

BERMUDAGRASS MANAGEMENT IN NORTH CAROLINA

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BERMUDAGRASS MANAGEMENT IN NORTH CAROLINA

The Growing Popularity of Bermudagrass

Bermudagrass (*Cynodon dactylon*) is a warm-season perennial grass that was introduced into the United States in the early 1700s. Over the past several years, the acreage of hybrid bermudagrass in North Carolina has increased steadily, primarily because of its use as a receiver crop for animal and municipal wastes. In addition, widespread use of cool-season grasses, such as tall fescue and orchardgrass, means that farms often need more warm-season grasses to balance a 12-month forage supply. As a result, many pastures contain common bermudagrass mixed with other warm-season grasses, such as crabgrass (*Digitaria* sp.) and dallisgrass (*Paspalum dilatatum*). Where soil types and climate permit the growth of cool-season perennials (grasses and legumes) and bermudagrass on the same farm, producers can allocate one-fourth to one-third of their pasture acreage to bermudagrass. This distribution balances out a 10- to 12-month grazing program, reducing forage shortage during midsummer and minimizing the need to establish expensive summer annuals each year. The seasonal production of fescue and bermudagrass are shown in Figure 1; their growth characteristics can be used to estimate acreage needed to establish year-round grazing.

Grass Selection and Characteristics

Although there are many varieties of bermudagrass available in the southern United States, only these seven are of importance to North Carolina growers: the hybrids Coastal, Tifton 44, Tifton 78, and Tifton 85; common bermudagrass, or “wiregrass”; Guymon, a common variety; and Giant, a large, non-winter-hardy common strain.

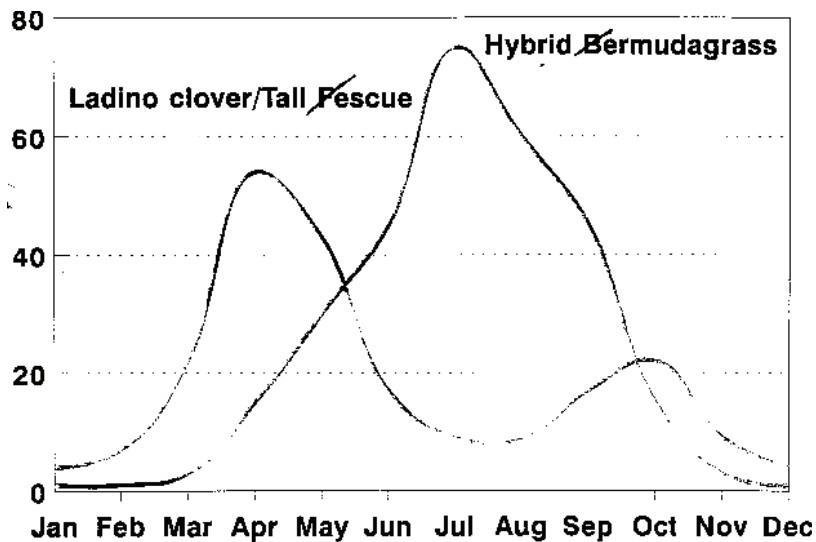


Figure 1. Seasonal production of tall fescue and hybrid bermudagrass.

Coastal bermudagrass is a hybrid between an old “cotton patch” common strain found near Tifton, Georgia, and a variety introduced from South Africa. Its stems, stolons, and rhizomes are larger and its internodes are longer than those of common bermudagrasses; in addition, the light-green Coastal bermudagrass leaves are more sharply angled to the stem. Coastal bermudagrass produces fewer seed heads than common bermudagrass, and the seeds are sterile. In sandy soils, Coastal bermudagrass roots extend as deep as 8 feet. When well fertilized, Coastal has nearly three times as many roots below the 4-foot level as common bermudagrass, making it more productive and drought tolerant (Table 1). Coastal bermudagrass is resistant to the root-knot nematode, which will die if it penetrates Coastal roots.

Tifton 44 is a hybrid between Coastal bermudagrass and a winter-hardy bermudagrass from Berlin, Germany. Compared to Coastal, Tifton 44 has finer stems, is darker green, and has a more vigorous rhizome and root system, thereby forming a denser sod. On heavy clay soils, Tifton 44 does not spread as rapidly as Coastal or the other hybrids. Even though it produces fewer seed heads, Tifton is often confused with common bermudagrass because of its fine stems and leaves. During short dry periods, it rapidly produces seed heads. It also recovers from

Table 1. Performance of Hybrid and Common Bermudagrass on Two Soil Types

	Lee County ¹ Lakeland Sand	Wake County ² Cecil Clay Loam		
		1st yr ³	5th yr	5-yr avg
Tons/Acre				
Coastal	6.0	—	—	—
Common	2.3	—	—	—
Tifton 44	—	2.6	7.2	6.1
Tifton 78	—	2.8	6.1	4.7
Pasto Rico (common)	—	3.3	6.5	5.5

¹ 100 lb N, 50 lb P₂O₅, and 100 lb K₂O applied per acre in April and on July 1. Source: D. S. Chamblee, North Carolina State University.

² 75 lb N, 50 lb P₂O₅, and 100 lb K₂O applied per acre in April, July, and August. Source: Forage Variety Test Report, North Carolina State University.

³ Year of establishment.

drought much more slowly than Coastal. Tifton 44 usually begins growing 7 to 14 days earlier than Coastal. Tests at the University of Georgia indicated that Tifton 44 is about 5 percent more digestible than Coastal and averages about 19 percent better daily beef gains. However, in North Carolina there is very little evidence of such quality differences.

Tifton 78 is the result of a cross between Tifton 44 and Callie bermudagrass (a large, vigorous, non-winter-hardy variety). Like Coastal and Tifton 44 varieties, it is sterile and must be propagated vegetatively. Compared to Coastal, it is taller, spreads much faster, establishes easier, and starts growth earlier in the spring, but it does have similar rhizomes. Tifton 78 is similar to Callie in growth habit, rate of spread, and ease of establishment, but it produces more rhizomes and is immune to the rust to which Callie is very susceptible. The northern adaptation limit for Tifton 78 is not well established, but tests conducted in Raleigh over a five-year period indicated that Tifton 78 dies back each winter, resulting in low yields for the first harvest. Some farmers in southeastern North Carolina have had good success with this hybrid.

Tifton 85, a new hybrid bermudagrass, was released to certified growers in 1992. Compared to Coastal and Tifton 44 varieties, Tifton 85 is taller, has larger stems and wider leaves, and is darker green. It is of

better quality than Coastal but has a lower tolerance to cold than Coastal and Tifton 44. Tifton 85 can be established from sprigs or from top growth; its rhizomes and very large stolons spread rapidly. North Carolina adaptation has not been determined, but Tifton 85 is expected to be comparable to Tifton 78.

Common (or “wiregrass”) bermudagrass is related to the hybrid varieties; they share the same scientific name [*Cynodon dactylon* (L) Pers. Var. *dactylon*]. However, common bermudagrass produces many viable seeds, whereas hybrids, even though they make seed heads, are sterile and must be established vegetatively from rhizomes, stolons, or mature stems. In North Carolina, there are many types of common

bermudagrass, often called “wiregrass.” Common bermudagrass grows low, forming a dense sod with very short internodes; it spreads profusely by rhizomes, stolons, and seeds. During late summer, it often suffers from severe leaf disease. During drought stress, it produces many short seed heads.

Guymon is a variety of common bermudagrass developed in Oklahoma. It is winter hardy and should survive better in North Carolina than some other types of common bermudagrass.

Giant bermudagrass is technically different from common and hybrid varieties because it has a different chromosome number and name (*Cynodon dactylon* var. *Aridus* Harlan et de Wet). Practically speaking, however, Giant is similar to common bermudagrass because it produces viable seeds from which it can be established. It is often sold in mixtures with common bermudagrass. Giant bermudagrass is not as winter hardy as common bermudagrass, Guymon, and Tifton 44 but probably offers the same feed quality as common bermudagrass. The first three years after planting, yields of mixtures containing Giant may be similar to some of the hybrids, but because Giant bermudagrass frequently dies over winter, yields may eventually resemble those of common bermudagrass.

Adaptation

As long as internal soil drainage is good, bermudagrasses will grow well in a variety of soil types, including sands, loams, silts, and clays. Bermudagrass grows best at high temperatures (85° to 95°F) and grows very little when the night temperature falls below 60°F. Therefore, bermudagrass varieties are most practical in the piedmont and coastal plain. The hybrid varieties, which vary in their winter hardiness, are recommended for soils too sandy to grow good row crops or clover-fescue mixtures. Figure 2 illustrates the general area of adaptation in North Carolina.

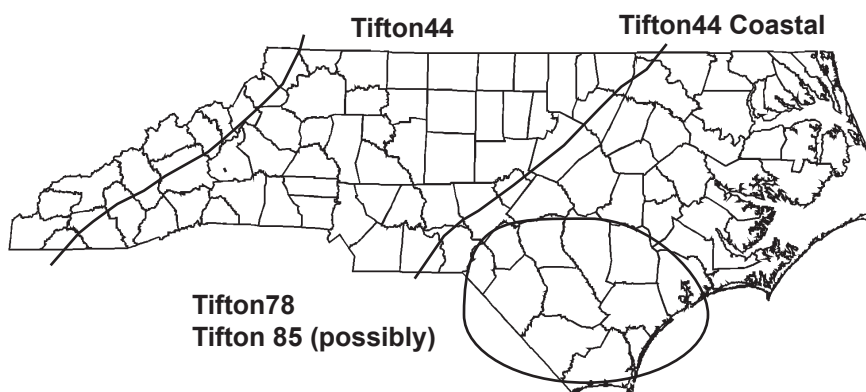


Figure 2. Adaptation of bermudagrass cultivars and types to North Carolina.

Uses

Bermudagrass can be used for grazing, hay, and silage. It also can be used as a receiver crop for wastes from confinement animal operations, processing plants, and municipalities because the extensive root system takes up large amounts of nutrients.

GRAZING

Bermudagrass is well adapted to close, frequent defoliation because of its low-growing, creeping growth pattern. During the active growing season, pastures often regrow rapidly enough to regrazed every 10 to 21 days. For good animal performance, bermudagrass must be kept short and leafy. Because bermudagrass tolerates a wide range of conditions and management, it is often planted in small pastures used by free-roaming grazing animals, such as pleasure horses. Bermudagrass, especially the common types, can withstand severe grazing pressure and trampling. Under more controlled management, hybrid varieties will likely give the highest production (Table 1).

HAY

Hybrid bermudagrasses can produce high yields in response to high fertilizer or manure application rates. Bermudagrass hay cures quickly and, with proper fertilization and harvesting schedules, can produce satisfactory feed quality for many classes of animals.

SILAGE

For good silage, manage bermudagrass as you would hay, and cut every four to six weeks. Chop as short as possible, and pack the forage tightly in the silo before it wilts. Fresh Coastal bermudagrass usually contains 65 to 75 percent moisture when cut at four to six weeks of age. For low-moisture silage, wilt the bermudagrass to 50 percent moisture and store it in a reasonably airtight structure (for example, a tightly packed trench silo sealed with plastic; a sealed plastic bag, capable of storing 100 tons or more of silage; or a covered, sealed tower silo.)

Establishment

Giant and common bermudagrass varieties produce viable seeds that can be used to establish your crop. Hybrid varieties, which do not produce fertile seeds, must be established from sprigs or top growth. Whether you are planting hybrid or common varieties, proper soil preparation is the key to success. In general, before planting have the soil tested and incorporate the recommended amounts of fertilizer and limestone; then thoroughly prepare and firm the bed, much as you would for planting row crops.

PLANTING METHODS

Seeds

Plant common and Giant bermudagrass seeds in April or May at a rate of 5 to 10 pounds of seed per

acre. Plant the seeds 1/4 to 1/2 inch deep, then firm the soil. If moisture conditions are good or if the area is irrigated, it is possible to produce stands from seeds planted as late as June and early July. If the field contains ryegrass, disk the field before planting the bermudagrass; living ryegrass produces a toxin that prevents bermudagrass from germinating.

Sprigs

If this is your first hybrid crop, we recommend that you begin with certified sprigs (Figure 3) to avoid planting common bermudagrass or noxious weedy species along with the desired hybrid variety. (For information on certified growers, see the North Carolina Crop Improvement Association's *Source of Certified Seed Handbook**) Sprigs are measured and sold by the bushel or cubic foot. One bushel equals about 1.25 cubic feet and contains about 1,000 sprigs. Certified sprigs of Coastal, Tifton 44, Tifton 78, and Tifton 85 are available.

Usually, farmers purchase enough certified sprigs to establish a 1- to 2-acre nursery. The following spring, the sprigs are harvested and used to plant larger acreage; maximum yield usually occurs by the third year. If there is a problem with disease or undesirable weeds or grasses, simply begin again with certified sprigs. Here are some guidelines on harvesting sprigs:

- Before harvesting the sprigs, remove excess forage residue from the sprig field by burning, clipping, or baling. If a sprig digger (Figure 4) is not available, you can cross-disk to break the sod and loosen the roots and rhizomes.
- To pull the sprigs to the top of the soil, use a spring tooth harrow, a field cultivator, or a Roto-tiller. Use a side delivery hay rake to shake the soil from the roots and windrow the sprigs for easy loading.
- To prevent drying and death, handle the sprigs carefully. Drying is a particular problem when planting nondormant sprigs in April through July; drying is rarely an issue when planting dormant sprigs in February or March. To avoid drying, dig, load, and replant the sprigs as quickly as possible. Table 2 shows the influence of drying time and temperature on the survival of Coastal bermudagrass sprigs. Sprigs quickly lose their viability as a result of high temperature and low moisture (Table 3). If sprigs must be held over for

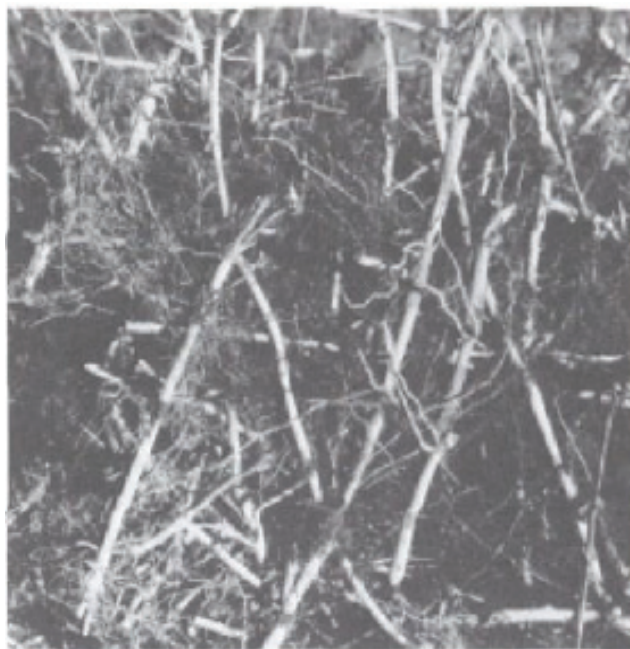


Figure 3. A good source of sprigs (3 to 6 inches long) can make the difference between success or failure. Take special care to prevent drying and death.

several hours, place them loosely in shallow piles or burlap bags, keeping them wet with cold water.

Hybrid bermudagrass is easiest to establish if you plant dormant sprigs in February or March; in the first year, probably 70 to 80 percent of the crop will survive. If moisture is adequate, you can plant actively growing (nondormant) sprigs in April, May, or June.

Sprigs may be planted in a number of ways, but the depth at which they are placed is extremely important. Ideally, you should place the sprigs vertically or semivertically, burying all but 1/2 to 1 inch of the tip of the sprig. You can vary this method when planting dormant sprigs, but there are certain conditions for success. Dormant sprigs can be completely covered with up to 2 inches of soil; they will penetrate as long as the soil surface does not become hard and crusty. Dormant Tifton 44 sprigs can be placed horizontally as deep as 3 inches and as late as November or even December, but expect only 20 to 50 percent to survive the following year. Nondormant sprigs should never be completely covered (Table 3).

Hand Planting. Use a notched stick or special hand

*The *Source of Certified Seed Handbook* is available from the North Carolina Crop Improvement Association, 3709 Hillsborough St., Raleigh, NC 27607.



Figure 4. Hybrid bermudagrass must be established from vegetative planting stock. Sprigs can be dug by several methods, including a specialized commercial digger, shown above.

planter to push the sprigs 3 to 4 inches deep into moist soil; leave the sprig tips barely exposed. Use your foot to firm the soil around the sprigs. This method is especially good if a limited number of sprigs are available. A tree planting spade also can be used.

Furrow Planting. Open a furrow 2 to 4 inches deep and drop the sprigs into it. Cover the sprigs with a

Table 2. Influence of Open-air Drying Time and Temperature on the Survival of Dormant Coastal Bermudagrass Sprigs

Open-air Drying Time	Temperature (°F)	
	90	60
	(survival percentage)	
1 hour	57	54
6 hours	20	36
LSD .05	10	10

Source: D. T. Gooden and D. S. Chamblee, North Carolina State University.

Notes: Data in this table are the average results from three experimental plots planted on March 27, March 29, and April 3, in the piedmont and coastal plain of North Carolina. Measurements were taken approximately five weeks after planting. A LSD (least significant difference) value indicates that there is a statistically significant difference between the percentages listed in that column.

cultivator or disk hiller that has been adjusted to leave the sprig tips exposed. Firm the soil around the sprigs with a press wheel, cultipacker, or tractor tire.

Mechanical Sprigger. Use a mechanical transplanter or colter-type planter, such as a tobacco setter, tree transplanter, or commercial bermuda-grass sprigger (Figure 5). Plant the sprigs 2 to 4 inches deep in moist soil, leaving the sprig tips exposed. Dormant sprig tips can be covered with 1 to 2 inches of soil. Use a press wheel to firm the soil around the sprigs.

Broadcast Planting. Sprigs can be broadcast onto the soil surface with a manure spreader or by hand. Press the sprigs into the soil using a disk with its blades set to cover slightly. Following the disk, firm the soil around the sprigs with

a cultipacker.

The rate of soil coverage depends on the num-

Table 3. Influence of Exposure to Drying (90°F) and Placement on Survival of Nondormant Coastal Bermudagrass Sprigs

Placement ¹	Survival Percentage 3 Weeks After Planting ²	
	Wet Year	Dry Year
Vertical		
Check (no drying)	80	12
Check plus irrigation	84	57
1 hour (drying)	41	8
6 hours (drying)	0	3
Horizontal (3-inch depth)		
Check (no drying)	23	1
LSD .05	11	6

Source: D. T. Gooden and D. S. Chamblee, North Carolina State University.

Notes: Tests were conducted in Wake County, N.C. A LSD (least significant difference) value indicates that there is a statistically significant difference between the percentages listed in that column.

¹Sprigs were protected from drying until planting.

²Planting dates: June 19 (wet year), May 22 (dry year).

ber of sprigs planted per acre. If the rows are 3 feet apart and sprigs are planted 12 to 18 inches apart by hand or tobacco transplanter, you will need 10 to 15 bushels (10,000 to 15,000 sprigs) per acre. Planting sprigs on 3-foot centers requires about 5 bushels per acre (5,000 sprigs). If moisture and nitrogen are readily available and weeds are controlled, the soil may be covered in one season.

Soil coverage will vary if sprigs are broadcast planted (that is, spread on the soil surface and disked); in that case, you will need 40 to 60 bushels per acre. When row planting Tifton 44 on clay soils, rows should be 2 feet apart, and you will need 25 to 35 bushels per acre. Custom sprigging operators in North Carolina have successfully established Tifton 44 using 35 to 40 bushels of sprigs per acre.

Top Growth (Clippings)

Use plants that are 8 to 12 weeks old. At that time (probably late June), the stems will be mature, which means that the nodes will be well developed. An acre of well-managed hybrid bermudagrass should provide enough green clippings to plant 8 to 10 acres. Do not let the clippings dry before you cover them with soil; if you do, they will lose their viability rapidly. *Keep in mind that this method is uncertain, especially if irrigation is not available.*

WEED CONTROL

Weeds must be controlled while bermudagrass is becoming established. To eliminate early competition, plant in fields that are relatively free of weeds. Sometimes mowing or grazing can control grassy weeds. In other cases, you will have to use a herbicide. See the most recent edition of the *North Carolina Agricultural Chemicals Manual* for labelled herbicides. For row plantings, you can use a field cultivator to remove weeds, but make sure that the cultivator attachments are moved away from the runners as the plants begin to spread.

FIRST-YEAR FERTILIZATION

Test the soil to determine how much lime and fertilizer must be added to the soil to establish and grow bermudagrass successfully. Nitrogen, phosphorus, and potassium are all required. Lime recommenda-



Figure 5. If possible, sprigs should be placed vertically or semivertically into the soil. Tobacco transplanters and tree planters are very efficient for establishing small acreage.

tions for establishment are based on a starting soil pH of 6.5. Therefore, before planting, mix the recommended amounts of lime and phosphorus into the soil to achieve that pH level. If a soil test report is not available at planting, apply 40 to 50 pounds of phosphorus and potassium per acre. When growth starts, add 30 to 40 pounds of nitrogen per acre on the row. After the plants begin to make runners (six to eight weeks after growth begins), you may apply another 30 to 60 pounds of nitrogen per acre.

If weedy grasses are not a problem, let the bermudagrass grow 8 to 10 inches tall before grazing or clipping. However, selective grazing and clipping will encourage the plants to spread across the soil surface rather than to grow erect and stemmy. Animals can graze any time, as long as they do not pull the runners or plants out of the soil.

Hay Management

FERTILIZATION (Established Stands)

Use soil test results as a guide for applying phosphorus, potassium, and lime. Because each ton of

dry bermudagrass forage contains about 40 to 50 pounds of nitrogen and potassium and 12 pounds of phosphorus, you will need a lot of fertilizer to achieve a good bermudagrass yield (5 to 8 tons per acre). Hybrid bermudagrass responds well to heavy fertilization.

Table 4 shows that an application of 200 pounds of nitrogen per acre per year (divided into three to four applications) on the deep sandy soils of the sandhills of North Carolina results in a yield of 4.3 tons per acre, compared to 0.6 ton per acre when no nitrogen is used. Increased yields have resulted when 300 to 400 pounds of nitrogen per acre per year were dispensed in three to four applications on the less sandy soils of the upper coastal plain (Table 5). On deep sand and in the piedmont, the maximum practical nitrogen application rate for hay production is probably around 200 pounds per acre annually. When using this quantity of nitrogen under average conditions, phosphorus and potassium requirements can be met by one application of 500 to 800 pounds of a 0-10-20 fertilizer per acre. On the better soils of the coastal plain counties, which have a long growing season, the nitrogen rate may be increased to 300 pounds per acre with a one-time application of 800 to 1,000 pounds of a 0-10-20 fertilizer (or equivalent) per acre. Of course, the price of fertilizer, environmental considerations, alternative feeds, and farm goals will influence the level of application.

Bermudagrass requires substantial amounts

of phosphorus and potassium, in addition to nitrogen. Many Coastal bermudagrass producers supply adequate nitrogen fertilization but not adequate phosphorus and potassium. In particular, potassium deficiency seems to intensify problems such as winterkill, low yields, and increased incidence of leaf spot disease.

When using more than 200 pounds of nitrogen per acre, it is best to split the potassium applications. If nitrogen is applied alone (either as a solution or as a granular), apply an additional 50 to 80 pounds of phosphorus and potassium in April or May using a 0-1-2 fertilizer. Then, a second application of potassium (using muriate of potash) can be made in mid-July. You also can put nitrogen, phosphorus, and potassium on at the same time using a 4-1-2 fertilizer. For example, if you use a 20-5-10 fertilizer, apply 200 to 400 pounds per acre in April, June, and in mid-July.

Soil test reports for maintenance call for a pH of 6.0, but bermudagrass will tolerate more acid soils. In fact, if the soil pH is between 5.5 and 5.8, there is usually little response to lime applications. Nevertheless, there are good reasons to lime. For example, if legumes are grown with bermudagrass, the pH should be maintained above 6.0. Liming also helps maintain adequate calcium and magnesium on sandy soils, and it can improve winter survival of Coastal bermudagrass. Also, lime is needed to neutralize the acidity caused by applications of ammonium forms

Table 4. Yield, Percentage of Crude Protein, and Percentage of Apparent Nitrogen Recovery as Influenced by Rate of Nitrogen Application at Two Locations in North Carolina

Annual Nitrogen Application (lb/acre) ¹	Sandhills, 10-Year Average			Upper Coastal Plain, 6-Year Average		
	Yield (tons/acre)	Crude Protein (%)	Apparent N Recovery (%)	Yield (tons/acre)	Crude Protein (%)	Apparent N Recovery (%)
0	0.6	8.0	—	0.5	8.8	—
100	2.9	8.9	86	2.6	10.6	85
200	4.3	10.8	84	5.0	12.5	100
400	5.4	14.0	70	6.7	16.3	97

Source: W. W. Woodhouse, Jr., North Carolina State University.

Note: Nitrogen was applied in three equal measures. Cutting frequency was every four to six weeks.

Table 5. Estimated Yield Response of Bermudagrass to Nitrogen Levels in Three Geographical Regions

Region	Nitrogen (lb/acre)					
	0	50	100	150	200	300
	Dry Yield (tons/acre)					
Sandhills	0.6	1.8	3.1	4.0	4.7	5.3
Upper coastal plain	0.8	2.0	3.3	4.5	5.5	6.4
Piedmont	0.8	1.9	3.2	4.4	5.3	6.1
	Pounds of Dry Matter per Pound of Nitrogen Applied					
Sandhills	—	50	51	46	42	32
Upper coastal plain	—	50	51	50	48	38
Piedmont	—	44	48	48	45	35

Note: These estimates are based on summaries from many experiments on many soils over several years.

of the nutrient nitrogen. It takes about 1.8 pounds of lime to neutralize the acidity of 1 pound of nitrogen resulting from the use of anhydrous ammonia, ammonium nitrate, or urea; it takes 5.4 pounds of lime to neutralize the acidity of 1 pound of nitrogen from ammonium sulfate. It is good practice to have your soil tested every two years.

Under certain conditions, Coastal bermuda-grass shows a measurable response to sulfur applications. In one eight-year experiment conducted in the sandhills of Lee County, sulfur was first applied in the fourth harvest year. The response was immediate; the addition of sulfur more than doubled the yield in the fourth, fifth, and sixth years. (The yield increase was less dramatic in the seventh and eighth years.) Therefore, when fertilizers containing little or no sulfur are used for several years on deep sandy soils, adding sulfur probably will increase the yield. Response is unlikely on heavier piedmont soils or where sulfur-containing fertilizers have been used.

Use the information in Table 6 to determine if the plant tissue contains sufficient concentrations of nutrients for optimal growth.

HARVESTING

Much research has been conducted to determine when bermudagrass should be harvested for the best compromise between yield and quality. Plant maturity (clipping interval) and seasonal rainfall can

influence yield and protein content (Table 7). As a rule of thumb, cut bermudagrass at four- to five-week intervals or when it is 12 to 15 inches tall, whichever comes first (Figure 6). When the forage is 12 to 15 inches tall, a delay of two weeks or more can result in the loss of regrowth and quality.

FALL MANAGEMENT

Fall management is important in maintaining vigorous stands and preventing winter injury, particularly in the piedmont. At the start of winter, bermudagrass should have 3 to 4 inches of growth that will serve as insulation against winter damage. This growth should not be grazed or otherwise removed before February 15. To encourage early spring growth, cut or burn in February or March (before top-dressing) to remove dead material from the previous year.

SUMMARY OF HAY PRODUCTION PRACTICES

- Have your soil tested and apply the amount of lime needed to maintain a pH of 6.0 or higher (even though bermudagrass will tolerate more acid soil).
- Apply nitrogen when growth begins in the spring (probably April) and after each harvest, except the last. Refer to Table 5 as a guide for the amount of nitrogen needed to obtain yield goals.
- All the phosphorus and potassium may be applied

in the spring. However, on deep sandy soils split the potassium, applying half in the spring and half after the second cutting, especially if the yield goal is more than 5 tons per acre.

- Burn old residue two to three weeks before the bermudagrass breaks dormancy in spring to ensure rapid growth.
- Make the first cutting when plants are 12 to 15 inches tall and every four to six weeks thereafter, depending on the quality of feed needed.
- Make tight, round hay bales and store them inside or on a well-drained site.

Pasture Management

FERTILIZATION

Because bermudagrass uses the nutrients in manure and urine, you can use about 25 percent less fertilizer for pastures than for hay fields, but test the soil regularly as part of your pasture-management program. Nutrient suggestions for sustained production are as follows:

- On sandy or low-potassium soils, apply 400 to 500 pounds of 0-10-20 fertilizer per acre every four to six weeks beginning in March or April, and add 50 to 70 pounds of nitrogen in April, June, and July.
- On red clayey soils, apply 300 to 400 pounds of 0-10-20 fertilizer per acre every four to six weeks beginning in April or May, and add 40 to 60 pounds of nitrogen in April, June, and July.
- On stands containing more than 50 percent winter annual legumes, use 400 to 500 pounds of 0-10-20 fertilizer in the fall, and omit the April application of nitrogen, but topdress with 40 to 60 pounds of nitrogen per acre in June and July.

GRAZING

Maintain bermudagrass in a young, leafy condition. Note the high protein content of frequently cut plots (Table 7). Continuous grazing to sustain a stubble

Table 6. Nutrient Concentrations in Bermudagrass for Optimal Growth

Nutrient	Dry Matter Concentration (%)	Nutrient	Dry Matter Concentration (ppm)
N	1.5 - 3.5	Mn	20 - 300
P	0.2 - 0.4	Fe	50 - 250
K	1.5 - 2.5	B	5 - 15
S	0.15 - 0.65	Cu	5 - 20
Ca	0.20 - 0.50	Zn	18 - 70
Mg	0.10 - 0.30	Mo	0.1 - 5

Sources: Plant Advisory Section, Agronomic Div., North Carolina Department of Agriculture; O. E. Anderson, et al., 1971. Georgia Agricultural Experiment Station Report no. 102; W. W. Woodhouse, North Carolina State University; S. R. Wilkinson and G. W. Langdale, 1974.

Note: Data are based on a wide range of harvest maturities and soil types.

Table 7. Influence of Clipping Frequency and Season on Dry Matter Yield and Crude Protein Content of Coastal Bermudagrass Grown at Tifton, Georgia

Clipping Interval (weeks)	Dry Yield (tons/acre)		Crude Protein (%)	
	Wet Year	Dry Year	Wet Year	Dry Year
	2	2.2	1.0	13.6
3	3.3	1.4	12.9	12.8
4	3.7	1.7	11.2	11.0
6	4.8	2.3	7.8	9.3
8	5.1	2.4	8.4	9.7

Source: G. M. Prine and G. W. Burton, *Agron. J.* 48:296-301.

Note: Phosphorus, potassium, and other elements were adequately supplied. Nitrogen was applied at 100 lb per acre.



Figure 6. For the best compromise between quality and yield, hybrid bermudagrass should be harvested at four- to five-week intervals or when the grass is 12 to 15 inches tall, whichever comes first.

height of 1-1/2 to 2 inches gives better animal gains than a stubble height of 3 or more inches. We recommend that you subdivide the pastures into several paddocks, then close graze and periodically clip or mow.

Bermudagrass is not the best choice for grazing dairy animals. However, according to North Carolina researchers, when animals receive 20 to 25 pounds of concentrate feed per head per day, milk yields are similar to yields from cows grazing pearl millet. In a four-year study conducted at the Piedmont Research Station, daily animal production of fat-corrected milk from Coastal bermudagrass and pearl millet was 45.3 and 45.8 pounds, respectively. The carrying capacity per acre on Coastal bermudagrass was 2.2 cows per acre compared to less than one cow per acre for pearl millet.

In general, the average daily gain of yearling cattle that graze on Coastal bermudagrass is not as high as those grazing ladino clover-fescue, but the number of animal days per acre is considerably higher (Table 8). The relatively high carrying capacity and satisfactory animal gain makes a small acreage in the forage program beneficial. In cow-calf operations, tall fescue-clover, and bermudagrass in grazing pastures can result in more than 500 pounds of calf

gain per acre, with average daily calf gains in excess of 1.5 pounds.

To control grazing pressure and animal performance, divide pastures into several fields. Also keep in mind that grass grows at different rates depending on the conditions, such as moisture, temperature, and other factors. Mow when the growth rate exceeds what the cattle can use during a three- to four-week period.

OVERSEEDING

To lengthen the grazing season, overseed bermudagrass with rye, ryegrass, or annual legumes. Where adapted, the perennial legumes ladino or red clover can be grazed with bermudagrass during the late spring and summer. During the summer, a bermudagrass-clover mixture will require much less nitrogen

than just bermudagrass. Overseed in October using a no-till drill, or lightly disk, then drill or broadcast the seed.

In recent studies, overseeding with winter rye or annual ryegrass produced dry matter yields of 2,500 to 5,000 pounds per acre during the cool season. The higher yields were obtained when the winter annuals were cut for hay. When Coastal bermudagrass was overseeded, the yield ranged from 1,200 to 2,500 pounds per acre. The higher yields were obtained when rye, rather than ryegrass, was used. In areas where bermudagrass is the only pasture species available, 50 to 100 percent of the acreage may be overseeded with winter annuals to provide supplemental grazing during winter and early spring (Figure 7).

When overseeding bermudagrass hay fields in fall with winter annuals, clip the bermudagrass to a stubble height of 3 inches or less. For pastures, establish a grazing height of 1 to 2 inches before overseeding because bermudagrass pasture sod is thicker than hay field sod.

A winter annual legume will lengthen the spring grazing season by four to eight weeks and also add a considerable amount of nitrogen to the grass. Use

15 to 20 pounds of a reseeding variety of crimson clover, or use 25 to 30 pounds per acre of hairy vetch on deep sands where vetch is better adapted. Ladino clover can be planted at 4 to 5 pounds per acre, and red clover at 8 to 10 pounds per acre. Rye is usually planted at 2 bushels per acre. Annual ryegrass is planted at 20 to 30 pounds per acre. Only rye and hairy vetch are adapted to the deep, sandy soils of the sandhills and coastal plain.

Spring and fall are critical periods for allowing crimson clover to re-establish from natural reseeding. In the spring, crimson clover seed must be allowed to mature, which will cause severe shading and delay spring growth of the bermudagrass. Therefore, do not overseed all the bermudagrass acres. In the fall, maintain the bermudagrass at a height of 2 inches to allow the clover seed to germinate and develop. A light disking is often helpful.

Pests and Disease

DISEASE

Helminthosporium leaf spot attacks the leaves, stems, and stolons of bermudagrass, causing the leaves to turn reddish brown or tan. The disease begins as small, brown, circular or elongate spots on the leaves. Heavy infection kills the leaves, beginning at the leaf tips. Warm, wet weather will accelerate the spread of the disease. Hybrid bermudagrass is more resistant to this disease than common bermudagrass strains. Also, Helminthosporium is a weak pathogen, usually affecting plants that are stressed; if this disease occurs, the field probably has an imbalance of nitrogen and potassium, or it suffers from another stress-inducing factor. To help contain this disease, as well as certain insects and winter weeds, burn dormant bermudagrass in the spring a few weeks before new growth appears. Other bermudagrass diseases are minor or sporadic.



Figure 7. Winter annuals such as rye (shown here) can extend the grazing season in areas where bermudagrass is the only perennial pasture species available.

Table 8. Beef Yields on Coastal Bermudagrass and Clover-Fescue Systems

	Ladino Clover Grass	Coastal Bermudagrass Plus Fescue
Days in season	117	178
Cow days per acre	185	389
ADG (lb)	1.95	1.11
Beef per acre (lb)	344	432

Note: Data represent a four-year average of tests conducted in Rowan County, N.C.

INSECTS

Insect pests of bermudagrass include the armyworm, green June beetle, and spittlebug. Larvae of the green June beetle are regularly a problem in manured and heavily grazed pastures because the manure attracts adult beetles for egg laying. In late summer, check pastures for areas worked up by the grubs. These cream-colored grubs crawl on their backs and injure plants by pulverizing the soil.

Both the true armyworm and the fall armyworm attack bermudagrass. These large worms feed heav-

ily and can completely defoliate a field when present in large numbers. True armyworms can be hard to detect because they hide at the soil surface in the daytime. Feeding signs will indicate worm numbers and their distribution, but search for the worms as well. Before treating with an insecticide, confirm that armyworms are still present.

To control grubs and armyworms, see the insecticides listed in the most recent *North Carolina Agricultural Chemicals Manual*.

Serious spittlebug invasions can occur when the grass is allowed to grow and the stand is beyond the best hay or grazing stage. Spittlebug nymphs (which cause the damage) secrete moist, spittlelike masses in which they live. If the top growth starts dying because of spittlebug infestation, burn the field to destroy the insects.

WEEDS

Well-managed and fertilized bermudagrass is competitive with most perennial and summer annual weeds. Winter annual grassy and broadleaf weeds are usually most troublesome when the sod is not overseeded. Except where legumes are growing with bermudagrass, most weeds can be easily controlled. (Herbicides that kill broadleaf weeds also will kill legumes.) See the most recent *North Carolina Agricultural Chemicals Manual* for herbicide rates that can be used to control specific weeds.



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