" after a nitrogen application, the problem could be sulfur deficiency because sulfur deficiency looks much like N deficiency.

Hybrid bermudagrass hay requires high rates of nitrogen to maximize yields. If a good stand

of grass is present and adequate rainfall occurs, hay yields rise proportionately to the amount of nitrogen applied. Protein also increases, assuming the grass is harvested at the proper stage of growth. Table 2 shows the effect of N rates on hybrid bermudagrass hay yield and protein content.

Table 2. Effect of N rate of hybrid bermudagrass hay yield and crude protein (5-year average)

N Rate	Hay Yield(lbs/A)	Crude Protein (%)
100	5,807	9.9
200	8,628	11.1
300	11,562	11.5
400	13,067	12.6
500	15,345	13.4

100 pounds N per acre applied per harvest as ammonium nitrate.

Source: Effect of Fertilizer Nitrogen Rates and Sources on Coastal Bermudagrass Grown on Coastal Plain Soil, Louisiana Agricultural Experiment Station Bulletin No. 797.

Bahiagrass also responds positively to nitrogen applications, assuming adequate rainfall occurs and the stand is properly managed (Table 3).

Table 3. Effect of N rate on Pensacola bahiagrass yield (5-year average)

N Rate	Hay Yield (lbs./A)	Crude Protein (%)
0	3,461	10.3
200	10,664	12.0
300	12,722	12.5
400	14,081	13.4

100 pounds N per acre applied per harvest as ammonium nitrate

Source: Responses of Bahiagrass to Applied Nitrogen, Phosphorus and Potassium, Louisiana Agricultural Experiment Station Bulletin No. 701

Dallisgrass can make excellent yields of good quality hay if stands can be maintained and a good fertility program is followed. Table 4 shows how dallisgrass can respond to nitrogen application.

Table 4. Effect of N rate on dallisgrass yield (5-year average).

N Rate	Hay Yield (lbs/A)	Crude Protein (%)
0	4,760	9.8
100	7,117	10.6
200	9,403	11.8
400	11,797	14.6
800	13,699	17.2

Nitrogen applied in four applications as ammonium nitrate.

Source: Dallisgrass Yield, Quality and Nitrogen Recovery Responses to Nitrogen and Phosphorus Fertilizers, Communications in Soil Science and Plant Analysis, 19(5), 529-542 (1988)

The LSU Agricultural Center recommends the following N rates for summer hay fields: hybrid bermudagrass - 300-400 pounds per acre; common bermudagrass - 200-300 pounds per acre; bahiagrass - 300-400 pounds per acre, and dallisgrass - 300-400 pounds per acre. Use these rates in split applications with no more than 100 pounds N per acre applied at any one time.

Nitrogen Sources

The source of N used can make a difference in the yield and quality of hay produced. As a rule, ammonium nitrate and ammonium sulfate suffer very little ammonia volatilization loss. This means they can be applied on the surface and they will remain "safe" until a rainfall occurs to incorporate them.

Urea and 32 percent urea-ammonium nitrate solutions can suffer high volatilization losses if they are surface-applied in hot weather and no rainfall occurs within two to three days.

Unless price heavily favors an N source containing urea, it is suggested they not be used for summer pastures or hay fields. Research has indicated that hay yields may vary according to the source of N fertilizer used (Table 5).

Table 5. Effect of N source on hybrid bermudagrass yield

N Source	Hay Yield (lbs/A)	Crude Protein (%)
Urea	10,284	9.5
Ammonium Nitrate	12,432	10.5
32% liquid N	9,760	11.2
Ammonium Nitrate	11,704	12.5

N rate 400 pounds per acre in a four-way split.

Source: Effects of Fertilizer Nitrogen Rates and Sources on Coastal Bermudagrass Grown on Coastal Plain Soil. Louisiana Agricultural Experiment Station Bulletin No. 797

Nitrogen Timing

With the high rates of nitrogen used in hay production (up to 400 pounds N/acre), it is usually not advisable to apply all the N at one time. Losses may occur because of heavy rainfall, or the applied N may not be fully used because of insufficient rainfall.

A better alternative is to apply 100 pounds N per acre at green up, then apply 100 pounds N after each hay cutting except the last. This will result in better hay yields (Table 6) and is more environmentally friendly.

Table 6. Effect of split N application on hay yield (3-year average)

N Application Method	Hay Yield (lbs/A)
Single spring application	9,848
4-way split	12,432

N rate was 400 pounds per acre. 4-way split involved 100 pounds per acre at green up, then 100 pounds per acre following the next 3 hay cuttings.

Source: Effects of Fertilizer Nitrogen Rates and Sources on Coastal Bermudagrass Grown on Coastal Plain Soil, Louisiana Agricultural Experiment Station Bulletin No. 797.

Phosphorus (P)

Phosphorus is shown in fertilizer rates as phosphate (P_2O_5). All rates discussed here will be in pounds of P_2O_5 per acre. Phosphorus is critical in establishment of a root system. It is essential in the storage and transfer of energy and is a component of several biochemicals that control plant growth and development. Phosphorus deficiency in warm season grasses is exhibited as small, unthrifty plants. In winter grasses and legumes, P deficiency is exhibited as a reddish-purple color on the leaves and stems.

Phosphate is used in much smaller amounts by hay than are nitrogen and potash. For this reason, it can all be applied in the spring, or it can be split-applied. Phosphorus does not leach from the soil. It is lost through crop removal and soil erosion.

Phosphorus availability to plants depends largely on soil pH. It is most available when the soil pH is 5.5 - 7.0, with the optimum pH for P availability of 6.2. When the soil pH is below 5.5, P is tied up by

iron and aluminum. When the pH is above 7.0, P is tied up by calcium.

Phosphate rates should be based on soil test results. Recommended rates of phosphate range from 0-140 pounds P_2O_5 per acre, depending on soil test level (Table 7).

Table 7. Recommended rates of P_2O_5 per acre by soil test level

Soil Test P Level	P_2O_5 Rate (lbs/A)
Very low	120 - 140
Low	90 - 120
Medium	60 - 80
High	30 - 40
Very High	0

Lower rates are for common bermudagrass or native grass hay.

Potassium (K)

Potassium is shown in fertilizer rates as potash (K_2O). All rates discussed here will be in pounds of K_2O per acre. Potassium is indirectly related to many plant cell functions. Some 60 enzymes require the presence of K. Plants sufficient in K are much more "winter-hardy" than are deficient plants. Potassium deficiency inhibits the ability of plants to use available water and results in plants prone to drought stress. Potassium-deficient plants are also much more susceptible to certain diseases.

Potassium deficiency is exhibited in bermudagrass as Helminthosporium disease. The symptoms begin as small black spots on the leaves. If the deficiency progresses, the spots widen to form dead patches on the leaves. Then the grass begins to die out in small clumps. These empty spaces are usually quickly occupied by weeds. In severe cases of K deficiency, the stand may be lost.

Bermudagrass and dallisgrass hay remove tremendous amounts of K_2O and bahiagrass also removes relatively large amounts (Table 1). Therefore, the recommended rates of K_2O are high for these crops. Potash rates should be established by soil test results. Recommended rates of K_2O range from 40-300 pounds per acre, depending on soil test levels (Table 8).

Table 8. Recommended rates of K_2O per acre by soil test level

Soil Test K Level	K_2O Rate (lbs/A)
Very low	280 - 400
Low	240 - 300
Medium	160 - 200
High	80 - 100
Very high	40 - 50

Lower rates are for bahia, common bermudagrass or native grasses.

At the higher recommended rates of potash, it is not advisable to apply all of the material in one application. On sandy soils, potassium can leach. For best results, split potash applications so that no more than 120 pounds K_2O are applied at one time.

Using the recommended rates of potash is essential in maintaining hay fields. Potassium-deficient fields will lose both yield and stand (Table 9).

Table 9. Effect of K_2O rate on yield and stand of hybrid bermudagrass (6 year average)

		---- bermudagrass stand % ----	
K_2O Rate	Hay Yield (lbs./A)	Year 1	Year 6
0	8,919	57	29
100	12,399	47	84
200	13,583	45	89
400	14,341	41	88

Soil test K very low

Source: Effect of Fertilizer Potassium on Coastal Bermudagrass Grown on Coastal Plain Soil. Louisiana Agricultural Experiment Station Bulletin No. 782

As can be seen from the data in Table 9, yields of hybrid bermudagrass were greatly increased by adding the recommended rate of potash. Even more striking was the effect of potash rates on stand. Where no potash was used, the stand of grass dropped from 57 percent the first year of the test to 29 percent after six years. Where the recommended rate was used, the stand increased from 41 percent the first year to 88 percent after six years. This was caused by the potash fertilization since no further planting of grass was done. These data clearly show the need to soil test and use the recommended rates of potash.

Sulfur (S)

Research has shown some benefits to using sulfur on bermuda, dallisgrass or bahiagrass hay crops when high nitrogen rates are used and high tonnages are removed. Sulfur will probably not increase yields when lower nitrogen rates are used and lower yields are produced.

Table 10. Effect of sulfur fertilizer on yield and protein content of hybrid bermudagrass hay (5-year average).

Sulfur rate/cutting (4 cuttings)	Yield (lb/acre)	Protein (%)
0	12,591	14.1
24	14,556	13.9

100 pounds N per cutting was applied. Hay was cut 4 times per year.

Source: 1990 Proceedings of the Louisiana Association of Agronomists, pg. 37-52.

In this study, sulfur fertilization at the rate of 24 pounds of sulfur per acre per cutting increased yields about one ton of hay per acre per year. Protein content was not affected.

Establishing Summer Hay Fields

It is important to fertilize summer hay fields properly when establishing (seeding or sprigging) them. Too much fertilizer at the wrong time will encourage weed growth. Too little fertilizer will prevent the grass from growing and spreading properly.

Phosphate and potash rates should be determined by soil testing. Apply all of the recommended phosphate and potash into the soil before the final tillage operation is conducted.

Nitrogen fertilizer must be applied in the proper amounts at the proper time for the establishment to be successful. Apply nitrogen (along with all the recommended phosphate and potash) at the rate of 20 - 40 pounds per acre before the final tillage operation. If heavy weed pressure exists, use the lower amount.

After the planted grass emerges and begins to cover, apply 40 - 60 pounds of nitrogen per acre. This will help the grass cover quickly. Do not apply nitrogen if the weeds are outgrowing the grass. It