Fertilizing Bermudagrass Hay and Pasture

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Bermudagrass is the single most important warm-season forage grass grown in Oklahoma. It is well adapted to the Oklahoma climate and soil types, which makes it relatively easy to maintain. It has the potential to produce high yields of high-quality hay and pasture. Unfortunately, much of the bermudagrass in Oklahoma produces less than its full potential. With adequate fertilization, some of the older bermudagrass varieties have the potential to produce up to 3 to 4 tons of forage per acre. Newer bermudagrass varieties can produce between 6 to 9 tons of forage per acre with a high level of management.

The potential for bermudagrass production in Oklahoma is generally limited first by the amount and distribution of rainfall that occurs during the growing season. However, soil depth also is important because it determines, to a large extent, the amount of water that can be stored. In most soils, one inch to two inches of water can be stored per foot of depth. If there is less than a foot of top soil to store water, bermudagrass yield will be limited regardless of the total rainfall.

Weak or slow growing bermudagrass may result from production on soils that are too shallow, too sandy, or too clayey. The primary reason for low forage yields and poor bermudagrass stands in Oklahoma, however, is inadequate soil fertility resulting from the continued use of improper fertilization and poor harvest management practices. Inadequate fertility can refer to any one or a combination of low soil pH, inadequate nitrogen (N) fertilization, inadequate soil phosphorus (P), and/or inadequate soil potassium (K) supply. All bermudagrass varieties respond to a good fertility program, which supplies adequate amounts of N, P and K. A soil test is the only way to determine if supplemental P or K is needed. Annual soil testing is required for intensively managed bermudagrass hay fields to monitor soil pH and nutrient availability. In grazed pastures, a soil test taken once every three years is adequate, unless there is a borderline nutrient deficiency. In these instances, annual soil testing is beneficial as well.

Actively-growing bermudagrass removes N, P_2O_5, and K_2O in an approximate ratio of 4:1:3. Based on this, yearly nutrient replacement values for P and K can be estimated. As an example, for each 100 pounds of applied N, bermudagrass would remove approximately 25 pounds of P_2O_5 and 75 pounds of K_2O. From a grazing management standpoint, this is not a large concern since the majority of the nutrients will remain in the pasture. For hay production, however, it will be important to replace the nutrients since much of the harvested hay will not be fed on the fields from where it was harvested.

Fertility as a Yield-Limiting Factor

Many recognize the importance of N in the production of bermudagrass. However, we should not forget that P and K fertility are also critical for proper growth and it is important to understand the interaction between N, P and K. It also is important to realize how fertility and nutrient availability interact to determine yield. Water availability and the availability of N determine the potential yield of bermudagrass. For example, if there is enough water to produce 6 tons per acre but only enough N to produce 4 tons per acre, the maximum of 4 tons per acre is all that will be produced. The same situation occurs for P and K. Forage growth potential is reduced if there are inadequate soil nutrient supplies either from the soil and fertilizers.

If there is adequate moisture and N to produce 5 tons per acre, but the soil test indicates a P sufficiency of 75 percent, the greatest attainable yield is 3.75 tons per acre (75 percent of the 5 tons per acre potential). In this case not only is there a loss of forage yield, but the efficiency of N fertilizer is reduced. This means that the 5 tons per acre of bermudagrass production fertilized at 250 pounds N acre (50 pounds N per ton) instead required 66.6 pounds N per ton. In order to achieve the maximum potential yields, about 45 lbs P_2O_5 per acre needs to be applied. Potassium has the similar effect on yield as P, and if insufficient, results in a reduction in forage yield and efficiency of the N fertilizer that was applied.

When both P and K are deficient, there is a multiplicative effect of the nutrients on bermudagrass forage yield. This means that if both nutrients are present at a level that is 75 percent sufficient, then overall sufficiency is 75 percent x 75 percent = 56 percent. Thus, the greatest potential yield without adding additional P and K fertilizer will be only 56 percent of the maximum potential (or about 3 tons peracre).

Forage yield for dryland bermudagrass forage production in Oklahoma is primarily limited by the amount and distribution

of rainfall throughout the season. Nitrogen determines yield and is likely the driving factor in irrigated forage production. One must understand that N fertilization rates and recommendations provided by soil testing labs are given as pounds of actual N per acre. Every source of fertilizer sold on the market has a specific concentration of N. For example, 50 pounds of actual N per acre could be supplied by:

275 pounds of diammonium phosphate (18 percent N)
150 pounds of ammonium nitrate (34 percent N)
110 pounds of urea (46 percent N)
160 pounds of 32 percent urea ammonium nitrate (UAN) solution
180 pounds of 28 percent UAN solution

The source of the N fertilizer is another factor to be considered. Depending upon the time of the year and weather conditions, one source may be better than another. In most cases, it is advisable to avoid applying urea in the summer. Many studies have shown that more N from ammonium nitrate and UAN fertilizers are recovered in summer application than from urea. However, N applied in the spring when temperatures are cooler and with a greater probability of rainfall makes urea a better choice than other N forms. This is because the nitrate in the other sources is susceptible to leaching during high rainfall events resulting in increased N loss.

Urea is usually a cheaper source of N on a net N basis and commonly is the only commercially available N source. It is common for urea to be the only commercially available N source. Nitrogen volatilization losses from urea may be as great as 50 percent under a combination of high humidity, hot temperatures, and windy conditions. To reduce potential N volatilization losses from urea, it is best to apply urea fertilizers later in the day after the dew has dried. It also is important to apply urea no more than 7 days prior to an anticipated precipitation event.

Bermudagrass is a luxuriant consumer of K, which means that bermudagrass may extract K from the soil in excess of its physiological needs. If supplemental K fertilizer is needed, it is important to not apply more K than indicated in the soil test. In almost all cases, it is never economical to apply any nutrient above a soil test recommendation.

Yield Expectations

Bermudagrass is a valuable forage for many livestock producers because it offers a wide range of management options. It produces an extensive root system that allows it to be somewhat drought tolerant. Bermudagrass is hardy enough to survive Oklahoma climatic conditions with minimal management inputs, but it responds well to N fertilization and is capable of producing plentiful forage dry matter yields when soil moisture is adequate.

The next most limiting production factor is available N. Also, available soil moisture and available soil N are closely related because both move in the soil. Nitrogen will be moved to the roots as the plant absorbs water. For optimum bermudagrass production, a reasonable N rate appears to be in the range of 150 pounds to 200 pounds actual N per acre to produce 3 tons to 4 tons of forage per acre, although it is common to produce much greater yields ranging from 8 to 10 tons per acre using improved, hay-type varieties with higher levels of N fertilization and adequate moisture (Table 1.)

Table 1. Yield expectations for nonirrigated bermudagrass production[1].

Region	*Yield* *---tons/acre---*
Eastern	5.0 to 10.0
Central	4.0 to 8.0
Western	3.0 to 6.0
Panhandle	2.0 to 4.0

[1]Yield expectations are based on using modern, tall, hay-type bermudagrass varieties grown under appropriate fertility practices and adequate precipitation.

Sustained moderate to high production from bermudagrass requires at least 150 pounds of actual N per acre per year. Depending on management objectives and soil type, N fertilizer can be applied in one application or in split applications. Applications of P and K should be made annually based on soil test recommendations. Lime applications based on soil test recommendations should be considered before soil pH falls below 5.5.

Dryland Bermudagrass Production

Bermudagrass will produce about 1 ton per acre with no applied N fertilizer. Bermudagrass yield responds in an almost linear manner to applied N according to a simple rule of thumb that each 50 pounds of N applied produces 1 ton of hay (up to 4 tons). Slightly higher amounts of N are needed for higher yields (Figure 1). Nitrogen efficiency is best at rates between 100 pounds and 200 pounds of N per acre.

Irrigated Bermudagrass Production

Yield potential is much greater when bermudagrass is irrigated and yield goals can be increased accordingly. Consistent yields ranging from 10 tons to 15 tons per acre have been reported for irrigated bermudagrass in Oklahoma. The seasonal N requirements for irrigated production should be applied in split applications in relation to yield goal per cutting. As an example, four cuttings that total 12 tons per acre for the growing season would require 150 pounds of N for each cutting.

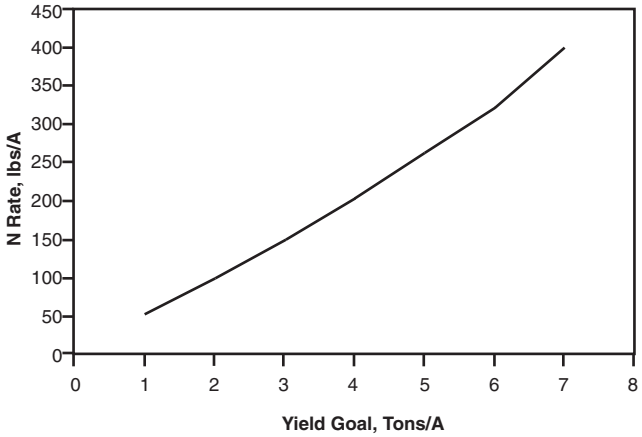

Figure 1. Relationship of bermudagrass forage yield to nitrogen (N) fertilization.

Common Types versus Upright Types

From a management standpoint it is important to realize that not all bermudagrass varieties respond to N fertilization the same. Bermudagrass varieties are often classified into two groups based primarily on their growth habit. The first group is referred to as common or grazing types, whereas the second group is sometimes called upright or hay types. The common types are usually shorter and form a more dense sod. The upright types tend to be taller and more open.

The common type cultivars have lower forage yield potential than the hay type cultivars once mature stands are established. It is important to note that the relation between N and yield is different for the common types than the upright types. The common types reach their maximum yield potential around 200 pounds of N per acre. Even with a higher N application, it is unlikely that the common types will produce greater than 4 tons of bermudagrass forage per acre. On the other hand, it is not uncommon for yields of the hay types to exceed 6 tons to 8 tons per acre.

Fertility Management

New Stands

Bermudagrass establishment can be expensive, so it is important to take management steps to ensure stand survival. Correcting soil pH prior to establishment will allow for faster emergence and coverage. Early seedling vigor is closely tied to available P and K levels in the soil. Thus, newly seeded and sprigged bermudagrass stands can be negatively affected by inadequate P and K levels, as well as low soil pH. It is critical to correct soil P and K deficiencies prior to planting. On seedling bermudagrass stands, no more than 30 pounds N per acre should be applied at planting so weeds will not compete with the bermudagrass. Once the new plants have become established and have stolons at least 6 inches long, an additional 50 pounds N per acre should be applied to increase stand establishment. If managed properly, it may be possible to harvest hay during the establishment year.

Established Stands

Bermudagrass Hay

Planning for hay production is usually more straightforward when it is managed separately from grazing. The primary reason is because forage yield and quality are difficult to predict in hay harvested from pastures that are also grazed.

In many cases, managing hay separately from grazing may not require additional pastures or more acres. When nutrients and moisture are adequate, bemudagrass growth often exceeds livestock needs early in the season. Hay production can be planned so that some pastures are hayed early and then grazed later in the season.

To maximize fertilizer efficiency, it is important to fertilize bermudagrass according to its yield potential. By fertilizing for higher yields per acre, it may be possible to produce the annual pasture and hay requirement for a farm from fewer acres. This would result in lower equipment costs and P and K fertilizer costs, since fewer acres are required to produce an equivalent quantity of hay. When yield goals are increased, only the N requirement increases. The P and K recommendations remain the same regardless of the desired yield goal.

If the primary forage production goal is dryland (nonirrigated) bermudagrass hay production, split applications of N fertilizer may not be necessary. Research studies conducted at the Eastern Research Station located near Haskell, Okla. found no difference between bermudagrass forage yields with 200 pounds of actual N per acre applied in a single application compared with 100 pounds of actual N per acre applied two times. Based on these results, up to 200 pounds of N can be applied in a single application in mid-May to late-May. It may be best to apply N in split applications under high yield goal when N requirements are greater than 200 pounds of actual N per acre or on coarse soils where nitrates are subject to leaching.

Bermudagrass Pasture

Nitrogen management for grazed bermudagrass pastures is not quite as easy as for hay production. Even though the amount of available N required to produce bermudagrass is the same as for hay production, the amount of forage yield is not as obvious because little forage will accumulate in well-managed pastures. Thus, the actual yield goal will be difficult to identify.

Nitrogen requirements for bermudagrass pasture can be estimated using a general rule of thumb when the forage is utilized by stocker animals. This is to apply 1 pound of N per acre to produce 2 pounds of beef per acre. For example, to produce 300 pounds of beef per acre would require 150 pounds of available N per acre.

A cow-calf production system will require about 6 tons of forage per year or about 1,000 pounds of forage per month. It is possible to graze unfertilized bermudagrass pastures. However, this should not be considered a sustainable, long-term solution.

Carrying capacity of bermudagrass pasture can be increased with N fertilization. For short-term grazing, the first 50 pounds of N per acre appears to be the most beneficial since there is a two-fold reduction in the number of acres required to maintain one cow during the summer grazing period (Table 2). For long-term grazing management using the rules of thumb that about 50 pounds of additional N are required to produce another ton of forage and that a cow needs about 1,000 pounds of forage per month, we can calculate that approximately 300 pounds of N is needed for each additional cow added to the herd each year.

Table 2. Nitrogen and acreage required for summer grazing based on bermudagrass forage yield goal.

Production goal tons/acre	*Nitrogen[1] lbs/acre*	*Summer grazing (90 days) acres/cow*
1	0	3.3
2	50	1.6
3	100	1.1
4	150	0.8

[1] Non-fertilized grass pastures will generally yield about 1 ton of forage per acre over the growing season. However, this will not be sustainable and should not be considered a long-term solution.

Under grazed conditions, it is advisable to apply N in split applications of between 50 pounds to 75 pounds of actual N per acre at each application. Bermudagrass will maintain more uniform growth and production throughout the summer if N is applied every three to six weeks.

Summary

In many cases, it may be more economical and efficient to increase N fertilizer on fewer acres of more productive soils. The forage production may be equal to or greater than a low N application rate across all soil types. Also, it is likely that costs associated with N application will be lower.

While it is possible to produce bermudagrass hay or pasture with little or no N fertilizer, there are problems with this approach. First, it will take the entire growing season (May through October) for the forage to be produced. Second, forage quality, especially crude protein, will not likely meet the nutritional requirements for any class of livestock. The key point to remember is that N fertilization has a much greater impact on bermudagrass growth and forage yield than any other management practice.

Key Points to Remember

Bermudagrass stands that have not been fertilized in several years or those with other nutrient deficiencies will not immediately respond to applied N fertilizer.

For bermudagrass grazing, split-apply 50 pounds N per acre beginning in mid May. Apply no more than 150 pounds to 200 pounds total of N during the growing season.

For dryland bermudagrass hay production, a single N application of 200 pounds N per acre in early May appears to be adequate. There is usually no benefit to split N applications in bermudagrass due to variable rainfall distribution that can occur during the season.

In high producing bermudagrass hay fields, applying 100 pounds N per acre in early spring, followed by 50 pounds N per acre following each harvest should result in production of more uniform yield and quality.

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