
Chapter 4

Forage, Forbs and Browse

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What Goats Eat

Goats are primarily browsers; they prefer to eat the leaves and buds of tree and shrub species. This, however, is not the entire story because goats will eat grasses, broadleaf herbs, shrub leaves and twig ends of many tree species. Which ones do they prefer? Just like humans who are introduced to a buffet table, goats introduced to a pasture with a variety of forage plants will select the most palatable forage to consume first. This palatability is usually associated with plants grown with the youngest tissue, highest protein and the most readily available plant carbohydrates on highly fertile soils.

As the seasons change, so will the palatability of the forages and the preference of the goat herd for certain forages (Table 4-1). Anything that can be done to provide the goat herd with young nutrient-rich forage will increase the health, productivity and profit potential of the goat herd.

Keeping Young Forage for the Goat Herd

New young plant growth can be provided in two ways.

1. Provide pasture that is manipulated to keep the forage from getting to a mature stage of growth.

Table 4-1. Average seasonal diet comparison of goats.

Season	% Browse	% Grass	% Forbs
Spring	34	49	17
Summer	33	53	14
Fall	53	37	10
Winter	53	42	5

Source: What Range Herbivores Eat and Why TAEX Pub B-6037.

The older the plant tissue becomes, the more lignins the plants lay down in their cell walls. These lignins make it difficult for the animals to digest the nutrients in the plants. Keeping them grazed, hayed or mowed any time the plants begin to mature reduces the forage maturity in the pastures. Keeping those plants in a tender vegetative state can provide plants that are highly selected for nutrient value by the goat herd.

2. Provide young nutritious forage by growing different forage species during different seasons of the year. Most plants are grouped into two categories: warm season and cool season plants. Warm season plants initiate growth in the spring, grow rapidly during May and June, maturing in July, August and September. Cool season plants grow during the fall and spring, and by their nature are generally higher in nutritional value than the warm season species. They also will begin to lose quality in late spring when they begin to mature and set seed heads.

By providing the goat herd with both cool and warm season forage pastures, producers can help provide new green growth for longer periods of the year and have a healthier and more productive goat herd as a result.

Keeping High-Quality Forage for the Goat Herd

Maintaining a high diversity of plant species in a pasture so the animals can select the most palatable plants during their most prominent time of growth is one method of providing high-quality forage. Mixing warm and cool season grasses with compatible legumes and herbs help accomplish this goal. Mixtures of Bermudagrass, annual ryegrass and clovers do well together when managed properly. They all can provide high-quality forage if kept in a tender vegetative state.

Providing the forage plants with the proper soil fertility not only increases the production of the forage in the pasture, but also affects the protein and nutrient content of the forage grown. Without proper nutrition, plants tend to produce less herbage and tend to mature earlier. These two things together reduce both the total forage available to the grazing herd, such as the one shown in Figure 4-1, and the nutritional value of those plants to the individual animal. Often, low fertility will decrease the palatability of forage enough so the animals will refuse to graze those plants.

Soil Fertility in Goat Pastures

Growing forage for any grazing animal, including goats, is dependent on the health of the soil in which the forage is grown.

Soil Testing

Soil testing is an essential element in providing high-quality forage and determining stocking rates based on potential forage production. An old saying warns, "If you don't know what you have, you'll never know what you might be able to get." Growing forage in a pasture without taking a soil test is like driving a car without a gas gauge. Producers have no idea how far they are going to get or how far they could have gone if the tank was filled up.

Soil testing gives an idea of how much of a particular forage can be grown. With this information, producers can set stocking rates in animals per acre without fear of running out of forage too soon. They

also have the ability to determine if adding more nutrients to the soil allows more animals put on a given land area. They can then determine whether or not these extra animals will pay for the additional cost of applying fertilizer. A \$10 soil test will more than pay for itself in increased utilization of the resources producers have or by allowing them to input nutrients to increase stocking rates to proper animal densities.

Taking a soil test is relatively easy to do, but it must be done properly so the information received from the test has value. Soil types and nutrient concentrations can change rapidly across a pasture. To get a soil sample representative of the true nature of the soil and get good test results; several subsamples must be taken from across the pasture. When taking a soil sample, 15 to 20 subsamples are needed from different parts of the pasture.

The goal is to measure the nutrient level in the top 6 inches of the soil, so every subsample should be taken from the soil surface to a depth of 6 inches. The best way to do this is to visit the local county Extension office and borrow a soil probe that is specifically designed for soil sampling. A shovel can also be used to cut a slice 6-inches deep. Put the slice into a bucket.

Walking from one corner of the pasture to the opposite corner and taking a 6-inch sample every 75 to 100 yards works well in getting a good representation of the pastures soils. Once 15 to 20 subsamples have been accumulated in the bucket, they should be thoroughly mixed up. Then about one pint of soil should be placed into a plastic bag and taken to the local county Extension office for analysis. If samples are needed from several pastures, each pasture should be sampled separately to get a good idea of how to manage each pasture.

Primary Soil Nutrients

A healthy soil will have all the plant nutrients needed by the plant to perform its life functions, and that soil will have a pH level that chemically makes those nutrients available for plant uptake. Most of the nutrients needed for plant growth are in high enough abundance so producers do not need to supply them to get adequate forage production. Three nutrients, however, are consumed in large quantities by the plants, and can be at low enough levels in the soil profile to inhibit maximum forage production. These three nutrients are nitrogen (N), phosphorus (P) and potassium (K).



Figure 4-1. A healthy goat herd needs a good forage pasture.

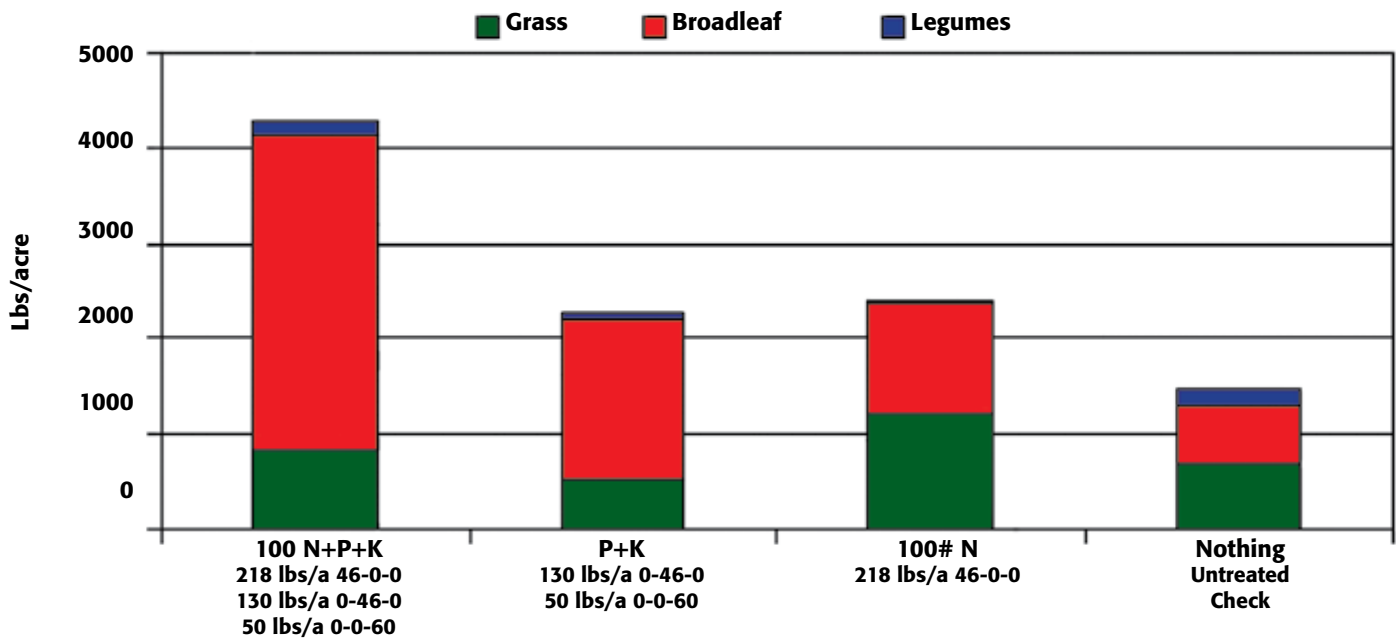


Figure 4-2. Yield data for May and June growth in a 2003 Hartshorne IPM experiment on forage response to selected treatments.

Figure 4-2 shows the results of an experiment on forage responses to selected treatments and the importance of nutrients on plants.

Nitrogen (N)

Nitrogen is the nutrient most needed by a plant. It is also one of the nutrients lost most readily in the environment either through volatilization or leaching. A large build up of nitrogen through time never occurs in soils because through natural processes, nitrogen is being lost through plant uptake, it is moving off into the air through volatilization or down through the soil profile due to its water solubility (leaching).

Phosphorus (P)

Phosphorus (P) is the second most common nutrient deficient in Oklahoma soils. P is not easily lost in the environment; once it is in the soil, it tends to stay. Two things result in low P levels in the soil:

1. The parent material that formed the soil was low in P.
2. Under heavy cropping, the P is removed with the plant material. High production hay meadows where hay is cut and moved to another location can lead to low levels of P. Likewise, old crop production areas converted back to

pasture can have low P levels from long histories of taking crops off these lands. Many Bermudagrass pastures in southern Oklahoma were at one time cotton fields that were cropped intensively without the addition of replacement soil amendments.

Potassium (K)

Potassium (K) is similar to phosphorus because it is not lost to the environment very easily once it is in the soil. Fewer low-K soils than low P soils exist, since most Oklahoma soils originally had large amounts of K. However, K also can be cropped out by high-intensity crop removal. Soils low in K can be found on old crop land and hay meadows.

With P and K levels, once a pasture has sufficient levels to promote proper plant growth, and plant material is not removed from the pasture, the levels of these nutrients will remain sufficient for many years. Although the plants may be removing large quantities of these nutrients, the animals eating these plants do not retain very much of the P and K in their bodies and essentially recycle them to the pasture through their manure.

With nitrogen, although much of the nitrogen in the plants passes through the animal back onto the pasture, a lot of this nitrogen is lost through volatilization and leaching. Therefore, with forage

production systems where high yields are expected, nitrogen will need to be added every year to maintain high forage production levels.

pH

pH measures the relative acidity or alkalinity of the soil. This is important because at low pH, nutrients plants need get chemically tied up in the soil, which makes them unavailable for plant uptake. At the same time, low pH causes molecules such as aluminum and magnesium to be freed from the soil particles. These two molecules can become toxic to the plants, inhibiting growth. For most forage plants, a pH of 5.5 and above is adequate for normal plant growth and enough of the nutrients the plants need to thrive are available in the soil solution for plant uptake.

Legumes such as clovers, alfalfa and lespedeza need pH levels above 6.0 to grow properly. The pH of a soil is easy to manipulate with the addition of agricultural lime. A soil test will determine if lime is needed for the forage species grown and suggest how much lime needs to be applied to correct any problems. The soil test also will tell how much nitrogen, phosphorus and potassium might be needed, based on the forage production levels and the stocking rates desired. The local county Extension educator can help counsel producers on the most appropriate management strategies for their specific operation once the soil test has returned from the lab.

Macronutrients and Micronutrients

Plants need several other nutrients in small quantities to grow. Most soils have high enough nutrients to supply all of the plants' needs. Occasionally, one or more of these nutrients can become deficient and result in reduced plant vigor. Other nutrient problems must be ruled out prior to looking for micronutrient and macronutrient problems, since they are rarely deficient.

If after a pasture has been supplied with the proper levels of N, P and K, and the pH is within the correct levels for adequate plant growth, the producer can then begin looking to other nutrient problems in the forage. If the producer still believes there is a problem with the forage growth after checking standard soil fertility test levels, forage samples can then be taken for macronutrient and micronutrient analysis to the county Extension office. If any of them are in low enough concentrations to inhibit plant growth, the soil can be amended to correct any deficiencies.

Forages

Warm Season Grasses

Bermudagrass

Bermudagrass is a warm season, perennial grass that grows well on most soil types throughout Oklahoma. Goats will actively graze this grass when it is young and palatable. They also will show a marked preference for it, if well fertilized. They will, however, consume other plants. Depending on the time of year, these plants may be higher in protein or contain more sugars and be more palatable. An example of this might be in the spring, in a pasture with low-growing shrubs, greenbrier, weedy forbs and Bermudagrass, the goats may select the brush species and forbs (broadleaf plants sometimes considered weeds) over the Bermudagrass.

As the brush and forbs begin to mature in late summer, the goats may shift their preference to Bermudagrass if it has been fertilized and cut or grazed back by other animals on a regular basis. Bermudagrass that has been allowed to grow and mature past five weeks, however, will be low quality and the goats may ignore it and graze on other, more palatable plants in the pasture.

Native Plant Communities

Native pasture and hay meadows are a complex of grasses and forbs that have evolved to the habitat conditions in Oklahoma through millions of years. Most people, however, think of native grasses in terms of the big four species of grass: big bluestem, little bluestem, Indiangrass and switchgrass. Native grasses encompass much more than these four species. Goats will do well on native grasses due to different species of grasses and forbs growing and maturing at different times of the year. The goats can pick the most palatable plants from a multitude of species. Overgrazing can easily damage native grass complexes and care must be taken to give the plant species in the pasture time to rest and recover between grazing periods. Keeping stocking rates low, using rotational grazing or both can help this recovery.

Old World Bluestem

Old world bluestem is an introduced warm season grass that grows well on upland soils where moisture may be limited. If well fertilized, goats will readily consume it in early spring, or in an early stage of regrowth. It can be very unpalatable to

grazing animals if allowed to become too mature or if fertility levels are low.

Bahia grass

Bahia grass is an introduced, warm season, perennial grass that grows well in southeastern Oklahoma. It has limited cold tolerance and will normally freeze out in the northwest four-fifths of the state. Bahia is a very hardy grass under grazing conditions and is very competitive with other plants for soil nutrients and water. In the early spring, it is a palatable grass to most grazing species but loses palatability and quality quickly in mid-summer. Where it is warm enough for Bahia to survive, it is a good species to grow on low-fertility soils.

Cool Season Grasses

Cool season forages are a great way to reduce purchased feed costs and should be considered anytime pasture resources will allow production and use.

Fescue

Fescue is an introduced cool-season perennial grass. It is both high in protein and digestibility. On varieties infected with endophyte (fungus that lives in the plant), palatability for some grazing animals is low and in some cases may harm the animal. Little scientific evidence exists that endophyte-infected fescue causes harm to meat or dairy goats. More studies need to be conducted to determine the effects. Newer varieties are available that are either fungus free or have a modified fungus in them to make it more palatable and healthier for the grazing animal. Without confirmation that the infected fescue is harmful to goats, the increased cost of establishing these endophyte-free and modified fescues may not be warranted in pastures where only goats will be grazed. They should, however, be considered where other grazing species, such as cattle or horses will be grazed with the goat herd.

Annual Ryegrass

Ryegrass is a cool-season, introduced, annual grass high in quality, protein and palatability. It works well as a single planting or over seeded into a warm season grass in October. It makes little forage during its fall growth period, but early spring production can exceed three tons per acre with the proper soil fertility regime. All grazing animals relish annual ryegrass and will graze it whenever it is available.

Cereal grains

Like ryegrass, the cereal grains (wheat, rye, barley and oats), make excellent cool-season grazing for goats. Wheat and rye, when planted on tilled ground, have the ability to produce a ton of forage in the fall that can be utilized by goats during the winter period. When over-seeded in a warm-season grass sod, it will act more like the annual ryegrass, and most of the forage production will be realized during the spring growing season.

Legumes

Sericea Lespedeza

Sericea lespedeza is a warm-season, perennial legume that grows well on deep soils in Oklahoma. Most ranchers consider it a weed since cattle will not graze it after it is about 6 inches tall in mid-June. Goats have been observed grazing this plant throughout most of the year and are sometimes specifically purchased to help rid ranching operations of this aggressive legume.

Annual Lespedeza

Annual lespedeza is a warm season, annual legume that grows well in most Oklahoma soils. It coexists with warm-season grasses that are not fertilized too heavily, and allow the annual lespedeza space to grow.

Red Clover

Red clover, shown in Figure 4-3, is a cool season, perennial legume that does well in the eastern half of Oklahoma. It is a short-lived perennial with stand life usually lasting from two to three years. Lightly reseeding a pasture with red clover seed every year will usually result in stands that contribute large amounts of forage for several years.

White Clover

White clover is a cool-season, perennial clover that is adapted to heavy grazing conditions because of its low growth habit. It prefers tighter soils with large water-holding capacities and does well when mixed with cool or warm season perennial grasses. White clover is high in protein and is very palatable to most grazing animals. Goats however, have been observed selecting taller forages in grazing systems rather than consuming white clover. White clover actually has been observed increasing as a component of the forage system rather than decreasing when goats graze a pasture.



Figure 4-3. Red clover.

Arrowleaf Clover

Arrowleaf clover is a cool-season, annual clover with high spring production potential. It does well on well-drained upland soils where white and red clover may not grow as well. It must be allowed to occasionally reseed itself, if yearly stands are expected. It is higher in tannin concentrations than red or white clovers, but will be grazed readily by goats.

Alfalfa

Alfalfa is a warm-season, perennial legume that grows well on deep, well-drained, fertile soils. It grows best when grown as a monoculture (by itself), but has been successfully grown when interseeded in warm season grass pastures. Alfalfa is high in protein and extremely palatable to grazing animals but has also been known to cause bloat in large grazing animals.

Miscellaneous Legumes

Many legume plants will grow in Oklahoma pastures depending on the geographic location, rainfall and soil type. Local county Extension educators can provide information on specific legumes adapted to their local areas.

Forbs

Forbs basically are any low-growing broadleaf plant that grows with grass plants. Many people in the cattle industry refer to these plants as weeds.

A weed is a plant that an individual does not want growing in a particular place at a particular time. Goats will readily consume many of the forbs growing in pasture situations during some time period of the year.

Most forbs respond favorably to fertilization, thus increasing their palatability to grazing animals. In goat production situations, using herbicides to control weeds may be detrimental to forage production, since the plants being killed may have been a preferred grazing species for the goat herd. Herbicides should only be used when it has been determined the goat herd will not utilize a particular plant and that plant has started to dominate the pasture.

Brush vines, briars and shrubs

As stated previously, goats are considered primarily browsers: they prefer to eat brush and shrubs, such as the one shown in Figure 4-4. They are opportunist grazers and will choose the most palatable plants available regardless of whether they are grasses, forbs, shrubs or trees. Goat feeding preference will change with the seasons and maturity of the plant species present. A goat is going to selectively feed on what it considers to be the best-tasting plant in the pasture.

Often, goats will select the new leaves of trees and shrubs in the spring instead of forbs and grasses. If they totally strip the trees of leaves, the plants will attempt to sprout new leaves. These new leaves will be attractive to the goats, and they will again feed on them. Through time, the goats will kill the plant by starving it to death by not allowing it to keep leaves long enough to feed itself. If a brush



Figure 4-4. Goat foraging on browse.

plant is tall enough to keep goats from consuming all of its leaves, the tree will survive on those leaves growing beyond the goats' reach. In the winter and early spring, goats will feed on the buds and bark of some trees and shrubs, which is where the plant concentrates a lot of its carbohydrates prior to spring growth. At that time of year, the bark and buds may be the most palatable plant material in the pasture. Any leftover grass may be overly mature, dry and low on protein and carbohydrates. Goats will select the best tasting plant during a particular time of year.

Goats are often purchased for brush control. This task could take a while to accomplish and need a lot of management of the goat herd. A more efficient goal might be to look at a goat herd as a means of making money rather than just for brush control. By intensively managing the herd, producers can realize some return on their investment. Any brush control received as a result is an added bonus.

Bloat

All ruminant animals can be affected by bloat, with cattle being the most susceptible. Goats sometimes have problems with bloat when feeding on wet, nutrient-rich forages. Any time producers introduce goat herds to a green, lush growing legume pasture, they should be sure to have them already full of a dry hay source. They should be watched closely for the first few days they are on the pasture. A commercial bloat prevention block or additive should be considered when putting goats on green lush vegetation.

Balanced Forage Systems

One of a goat producer's goals should be to attempt to get the goat herd to harvest as much of the yearly intake of forage it needs on its own. Animals harvesting their own forage rather than being fed processed feeds will generally cost the producer less, providing a better profit per unit sold. Buying processed grain and hay is expensive when compared to forage grown on the farm and harvested by the animal.

The problem with most grazing systems is they are based on warm-season grass production that only provides high-quality forage for seven months of the year. For the other five months, producers are left to provide for the animals' needs with mature standing dead forage, stored hay or purchased

grain-based feeds. The goal of the producer should be to attempt to spread out the seasonal production of forages grown by utilizing seasonal fertilization strategies and by using forage species that grow during as many months of the year as possible.

Fertilization strategies are as simple as moving fertilizer input dollars to different times of the year. A good example of this is the fertilization of Bermudagrass in late August. This late summer fertilization takes advantage of September rainfall to grow tender, high-quality Bermudagrass during the month of September. This new growth Bermudagrass provides high-quality grazing during October, November and early December.

This growth is sometimes referred to as a standing hay crop. The Bermudagrass needing fertilization should be grazed close during August, so any growth in September is young, high-quality forage. Once the Bermudagrass stops growing in October, this young, high-quality forage will retain most of its quality well into December. The whole area need not be fertilized; just enough acres to carry the herd for two months of grazing. Fertilizing about one-third of an acre for each goat for the two months of grazing would be a close estimate when trying to provide the goat herd with early winter grazing.

Raising annual, cool-season forage such as ryegrass, wheat, rye and barley would be another strategy to reduce the producers' dependence on purchased feeds. By planting and fertilizing one-third of an acre for each goat in the herd, they should be able to reduce the amount of off-farm nutrition sources.

Annual cool-season forages should be planted as early in the fall as possible to take advantage of the moderate temperatures. The earlier the planting, the more forage growth will be achieved before cold temperatures stop the growth of the plants. Wheat, rye and barley should be planted sometime in early September, if large quantities of fall forage are expected. Annual ryegrass seems to establish better if planted the first of October. Not much fall forage production is expected from ryegrass, but when fertilized properly, it will provide the largest amount of spring grazing, compared to the other cool-season annual grasses.

Stocking rates

The stocking rate of any grazing animal should be based on the estimated forage intake of the class of animal being grazing and the production potential of the forage available to that animal. Most of

the literature suggests that for goats, forage intake runs somewhere between 4 to 4.5 percent of body weight of the animal. For a 125-pound doe, such as the one shown in Figure 4-5, this would equate to 5 pounds of forage intake of dry matter per day ($125 \times .04 = 5$ lbs). If a Bermudagrass pasture was fertilized with 50 units of N (108 pounds per acre of urea) and had a projected overall yield of forage at 4,000 pounds per acre, the stocking rate could be determined based on animal intake and available forage production.

One hundred percent utilization of the forage grown in a pasture is never possible because of losses from environmental factors. Fifty percent utilization is a normal amount of forage that will actually occur. Percent utilization factors for grazing goats is not well documented and could vary from 50 to 70 percent, depending on grazing management. Fifty percent utilization is a good estimate of the amount of forage actually consumed by the grazing animal with continuous grazing systems. At 50 percent utilization, a 4,000-pound per acre yield would result in 2,000 pounds per acre actually being eaten by the animal. The other 2,000 pounds would be lost to environmental factors. If a doe needs five pounds of forage per day and she was going to be grazing in this pasture for 200 days, she would need 1,000 pounds of forage, or about one-half acre for 200

days. On 20 acres, 40 does should be able to graze for 200 days.

Stocking rates on brushland are a little more difficult to determine. Measuring the amount of browse per acre can be next to impossible. If brush and shrub control is one of the primary objectives of the producer, then a good rule of thumb on stocking brushland is to start with three to four animals per acre, then to pay close attention to browse lines on the existing vegetation. If the goats are quickly reducing the available browse, stocking rates should be reduced. If no apparent utilization of the existing brush species is observed, the producer may want to increase stocking rates.

When determining stocking rates where cattle and goats are to be grazed on the same pasture, determining stock densities for both species needs to be considered. An 1,100-pound cow consumes about 30 pounds of dry matter per day. If a 125-pound doe consumes 5 pounds of dry matter per day, then six 125-pound does could be substituted for one cow. If 50 cows had previously been run on a pasture during the grazing season, then for every six does desired on that same pasture, the number of cows should be reduced by one. To run 60 does, the number of cows on that pasture would need to be reduced by ten. Therefore, 40 cows and 60 goats would be put on the pasture.

Figuring stocking rates by this method is easy to do, but it may not be the whole story. In pasture land that is a mixture of grass, forbs and brush, the goats may utilize plants the cattle do not eat. When consuming the plants the cattle do not eat, they are not consuming the grass, which would then be available to the cows. Most Texas studies show only a 50 percent overlap in diet preference of cattle and goats, so in a brushy pasture more animals may be possible than is indicated by figuring six goats equals one cow. The smart move would be to stock the pasture based on six goats equaling one cow, then through time, adjust the stocking rates of the cattle and goats to fit the grazing and browsing resource. This method might take a little time and require some observation, but it should result in the most efficient use of the resources.

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Figure 4-5. An average doe and her kid: 125 pounds of grace and beauty in a good forage pasture.

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