Pasture for Meat Goats
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Unit Objective

After completion of this module of instruction the producer should be able to distinguish between control versus continuous grazing and apply forage management practices for reducing parasite load. The producer should be able to classify plants as cool or warm season and apply forage management practices for establishment of goat pastures. The producer should be able to score a minimum of 85% on the module test.

Specific Objectives

After completion of this instructional module the producer should be able to:

1. Identify the highest expense of any goat operation.
2. Identify the percentage of the goat's daily diet that is selected from brush and woody plants.
3. Select the grazing patterns of goats when in a pasture setting.
4. Distinguish between true or false observations related to goats while in a pasture setting.
5. Distinguish between control and strip grazing.
6. Identify advantages of control grazing versus continuous grazing.
7. State the purpose of forward creep grazing.
8. Define limit grazing.
9. Identify one of the best ingredients of a parasite control program.
10. Identify ways to manage your pasture in which to reduce parasite load.
11. Select positive factors for using goats in a multi-species grazing program.
12. Classify plants as poisonous, photodynamic and cause mechanical injury.
13. State why meat goats need some shelter.
14. Identity the most critical factor for raising goats on pasture.
15. Identify fencing options for meat goat production.
16. Identify the most common predator that the majority of goat producers face.
17. Respond to advantages and disadvantages of using different types of animals for predator control.
18. State why goats require nutrients.
19. Identify the essential nutrients that goats require.
20. Match the quality of forage to the percent of TDN.
21. Select the cheapest feed ingredient.
22. Identify the water intake requirements for meat goats.
23. Identify major minerals that are likely to be deficient in the goat's diet.
24. Match plant terms to the correct definition.
25. Respond to correct and incorrect statements related to different types of forages.
26. Respond to correct and incorrect statements related to establishment of goat pastures.
27. Classify plants as cool or warm season.
Module Contents

- Objective of Goat Enterprise, Purpose of Pastures for Goats and Implications for Pasture Management
- Considerations to be Given to Goats for Pastures
  - Control grazing and strip grazing
  - Control grazing versus continuous grazing
  - Forward creep grazing
  - Limit grazing or supplementation with other crops
  - Parasites and pastures
- Co-and Multi-Species Grazing
- Poisonous Plants
  - Common poisonous plants
    - Plants that contain prussic acid (hydrocyanic acid)
    - Plants containing deadly alkaloids
    - Plants that are photodynamic
    - Plants that produce mechanical injury
- Shelter, Fencing and Predator Control Needs on Pasture
  - Shelter
  - Kidding facilities
  - Fences
  - Predators and predator control
- Nutritional Considerations
  - Matching forages to nutritional needs of goats
  - Matching kidding season to forage supply and quality
  - Nutritional management of replacement does
  - Suggested supplemental feeding program
  - Water
  - Providing mineral supplementation on pasture
- Pastures and Pasture Management
  - Explanation of plant terms
  - Warm season improved grasses
  - Warm season improved legumes
  - Cool season improved grasses
  - Cool season improved legumes
  - Cool season improved herbs or forbs
  - Cool season miscellaneous plants
  - Establishing pastures for goats
  - Establishing mixed-plant communities as pastures
  - Renovation of pastures
  - Year-round grazing systems
  - Go-back land
- Acknowledgements
Objective of Goat Enterprise, Purpose of Pastures for Goats and Implications for Pasture Management

Feeding may be the highest expense of any meat goat operation. Goats raised for meat need high quality feed in most situations and require an optimum balance of many different nutrients to achieve maximum profit potential. Because of their unique physiology, meat goats do not fatten like cattle or sheep, and rates of weight gain are smaller, ranging from 0.1 to 0.8 lb/day. Therefore, profitable meat goat production can only be achieved by optimizing the use of high quality forage and browse and the strategic use of expensive concentrate feeds. This can be achieved by developing a year-round forage program allowing for as much grazing as possible throughout the year.

Many people still believe that goats eat and do well on low quality feed. Attempting to manage and feed goats with such a belief will not lead to successful meat goat production. Because of nimble lips, goats are selective feeders capable of picking off the most nutritious plant parts. On pasture or rangeland, maximum goat gains or reproduction can be attained by combining access to large quantities of high quality forage that allow for selective feeding.

Considerations to be Given to Goats for Pastures

Goats are very active foragers, able to cover a wide area in search of scarce plant materials. Their small mouth, narrow muzzle and split upper lips enable them to pick small leaves, flowers, fruits and other plant parts, thus choosing only the most nutritious available feed. As natural browsers and given the opportunity, goats will select over 60% of their daily diet from brush and woody perennials (multiflora rose, saplings, small deciduous trees, black locust, briars, brambles, sumac, privet, honeysuckle), and broadleaf plants (pigweed, dock, horseweed, plantain, lambsquarter, etc.) over herbaceous species such as fescue, bluegrass, orchardgrass, crabgrass, bermudagrass. The ability to utilize browse species, which often have thorns and an upright growth habit with small leaves tucked among woody stems, is a unique characteristic of the goat compared to heavier, less agile ruminants.

Goats have been observed to stand on their hind legs and stretch up to browse tree leaves or throw their bodies against saplings to bring the tops within reach. Goats are more likely to select plant parts containing tannins than other domesticated ruminant animals. Goats even sometimes climb into trees or shrubs to consume the desired forage. In spite of their grazing preferences, goats can be grazed on pasture alone. The feeding strategy of goats appears to be to select grasses when the protein content and digestibility are high, but to switch to browse when the latter overall nutritive value may be higher. This ability is best utilized under conditions where there is a broad range in the digestibility of the available feeds, giving an advantage to an animal which is able to select highly digestible parts and reject those materials which are low in quality.
In a pasture situation, goats tend to graze from the top to the bottom of plants and do not like to graze near the soil surface. Therefore, goats will more uniformly graze a canopy than other ruminants. This behavior results in even grazing and favors a first grazer-last grazer system. This might consist of using a goat herd as the first group and cattle as the last group. This management system is most appropriate with lactating does or growing kids whose nutrient requirements are high.

Goats have been observed to:

- select young grass over clover.
- prefer browsing over grazing pastures, and eat more browse than do other domestic ruminants.
- eat a wider range of plant species than do sheep or cattle.
- prefer foraging on rough and steep land over flat, smooth land.
- graze along fence lines before grazing the center of a pasture.
- graze the top of pasture canopy fairly uniformly before grazing close to the soil level.
- will travel longer distances in search of preferred forage than will other domestic ruminants.

Grazing time can be influenced by several factors including the season of the year, the temperature and humidity, the topography of the land, the nature of the plant canopy, pasture availability and social interaction between animals. The season of the year, with changes in day length and intensity of sunlight, cause goats to graze in different patterns. At mean temperatures below 50°F, goats spend very little time grazing at night. At mean temperatures above 50°F, some grazing time will occur at night; and when mean temperatures exceed 77°F, one or more grazing periods will occur at night. During hot weather, frequent movement of goats during the day will increase intake. The topography and size of the pasture also will have an effect on grazing time, as will forage availability and ease of forage removal. Sites within the pasture where urination and defecation have taken place and this can increase the time it takes to graze. Goats are generally sociable so if one animal gets up to graze, others will follow.

**Control grazing and strip grazing**

The basic principle of control grazing is to allow goats to graze for a limited time leaving a leafy stubble, and then to move them to another pasture or paddock (a subdivision of a pasture) or sub-paddock. Smaller paddocks are more uniformly grazed and surplus paddocks can be harvested for hay. The pasture forage plants, with some leaves still attached, can then use the energy from the sun through photosynthesis to grow back without using up all of their root reserves. Even brush will need a recovery time if it is being used as forage for goats. Without this rest period, the goats can kill the brush through continuous browsing.
Under control grazing, legumes and native grasses may reappear in the pasture, and producers often report that the pasture plant community becomes more diverse. Control grazing can be used to improve the pasture, extend the grazing season, and enable the producer to provide a higher quality forage at a lower cost with fewer purchased inputs. Control grazing can also be useful in reducing internal parasite problems, if meat goat producers are careful to move the goats to a new pasture before the forage plants are grazed too short (less than about 4 inches). In addition, the use of the FAMACHA system to selectively deworm goats will overcome the problems of pasture infestations by resistant intestinal nematodes due to increased refugia. Refugia is the proportion of nematodes that provide a pool of susceptible genes and dilutes dewormer-resistant genes in that population.

Strip grazing can be easily superimposed on control grazing in large paddocks by placing movable electric fences ahead and behind the goats, giving them sufficient forage for 2 to 3 days. Strip grazing is very effective and results in high pasture utilization because otherwise goats will not graze soiled forage well. Strip grazing results in high average daily gain, increased gain per acre, and in rapid improvement of body condition when pasture is vegetative and of excellent quality such as during cool weather when plant quality declines only slowly. Strip grazing is very effective with stockpiled fescue during late fall and early winter. Strip grazing is not recommended when pasture is of low quality because of reduced goat selectivity.

Control grazing versus continuous grazing

Control grazing allows the manager a better utilization of the forage at hand because this grazing method gives more control over grazing animals. During periods of fast growth, the excess forage can be harvested for hay. Control grazing can stretch forage availability and the grazing season as spring forage growth slows during the hot summer months. It also slows the gradual predominance of less palatable and less nutritious plants because goats are forced to consume all plants before moving on.

Another level of managerial control is achieved by having more than one pasture. Under a control grazing system a) goats are easier to handle and more docile because they are in frequent contact with humans when fences, water tanks and mineral troughs are moved, b) plants that are sensitive to close and continuous grazing will persist longer and producer better, c) less forage is
wasted by trampling and soiling, d) urine and dung are distributed more uniformly, e) managerial and observational skills of the producer will improve because goats will be observed more frequently, and pasture species and productivity will be evaluated more carefully. Conversely, control grazing may not be beneficial because of a) high cost, b) unsatisfactory layout such as long, narrow paddocks or wet and dry areas within the same paddock, c) overstocked pastures, d) rest period is too long between grazing such that the available forage becomes mature and of low nutritive value with a lesser amount of young green leaves, d) pastures dominated by low forage quality.

Continuous grazing or stocking means that goats are maintained on one pasture for the entire grazing season. Therefore, the goat makes the decision as to where to graze, when to graze, where to congregate and to selectively graze unless the stocking rate is too high. Goats may overgraze the plants they prefer and undergraze other, less preferred plants if the stocking density is not adjusted as conditions change. Forage availability may be ideal, too high or too low during different periods of the same grazing season. Therefore, adjusting the stocking density as needed greatly improves forage utilization. Temporary fences can be used to fence off portions of the pasture and harvest surplus forage for hay. Finally, certain forage species such as switchgrass, big bluestem, indiangrass and johnsongrass are not suitable for continuous grazing unless the stocking rate is low enough to maintain a 6 to 8 inch leafy stubble.

**Forward creep grazing**

Installing an opening in the fence with a small gate allows animals with the highest nutritional requirements such as kids, to have first access to fresh, high quality, ungrazed forage ahead of their mothers. Forward creep grazing can be easily used in a control/strip grazing system.

**Limit grazing or supplementation with other crops**

Limit grazing is a strategy used to meet goat nutritional requirements with grasses of differing nutritive values, or with a cool-season grass and legumes sown in separate pastures. Adult does could be maintained on a low quality warm-season bermudagrass or switchgrass after frost, but allowed to strip graze a high quality winter annual forage such as cereal rye, annual ryegrass, wheat, or oat as a protein supplement for only a few hours each day or every few days. The same principle can be used with a low quality cool-season grass grazed during the hot summer months, and warm-season legumes such as soybean or the fodder trees black locust or mimosa. The foliage quality of these legume plants change little throughout the growing season, thus they are referred to as protein banks.

**Parasites and pastures**

One of the best ingredients of a parasite control program is reducing the number of parasites that the goats are exposed to in the first place. One way to accomplish this is to manage your pastures in a way that will reduce its parasite load. There are several ways to do this:

1. Take a hay crop. This type of pasture can be incorporated into a dose-and-move program in which goats are grazed on one pasture in the early grazing season and then moved to
another goat pasture which was used for a first cutting of hay. Another move before the end of the grazing season will probably provide the best parasite control.

2. Incorporate annual pastures into the grazing system and drag some implement in the stubble before planting.

3. Incorporate into the grazing system plants containing high concentrations of tannins such as sericea lespedeza and chicory. Alternatively, incorporate fodder shrubs that contain high concentrations of tannins, such as black locust.

4. Graze a contaminated pasture with another livestock species. The goat parasite larvae cannot survive in the gastrointestinal tract of another herbivore species. THIS DOES NOT APPLY TO SHEEP, which share worms with goats. Another approach is to use a first grazer, second grazer system using two livestock species.

5. Use control grazing practices to optimize pasture production. This is a better practice than continuous grazing on the same pasture because goats will return to the same areas where their favorite plants are growing, thus those areas will become heavily infected by gastrointestinal parasite larvae.

6. In extensive situations with an abundance of pasture land compared to the number of goats, allow the goats to have plenty of forage, thus giving them the opportunity to select the most nutritious parts of plants. In such situations, goats will not graze close to the ground and thus will not ingest many gastrointestinal parasites.

7. Put goats in a browse area (woodlot) when environmental conditions favor the rapid life cycle of gastrointestinal parasites (hot and humid). By browsing, goats will not consume forage close to the ground where the parasite larvae are located (0 to 5 inches from the ground level). In addition, many browse plants have the additional benefit of harboring high tannin concentrations. Tannins have been shown to reduce fecal egg counts and possible gastrointestinal parasite larval numbers.

8. Always put goats with the highest nutritional requirements on the best quality pastures you have on your farm. Good nutrition allows a more effective immune response to fight gastrointestinal parasites.

9. Rest a pasture. Unfortunately, it takes a long time for the worm eggs and larvae to die off if the pasture is just left empty. A year or at least an entire grazing season is required, which is usually impractical.

Co-and Multi-Species Grazing

The differences in feeding behavior among cattle, sheep and goats uniquely fit each species to the utilization of different feeds available on a farm. These differences should be considered in determining the best animal specie to utilize a particular feed resource.

Feeding behavior is also important in determining whether single or multi species will best utilize available plant materials. Most studies indicate greater production and better pasture utilization are achieved when sheep and cattle or sheep, cattle and goats are grazed together as opposed to grazing only sheep, goats or cattle alone. This is especially true where a diverse plant population exists.

Because of the complimentary grazing habits, the differential preferences and the wide variation in vegetation within most pastures, one to two goats can be grazed with every beef cow without
adversely affecting the feed supply of the beef herd. The selective grazing habits of goats in combination with cattle will eventually produce pastures which are more productive, of higher quality, and with little weed and brush problems as a result of mixed-species grazing.

Judicial mixed-species grazing can have additional benefits. Because gastrointestinal parasites from goats or sheep cannot not survive in the stomach of cattle, and because gastrointestinal parasites from cattle cannot survive in the stomach of goats or sheep, mixed-species grazing will decrease gastrointestinal parasite loads and slow resistance of gastrointestinal parasites to conventional dewormers. Several strategies can be used to one's advantage. In fields with a low parasite load, animals can be grazed together (co-grazing) or animals with the highest nutritional requirements can have access to the field first, followed by the animal species having lower nutritional requirements (first grazers, last grazers). A variation of co-grazing with nursing animals is to have openings in the fence giving forward access to ungrazed pasture to young stock. Alternatively, in a field infected with a high load of goat or sheep parasites, cattle should be grazed first, followed by goats or sheep.

**Poisonous Plants**

Because of their inquisitive nature and tolerance of "bitter" or high tannin material, goats may eat unpalatable weeds and wild shrubs that may be poisonous, such as cherry or milkweed. The absence or the severity of poisoning is related to the quantity of material consumed, the portion and age of the plant eaten, the season of the year, the age and size of the animal, and other factors. In addition, several ornamental plants that are grown outdoors or indoors are highly toxic. For example, goats should not have access to, or be fed clippings of yew, azaleas, oleanders, rhododendrons, delphinium, lily-of-the-valley and larkspur.

Goats are often not affected by poisonous compounds or anti-nutritional factors if a sufficient number of other plant species are available. Because goats prefer to consume a very varied diet, the detrimental affects of poisonous compounds found in certain plants are diluted.
Common poisonous plants

Plants that contain prussic acid (hydrocyanic acid)

These plants contain under certain conditions, prussic acid (hydrocyanic acid), a deadly poison which interferes with the oxygen-carrying ability of the blood. Death in these cases is usually rapid and with few outward symptoms. Members of the Prunus family of plants, especially wild cherries, are dangerous. Peaches, plums, wild cherry, and other stone fruits belong to this group of plants. Wilting of the green leaves caused by frost, storm damage, or by cutting, changes a glucoside (glycoside) found in the leaves to hydrocyanic acid (HCN) and sugar. The sweet, wilted leaves are thus more attractive to animals than normal foliage. Hydrocyanic acid content varies widely, but under some conditions a few handfuls of leaves may be enough to kill a horse or cow. This type of poisoning should be suspected when sudden death of animals follows windstorms or early sharp frosts. These leaves apparently lose their poison after they have become dry; the limp, green or partially yellowed leaves are the most dangerous.

Sudan grass and sorghums are also cyanogenetic plants. These plants are usually deadly when damaged or frozen. Aftermath sprouts following an early frost are particularly dangerous. Very little sudan grass poisoning occurs from animals trampling down plants and later eating them although this is often listed as dangerous. In dry weather, sudan grass is often pastured to the ground without ill effects. After sudan grass has been repeatedly frozen and the plants are completely dead, it is safe but not very valuable for pasture. Once frozen, sorghum, sorghum sudan hybrids, or their aftermath should never be pastured. As long as the plants show any green color they may be very poisonous. Both frosted sorghum and sudan grass can be best and most safely utilized by ensiling them for at least two weeks before feeding. Normal ensilage fermentation safely eliminates the poisonous compounds.

Other plants of this group include:

Common milkweed, a perennial that grows three or four feet high, has a heavy stem and leaves and is frequently found in pastures.

Horsenettle, a perennial plant, two-feet high, with spiny stems and leaves, and smooth, orange-yellow berries. Fruits are more toxic than the foliage. It's a common plant in grasslands and fields and is a member of the nightshade family.

Black nightshade, an annual plant, two-feet high, with many branches. Leaves are variably smooth or hairy. The stems are angled in cross-section and sometimes spiny. Clusters of white flowers, one-fourth inch across, bloom in midsummer and are followed by small, black fruits. Both the foliage and green berries are toxic. The ripe berries are not poisonous. Black nightshade is widely distributed.

Mountain laurels and rhododendrons, evergreen shrubs of the Appalachian Mountains region. Plants grow five-feet tall and have glossy green leaves. Flowers appear in clusters at the ends of branches. Livestock eat the leaves in early spring when little other foliage is available.
Piedmont Azaleas are deciduous plants of the Piedmont.

Several varieties of Leucothe, also called Fetterbush or Dog-hobble, are evergreen or deciduous plants found in most regions of North Carolina and other southeastern states. Weakness, nausea, salivation and vomiting are symptoms of poisoning. The preventative is to keep livestock out of areas where these plants are abundant.

**Plants containing deadly alkaloids**

Fortunately these plants are unpalatable for most wild and domestic animals:

Water hemlock and poison hemlock are deadly. Poisoning rarely occurs except in early spring when young plants are accidentally eaten.

Mayapple, bloodroot, pokeweed, nightshade and hellebore are other alkaloid-containing plants. They are rarely eaten except when animals are starving for better feed. Deaths from alkaloid-containing plants usually result from severe digestive disturbances, pain and nervous symptoms. Animals usually die in convulsions.

**Plants that are photodynamic**

This means photo-sensitive animals get a reaction. In typical cases, an animal suddenly becomes sore on the white areas of its body. Whole areas of white skin may raise up and slough off. White goats may become severely affected and die from this condition. Some common plants, which cause photosensitization are:

Rape (canola), alsike clover, buckwheat, lantana, St. John's wort, and ornamental hypericums. Both St. John's wort and ornamental hypericums have showy, golden-yellow flowers. Animals do not readily eat them. White goats frequently become badly "sunburned" when they are on rape (canola) pasture in bright, sunny weather with little or no shade.

**Plants that produce mechanical injury**

A number of plants may have a spiny covering, long beards, fine hairs and when eaten may cause mechanical injuries or form hairballs in the stomach and intestines. Sand bur, downy brome grass, squirrel-tail grass, poverty grass, mesquite, and cocklebur are some of the offending plants.

**Shelter, Fencing and Predator Control Needs on Pasture**

**Shelter**

Meat goats require minimum shelter compared to dairy goats. Nevertheless, goats seem to be less tolerant of wet cold conditions than sheep and cattle, and will naturally seek shelter when it is available. During warm weather, rain may cause no or only mild discomfort, but in colder temperatures, goats in general should not remain cold and wet for long periods.
The ability of goats to withstand adverse weather conditions is strongly related to body condition. Goats in good condition, that is goats that have developed a fat layer under the skin, can withstand rain and cold weather without much problem if they have access to good quality forage. Conversely, thin and/or young goats are particularly vulnerable to respiratory infection and to hypothermia if they do not have access to shelter during rainy and cold weather. And it is not uncommon for a combination of cold wind and rain and the occasional snow and sleet to cause losses of young animals. Thus, the necessity for sheltering meat goats probably relates to the expected weather pattern in the area, the nutritional level and body condition of the herd, the physiological stage of the animals (newborn kids, dry does or does in early pregnancy, does in late pregnancy or lactating does) and the class of animals.

A sturdy shed, dry and open to the south side, can usually provide adequate protection. Rear eave heights of 4 feet to 6 feet and front eave heights of 6 feet to 8 feet are adequate. Eight to 10 square feet per goat is desirable for open housing. Other references suggest 5 ½ square feet per goat. Goats also like to be in or near a shed during the night hours, especially if they were raised with sheds. If the facility is part of the farmstead, so much the better because nearness to human activity plays a role in predator control. For feeding hay, grain or concentrate, 16 linear inches of feeder space is sufficient per doe, or 8 to 12 linear inches of feeder space if hay is self fed. For young stock, recommendations are 12 linear inches of feeder space per animal, or 2 to 4 linear inches if hay or grain is self-fed. Troughs need to be easy to clean, should prevent goats from urinating or defecating on the feed, and be accessible from both sides.

In warmer and wetter climates, the type of goat shelter commonly found is one with an elevated, slatted floor. This design protects goats from rain, keeps hooves dry, allows air movement and reduces accumulation of urine and feces, which in turn, favors sanitation.

**Kidding facilities**

Kidding during cold months may require shelter for the does and kids to guarantee kid survival. Temporary kidding pens 4 feet x 5 feet have been used by goat producers with much success. The kidding pens should be located in an area free of cold wind. Does are placed in these jugs during kidding and for 3 to 5 days after kidding. This practice increases the bonding between the
doe and the newborn, especially for the first-kidding does. In addition, it allows the producer to provide assistance if there are kidding complications. It also allows the producer to ensure that weak newborn kids get a sufficient amount of colostrum during the first 12 to 24 hours of life. After the kidding season, these pens can be taken apart and stored.

**Fences**

Fencing is the most critical factor in raising goats on pasture. There is nothing more frustrating than having to constantly chase goats back into the pasture. Once they have been trained to an electric fence, goats can usually be controlled with two to three strands of wire in a cross-fence. Electric netting is also an option for temporary or permanent fencing in management intensive grazing systems; however, several goat producers have lost animals that tangled their horns in the netting.

Permanent fencing applications call for 12 ½ gauge, smooth high-tensile, class 3, galvanized steel wire. Goats can be controlled with 4-5 strands of high-tensile electrified wire. The wire spacings can vary from 6 to 8 inches near the ground to 8 to 12 inches for the top strands. Perimeter fence height should be at least 42 inches tall. A high wire, or an offset wire set one foot inside the fence near the top, may be needed if goat jumping is a problem. As a rule, goats will crawl under rather than jump a fence, so the bottom wire should be kept close to the ground. Training animals to respect electric wire fences can be done effectively by forcing animals to stay in a small paddock which encourages them to "test" the wire. Boundary fences should control all stock at all times. However, interior and cross fences may be made of 3 to 4 smooth strands of high tensile wires assuming animals are well trained. Because goats like to climb, the corners of fences should not have the diagonal bracing for posts or the animals will climb out of the pasture. Corner posts should be driven with a deadman or H-braces.

Woven wire (6" x 6", 6" x 9", or 6" x 12" openings) is very effective as a permanent fence, but costs at least twice that of a 5 strands of smooth high tensile electric fence. Further, horned goats frequently become caught in the 6" x 6" openings or in 6" x 12" openings split by a T-post. To address this problem with existing fences, an electric wire offset about 9 inches from the woven wire fence and about 12 to 15 inches from the ground will reduce the number of animals caught in the woven wire fence. However, this practice also reduces control of forage growth on the fence line. Woven wire with a 6" x 9" or 6" x 12" opening are new and cheaper alternatives than the woven wire with a 6" x 6" opening, which do not require an electric offset wire. Horned goats usually do not get caught or, if caught, they are able to free themselves because of the larger opening.

Temporary wire applications have a wide variety of types from which to select. Polywire and polytape are unique combinations of braided, UV-stabilized polyethylene plastic interwoven with 3 to 9 stainless steel, copper or aluminum filaments. Polytape is similar in composition to
polywire but is flat, 5/8" to 11/2" wide and is used because of its excellent visibility. Polytape and polywire fencing can be used very effectively in control grazing situations. Electric netting, a prefabricated fence of electroplastic twines and white push-in insulated plastic posts is a very effective temporary fence for sheep and goats. It has been reported that several goat producers have lost animals that tangled their horns in the netting. Therefore, goats should be trained to electric netting;

Electric fences should be charged at 4,500 to 9,000 volts at all times. Regular checking and testing are necessary, and any problems must be fixed promptly, or goats will escape.

**Predators and predator control**

Contrary to popular belief, the most common predator that the majority of goat producers face is their neighbor's dog and/or errant dogs running in a pack. A pack of dogs can kill 20-30 goats in one night because they do so for sport and will attack hind legs first. In certain regions, coyotes and bobcats represent the major problem. Foxes can prey on weak, just born kids. Predators generally only kill one animal every 2-3 nights, kill by strangulation (throat marks), and feed on the carcass.

Dogs, donkeys (preferably jennies because male donkeys are too aggressive with the animals they are supposed to protect), and llamas and alpacas can all serve as full-time guard animals, but the effectiveness of any of them will also depend on the bonding, training, instincts, and temperament of individual animals. All guard animals require an investment of time and money, and there is no guarantee that they will be successful. Dog breeds specifically developed for flock protection (for example Great Pyrenees) should be used. Sometimes a single guard animal will not be enough to protect the livestock. Several guard dogs may be necessary to patrol larger areas or to better protect against packs of predators. A llama and guard dog combination can be trained to work cooperatively, but donkeys or llamas will not properly bond to livestock if more than one of their own species is present with the livestock. Rotational grazing can sometimes help, because the livestock are confined to a smaller area, allowing guards animals to be more effective.

In addition to guard animals, a highly powered electric fence having the first two bottom strands 6 and 14 inches from the ground is an additional strong deterrent. These should be placed on the exterior of the fence and are most effective against climbing predators if offset from the wire fence by 18".

Because many predators, including coyotes, are usually active between dusk and dawn, confining goats at night in predator-proof pens located close by the goat owner's residence can reduce losses. Kidding in sheds or on a pasture lot located close to where humans live can reduce losses to predators. Coyotes have their pups in spring, so kidding can be timed to avoid this high-demand time.
Nutritional Considerations

Meat goats require nutrients for body maintenance, growth, reproduction, pregnancy, and production of meat, milk and hair. The groups of nutrients that are essential in goat nutrition are water, energy, protein, minerals and vitamins. Goats should be grouped according to their nutritional needs to more effectively match forage quality and supply to animal needs. Weaned goats prepared for market, does during the last month of gestation, high lactating does and young replacement doelings have the highest nutritional requirements and should be grouped separately from dry does, bucks, etc. which have only maintenance nutritional needs. Does carrying or nursing twins or triplets have greater nutritional requirements than does nursing a single kid. Goats grazing very hilly pastures will have higher nutritional needs than goats on level pastures of the same quality because they will expend more energy to gather feed.

Matching forages to nutritional needs of goats

Highest quality forage and/or browse should be available to does during the last month of gestation, to lactating does, to developing/breeding bucks, and to weanlings and yearlings. Female kids needed for reproduction should be grazed with their mothers during as much of the milk feeding period as possible and not weaned early. When the quantity of available forage and/or browse is limited or is of low quality, limit grazing or feeding a concentrate supplement may be considered to maintain desired body weight gain or body condition, depending on cost:benefit ratios. Whole cottonseed makes an excellent supplement for goats when fed at no more than 0.5 lb/head/day. Dry does and non-breeding mature bucks will meet their nutritional requirements on low to medium quality forage (10-11% protein and 50-60% TDN).

In a barn feeding situation such as during the winter months, goats with the highest nutritional requirements should be offered the highest quality hay available. Whether grazed or barn fed, meat goats should be limit grazed or supplemented with a concentrate feed when either the forage that they are grazing or the hay that they are fed do not contain the necessary nutrients to cover their nutritional requirements. To give producers an idea where some of these requirements fall, low quality forages contain 40-55% TDN, good quality forages contain from 55 to 70% TDN, and concentrate feeds contain from 70 to 90% TDN.

In some situations where brush control in rough areas is the primary purpose of keeping goats, less productive animals or maintenance animals can be forced to consume lower quality feed. If their body condition deteriorates, these animals can then be grazed on better quality pastures or brushy areas. Once desirable body condition is achieved, the same goats can again be used to control brush.

Matching kidding season to forage supply and quality

Goats have the highest nutritional requirements during late pregnancy and early lactation. Therefore, a late winter or early spring kidding when lush pasture is starting to grow rapidly is usually the best strategy. Both the does and kids will have access to the highest quality pasture found anytime during the grazing season on any farm. Thus, does will not lose too much body condition while milking heavily. In turn, kids will grow fast on milk and high quality pasture and
will be strong by the time stressors such as temperature and humidity (heat index) and pasture worm loads increase.

**Nutritional management of replacement does**

Doe kids needed for replacement should be grazed with their mothers during as much of the milking period as possible and not weaned early. Following weaning, doe kids should be separated from the main herd and have access to high quality forage and receive good nutrition through first kidding at 1-2 years of age, depending on the nutritional plane. Leaving replacement doe kids with the main herd will result in undernourished doelings that are bred too young and too small; these animals will never reach their production potential. A yearly supply of replacement does that are healthy and of good size is essential to the success of any meat goat enterprise.

**Suggested supplemental feeding program**

A complete goat mineral containing selenium should be offered free choice year-around in most production situations. When goats are raised on browse, abundant supply should be made available to allow goats to be very selective and to ingest a high quality diet that will meet their nutritional requirements. When forage or browse is limited or of low quality (< 10% protein), does in the last 30 days of gestation, lactating does, and developing/breeding bucks should be fed 1.0 lb/day of a 16% protein mixture (77:20:2.5:0.5 ground corn : soybean meal : goat mineral : limestone). Alternatively, ground corn and soybean meal can be substituted by whole cottonseed for gestating and lactating does. Low to medium quality forage (> 10% protein) will meet requirements of dry does and non-breeding bucks. When forage or browse is limited or of low quality (< 10% protein), weanlings prepared for market, replacement doelings and yearlings should be fed 1.0 lb/day of the 16% protein mixture described above. Weight gains of growing goats supplemented with whole cottonseed on pasture have not been assessed yet to make recommendations. Goats can be forced to eat very low quality feed including twigs, tree bark, etc., but producers should be aware this practice will hurt the productivity of the meat goat herd.

**Water**

Water is the cheapest feed ingredient. Production, growth and the general performance of the goat will be affected if insufficient water is available. Water needs vary with the stage of production, being highest for early lactating does, and during times when the weather is hot and forages are dry. In some instances, when consuming lush and leafy forages during cold weather, or when grazing forages soaked with rain water or a heavy dew, goats can get all the water they need out of the forage. However, water is almost always needed by some members of the herd such as lactating does. Because it is difficult to predict water needs, goats should always have access to sufficient high quality water. Water needs range between ½ to 4 gallons per day, the latter value for high lactating goats. Clear, flowing water from a stream is preferable to stagnant water as the latter may contain excessive levels of blue-green algae, which may be toxic. Nitrate in drinking water should also be of concern because it is becoming the predominant water problem for livestock. Safe levels in drinking water are as follows (in parts per million): less than 100 for nitrate nitrogen, or less than 443 for nitrate ion, or less than 607 for sodium nitrate. Well,
city or community water can be delivered by above ground or underground water lines hooked up to float-containing movable water troughs, a water delivery system offering optimum flexibility for control grazing.

**Providing mineral supplementation on pasture**

Goats require many minerals for basic body function and optimum production. Providing a complete goat mineral or a 50:50 mix of trace mineralized salt and di-calcium phosphate free choice is advisable under most situations. Make sure that mineral mixes are kept dry and clean, and that your goats eat them, and record how much is consumed. Major minerals likely to be deficient in the diet are salt (sodium chloride), calcium, phosphorous and magnesium. Trace minerals likely to be low in the diet are selenium copper, and zinc.

Most forages are relatively high in calcium (grass: less than 0.5%; legumes: more than 1.2%), so calcium is low only if high grain diets are fed, which would be unusual for meat goats. Low quality, mature or weathered forages will be deficient in phosphorous, especially for high and average lactating does. For example, bermudagrass hay harvested at 7 to 8 weeks regrowth only contains 0.18% phosphorous. The ratio of calcium to phosphorous in the diet is important and should be kept about 2:1 to 3:1 (Table 1).

| Table 1. Daily Nutrient Requirements for Meat Producing Goats<sup>1,2</sup> |
|-------------------------|------------------|------------------|------------------|------------------|------------------|
| Nutrient                | Young Goats<sup>3</sup> | Does (110 lb) | Bucks (80-120 lb) |
|                         | Weanling (30 lb) | Yearling (60 lb) | Pregnant | Lactating | Early | Late | Avg Milk | High Milk | Early | Late | Avg Milk | High Milk |
| Dry matter, lb          | 2.0              | 3.0              | 4.5      | 4.5      | 4.5   | 5.0   | 5.0      | 5.0      | 10   | 10   | 14       | 11       |
| TDN, %                  | 68               | 65               | 55       | 60       | 60    | 65    | 65       | 60       | 14   | 11   | 14       | 11       |
| Protein, %              | 14               | 12               | 10       | 11       | 11    | 14    | 11       | 11       | 14   | 11   | 14       | 11       |
| Calcium, %              | 0.6              | 0.4              | 0.4      | 0.4      | 0.4   | 0.6   | 0.4      | 0.4      | 0.2  | 0.2  | 0.2      | 0.2      |
| Phosphorus, %           | 0.3              | 0.2              | 0.2      | 0.2      | 0.2   | 0.3   | 0.2      | 0.2      |      |      |          |          |


<sup>3</sup> Expected weight gain >.44 lb / day.

Grass tetany is associated with low levels of magnesium in the blood. Grass tetany can occur when goats in early lactation are grazing lush, leafy cereal grains, annual ryegrass or grass/legume pastures heavily fertilized with nitrogen on soils low in phosphorous but high in potassium. It mostly affects does in early lactation and especially the highest-producing animals. Under those conditions, it is advisable to provide a mineral mix that contains 5 to 10% magnesium.

Selenium is marginal to deficient in most of the Southeast. Trace mineralized salts that include selenium should be provided to the goat herd at all times. In case selenium is absent, producers
should encourage their local feed store to include it in commercial mixes or to order trace mineralized salts that contain selenium.

Copper requirements for meat goats have not been definitively established, although requirements for dairy goats have been established in Europe. Growing and adult meat goats are less susceptible to copper toxicity than sheep, however, but their tolerance level is not well known. Young, nursing kids are generally more sensitive to copper toxicity than mature goats, and cattle milk replacers should not be fed to nursing kids. Mineral mixes and sweet feed should contain copper carbonate or copper sulfate because these forms of copper are better utilized by the goat than copper oxide. Grains are generally lower in copper than forages. However, copper levels are of limited value in assessing adequacy unless forage concentrations of copper antagonists such as molybdenum, sulfur, and iron are also considered.

Forages, especially low quality forages, often contain concentrations of zinc that are thought to be below recommended levels for ruminants. However, zinc requirements of goats have not been defined, and little is known regarding factors that affect zinc availability in forages.

Pastures and Pasture Management

Explanation of plant terms

Annual: A plant that germinates, grows, reproduces only by seed, and dies in one year or growing season.

Perennial: A plant that persists for several years with new growth from a perennating part, and can live indefinitely. Often a combination of diseases and/or insects will cause a perennial to be short lived.

Cool Season Perennial: Perennial plant species that is usually seeded in late summer or early fall (may be seeded in late winter or early spring, resulting in less growth the year of establishment). The major proportion of its growth is during the cool season in the spring with a lesser peak growth in the late summer and early fall. For example, in the piedmont of North Carolina a mixture of tall fescue-ladino clover will produce about 55% of its total production in March, April and May, and about 20% in August, September and October. Cool season grasses usually flower profusely in mid-spring and, if permitted, seeds will mature by late spring. Cool season legumes vary greatly in their periods of floral production. For example, alfalfa will usually produce some flowers after every harvest. In the year of establishment, the seedling growth of perennials is less vigorous than winter annuals.

Warm Season Perennial: Perennial plant species that is usually seeded or planted vegetatively in late winter or spring and produces the major proportion of its growth during the warmer months, June, July and August in the Piedmont of North Carolina. For example, hybrid bermudagrass will produce about 70% of its total production in June, July and August in the piedmont of North Carolina. Bermudagrass completely ceases growth at frost. Warm season grasses vary greatly in their period of floral production. A warm season perennial legume such as sericea lespedeza produces a seed crop every year in early to mid fall.
**Warm season improved grasses**

Warm season grasses are often of tropical or subtropical origin and grow mainly during late spring, summer and early fall. Frost will kill warm season annual grasses, whereas warm season perennial grasses become dormant and unproductive during the winter months. With adequate fertilization, some of the warm season grasses have very high forage yields. However, forage quality of warm season grasses, especially perennials, is generally much lower than that of cool season grasses.

**Perennials**

**Bermudagrass** (*Cynodon dactylon*)

Bermudagrass is well adapted in the Southeast except on poorly drained soils. It is particularly well adapted to sandy soils and grows well on deep sands. However, it is subject to winter injury in the Appalachian mountain areas, especially the upper mountains. Bermudagrass spreads by rhizomes, stolons, and by seed in some types. General growth period is April to October. Peak production months are June, July, and August. Yields range from 3 to 6 tons dry matter per acre. It is difficult to grow a summer legume with bermudagrass, but it is possible to overseed with crimson clover, red clover, ladino clover, cereal grains, or annual ryegrass for winter or early spring grazing. Quality is moderate (60 to 63% digestible and 12 to 16% crude protein) if kept immature and leafy (under 4 inches). Stocking rate needs to be high (up to 60 goats per acre) because of its high productivity to keep it vegetative compared with switchgrass and gamagrass.

Winter hardiness is a very important trait to consider. There are differences in the degree of winter hardiness of different cultivars, and these differences can be critical for stand persistence. The common cultivars with best proven winter hardiness are Greenfield, Guymon and Wrangler, whereas the hybrids with best proven cold tolerance are Midland 99, Midland, Tifton 44, World Feeder and Lancaster.
Tifton 44 is hardier in the winter than Coastal and Tifton 85, the latter growing best in the coastal plains.

Bermudagrass hybrids are similar in general appearance to common bermuda but are taller and usually yield more forage. Unlike common bermuda, which spreads by seed, hybrid bermudagrass cultivars produce no live seed, spreading instead by rhizomes and stolons.

Therefore, hybrid bermudagrasses must be established from sprigs. DO NOT let sprigs dry in sun or wind before planting by using dormant plants in February, March, and early April. They can also be planted in late spring and summer whenever moisture is ample. When sprigging Coastal or Tifton 78, use at least 10 bushels of sprigs per acre in rows 3 to 4 feet apart, and sprigs spaced 2 to 3 feet in the row. Tifton 44 is slower to establish than Coastal, therefore double the sprigs per row and cut in half the row spacings (about 40 bushels per acre). Herbicides that control germinating seeds are very effective for new sprigged pastures.

With commercial planters, hybrid bermudagrass cultivars may be planted in 18- or 20-inch rows by off-setting and going over the field twice. Use from 40 to 75 bushels of sprigs per acre. On farms where sprigs are plentiful, stands can be established by broadcasting liberal quantities (75 to 100 bushels per acre) in late winter and disking in. One bushel equals approximately 1.25 cubic feet and contains about 1,200 sprigs.

Common bermuda is established by seeding sometime around corn planting time into a prepared seedbed. Acceptable stands are generally obtained in six to eight weeks. For both hybrid and common bermudagrass, care should be exercised to control weeds, particularly crabgrass in the first year, by cultivation, mowing, or careful grazing. After establishment, graze when 4 to 10 inches tall. Close grazing will reduce yields of bermuda in the first year. After the first year, graze when 6 inches back to 1-inch stubble. Harvest hay at height of 12 to 15 inches or at four-to six-week intervals during the growing season. Bermudagrass should go into the winter with 3 to 4 inches of growth to serve as insulation against winter damage. Burn or flail off the residue in late February or early March. It is necessary to graze or mow very closely and disk lightly in order to establish legumes after sod has become thick.

Switchgrass (*Panicum virgatum*)

Switchgrass grows best on well-drained soils with good moisture supply; however, it will grow on droughtry or moderately wet soils and will tolerate occasional flooding. Switchgrass is a long-term perennial (15 years in Raleigh, N.C.) once established and properly managed but carrying (stocking) capacity is not as high as hybrid bermudagrass. Yields range from 3 to 5 tons per acre. Switchgrass is an erect, bunch-type grass with medium to large stems and short rhizomes. Under grazing, leafy regrowth develops from basal and axillary tillers. Plants are ready for grazing several weeks earlier than Coastal bermuda. Peak production months are May to July. Cultivars vary widely in heading dates, ranging from June to early August. This plant has weak seedling vigor. Switchgrass is a very high-quality grass (70 to 78% digestible and 10 to 15% crude protein) when continuously grazed to a 6-inch stubble. It is very palatable and intake is high. Switchgrass is not recommended for young growing stock because crude protein is usually not high enough for adequate growth. In addition, severe cases of photosensitization have been
observed under wet and humid conditions with litter from previous hay crop on the ground.

**Eastern gamagrass** (*Tripsacum dactyloides*)

Eastern gamagrass is native to North Carolina. Eastern gamagrass grows on well-drained uplands, but also persists on wet-natured soils. It is a long-lived perennial that produces 4 to 6 tons of hay per acre from two to three harvests or several grazing.

Eastern gamagrass is a tall, erect bunch grass that grows in large clumps from 1 to 4 feet in diameter. It spreads by short rhizomes and produces seed from July to September on stems 3 to 9 feet tall. Its growth cycle is similar to switchgrass. Eastern gamagrass is palatable, nutritious, and
readily eaten by all types of livestock. Young, actively growing leaves are 65 to 72% digestible and 12 to 18% crude protein. Goats are somewhat reluctant to eat Eastern gamagrass at first because short, fine spiny hairs grow on the leaf edges that may produce some mechanical injuries in a few cases.

**Summer Annuals**

**Pearl millet (Pennisetum americanum)**

Pearl millet is adapted to most medium- or well-drained soils except deep, sandy soils. It has proven superior to sudangrass and sorghum-sudan hybrids on sandy loams. Pearl millet is an erect summer annual that is more leafy than sorghum-sudan hybrids. In addition, pearl millet does not produce prussic acid. Many good cultivars are available. Pearl millets can be classified into three categories: dwarf (less than 4 feet), semi-dwarf (4 to 6 feet), and tall (6 to 8 feet). The taller the millet, the more stemmy the growth. The general growth period is May 1 to October 1. The peak production months are June, July, and August. It will produce 3 to 4 tons of dry forage per acre. Pearl millet has a good nutritive value (60 to 65% digestible and 14 to 18% crude protein) if grazed when 12 to 24 inches tall but becomes less palatable when allowed to head. Pearl millet should be control-grazed with one- to three-day durations. It should be grazed when 14 to 24 inches tall to a 6- to 8-inch stubble. The dwarf selection (Tifleaf) is much easier to manage for grazing. It has less stalk with the same number of leaves as the tall form.

![Pearl millet](Author supplied photo)

**Crabgrass (Digitaria sanguinalis)**

Large or hairy crabgrass is widely distributed and well adapted to most soils, but does not tolerate water-logged conditions. It is drought tolerant and responds to moisture more quickly than do many summer grasses. Crabgrass has a semi-erect growth with prostrate stems which often root at the nodes when in prolonged contact with moist soil (resembles stolons). It is a
warm-season annual that volunteers readily from seed and is very competitive with other grasses, especially with slower-growing species.

It produces good growth from June through September. Yields range from 3 to 5 tons per acre. Crabgrass is a highly palatable plant and provides higher quality forage than bermudagrass. Digestibility is usually 5 to 8% higher than bermudagrass at equivalent stages of maturity (ranges from 62 to 72%). Crude protein ranges from 7 to 18% depending on stage of growth and nitrogen fertilization.

Crabgrass can be planted into prepared seedbeds immediately after the last spring frost. Disking or other tillage during the dormant season (fall-winter) appears to be essential for productive reseeding stands. Breakdown of the residue from the previous year is important because crabgrass is self-toxic (auto-allelopathic). A procedure for double cropping is to cut or graze crabgrass completely by September 1. Then, disk, drag, and plant cereal rye as soon as possible and graze cereal rye to completely use growth by about April 15 to May 1. If crabgrass volunteers in the pasture before May 1 (or the end of grazing cereal rye), do not till the pasture. If not present at rye graze-out, disk and drag the pasture and as soon as crabgrass is up and beginning to tiller, apply 70 to 80 pounds of nitrogen per acre. Repeat nitrogen application in late June or early July. Start grazing when crabgrass is about 4 inches tall. Because the stand must be allowed to produce seed sometime during the summer, controlled-rotational grazing is a good method.

**Warm season improved legumes**

Warm season legumes that provide good quality forage and fix atmosphere nitrogen are lacking in the southeastern United States. Sericea lespedeza is the most useful warm season perennial legume albeit it is considered an invasive plant in parts of the country. Another perennial specie is alfalfa, a cool season legume growing throughout the summer. Alfalfa, however, is usually not grown for meat goats due to establishment costs and lack of persistence. Perennial peanut is also an excellent warm season perennial forage but it is adapted only to the lower coastal plains, and it is slow to establish. As a warm season annual legume of high quality, soybeans or cowpeas can be easily integrated into a summer forage grazing system.
**Perennials**

*Sericea lespedeza* (*Lespedeza cuneata*)

Sericea is widely adapted in the Southeast, but is best suited for use as a pasture plant on medium to well-drained clay to sandy loam soils and deep sands as well as eroded areas from southern Ohio to central Alabama and from eastern Oklahoma to the Atlantic coast. It also does well on shallow soils with drainage restrictions. Sericea lespedeza will tolerate lower pH (more acid) soils than clover but will definitely respond to lime applications on acid soils. Its ability to grow in poor, droughty soil makes sericea a popular choice for stabilizing critical areas such as road banks and mine reclamation sites. However, it can also fill a niche on many livestock farms in areas in which most pastures are dominated by cool season forage crops, especially on sites where other forage crops are not well adapted.

Sericea lespedeza is an erect, deep-rooted perennial legume that persists for many years, especially on low-maintenance areas. It usually grows only 6 to 12 inches the first year. It does not spread by rhizomes and stolons. The first growth in the spring arises from crown buds. New growth after cutting or grazing arises from buds on the stubble and not the crown. General growth period is April to November 1. Peak growth period is June, July, and August with annual yield of 2 to 3 tons per acre. Sericea lespedeza does not self-destruct if not used because it produces a seed crop in late summer and fall.

Sericea lespedeza is preferably seeded alone and does not compete well with other plants. It may be overseeded with winter annuals if carefully managed. The main winter annual legume sometimes grown with sericea lespedeza is crimson clover. Seeding crimson clover in the fall will provide grazing in the spring and not damage the lespedeza if the clover is grazed closely in April and May. Sericea lespedeza is of moderate quality (50 to 55% digestible and 12 to 16% crude protein), but forage quality of improved varieties is better than most warm season perennial grasses.
Goats graze the leaves and the tender and terminal stems and will consume it at all stages of growth. If allowed to reach 18- to 24-inch growth or more, it becomes woody, stemmy and high in fiber.

Tannins, compounds that naturally occur in sericea lespedeza and some other forage plants, reduce the intake and digestibility of fresh forage. Consequently, forage-type sericea lespedeza varieties are often categorized as being high-tannin or low-tannin types. Serala and Serala 76 are improved varieties that have smaller stems and higher forage quality than the older, common varieties. Serela 76 was released by Auburn University because of its resistance to nematodes. Interstate 76 is also an Auburn variety. It was selected because of its resistance to pests and erosion control potential on roadsides and areas that erode easily. Au-Lotan and Au-Donnelly are more recent Auburn releases developed with low tannins for improved palatability and digestibility. AU Grazer, another variety developed by Auburn especially for grazing, has intermediate tannin levels.

Up to a certain level in the daily ration, tannins are known to increase the amount of protein bypassing the rumen, thus making the goats use their feed more efficiently. In addition, there has been some recent success in reducing barber pole fecal egg counts and perhaps the adult worm numbers by feeding sericea lespedeza, either fresh or as hay. Animals prefer the young plants, but it should not be grazed until it is at least four to six inches in height to preserve the stand. Whether goats need to graze sericea lespedeza on a daily basis or only at regular intervals for tannins to have a beneficial effect on parasite loads has not yet been fully determined.

**Summer annuals**

**Soybean** (*Glycine max*)

Soybean varieties were developed for oilseed production but can be used for high quality grazing or hay with yields of 2 to 3 tons of dry forage per acre. Hay should be harvested when pods are
75% filled, requires a hay conditioner and is difficult to cure. Soybean grows best in well-drained soils and tolerates drought when grown for forage. Soybean should be control-grazed with one- to three-day duration. Goats should be moved to a fresh cut when the plants are not totally defoliated to insure regrowth. Under proper management, soybean can be grazed three times during the growing season (July - September). Soybean can be first grazed when 24 inch tall and has excellent nutritive value (>25 to 30% crude protein).

**Cowpeas (Vigna unguiculata)**

Cowpeas grow very well during hot weather and can be grazed repeatedly if an indeterminant (does not produce all its seeds at once) variety is used. Management is similar to soybeans but productivity is greater.

**Cool season improved grasses**

Cool season perennial and annual grasses are generally of higher quality than warm season grasses. Cool season perennials have a longer productive season than warm season perennials. Cool season annual grasses provide very high quality forage for grazing when warm season grasses are dormant. Cool season perennial grasses generally do not grow well in the hotter parts of the Southeastern United States.

Incorporating cool season perennial and annual forages in a grazing system allows meat goat producers to kid earlier in the spring on cereal grains or annual ryegrass followed by grazing a cool-season perennial pasture. This strategy will not only increase lactating does milk output thus permitting high rates of growth of nursing kids and weanlings while pastures worm loads are low, but will also reduce feed costs. The same principle can be used for fall kidding on a cool-season perennial pasture followed by grazing cereal grains.

**Perennials**

**Tall Fescue (Festuca arundinacea)**

Tall fescue is adapted to all soils except the dryer sands and grows well on soils too wet for orchardgrass. Tall fescue is tolerant of soil acidity and is relatively tolerant of drought. The presence of an endophyte fungus (Neotyphodium coenophialum), found in more than 90% of the
old Kentucky 31 tall fescue, has been associated with persistency. Persistence of endophyte-free
and MaxQ tall fescue (containing a novel endophyte fungus not detrimental to animals) is not yet
known, as these varieties have been observed for only 3 years in North Carolina while being
control-grazed by goats.

Tall fescue is a semi-erect bunch-type grass, with short rhizomes. It spreads very slowly by
rhizomes. Tall fescue remains green throughout much of the year in the Southeast. The peak
production months are March, April, May, September, October, and November. Tall fescue
makes fair growth in mid-summer when fertility and moisture are ample, but frequently becomes
dormant after 14 to 21 days of no rain. Yields range from 3 to 5 tons per acre. Tall fescue grows
well with ladino clover and red clover. Tall fescue is high in quality (70 to 80% digestible) when
immature and leafy, but declines (55 to 60% digestible) when allowed to head.

The presence of the endophyte fungus found in most of the old Kentucky 31 tall fescue pastures
has been associated with beef cattle health disorders and poor animal performance. Adding
ladino clover and managing these pastures to favor other grasses such as Kentucky bluegrass,
orchardgrass, crabgrass and common bermudagrass will dilute the toxic tall fescue. Other
strategies to eliminate toxicity problems are not grazing infected fescue during mid-summer by
using warm season alternatives and not grazing below a 2-inch stubble.

In North Carolina during the last two springs, we have observed that lactating crossbred (3/4 and
up) Boer does either maintained (2004) or lost some weight (2005: -0.15 lb/day) while control-
grazed on 90% endophyte-infected Kentucky 31 tall fescue. Conversely, lactating does control-
grazed on Jessup non-infected or MaxQ tall fescue gained weight (2004: 0.16 lb/day; 2005: 0.13
lb/day). All nursing kids gained weight. In 2004, kids on the endophyte-infected Kentucky 31
tall fescue plots, however, gained less weight (0.18 lb/day) compared to the kids on the
endophyte-free Jessup and the MaxQ tall fescue plots (.25 lb/day). In 2005, nursing kids gained
more weight, but there was very little difference between the three forages (Kentucky 31: 0.35
lb/day; Jessup endophyte-free: 0.37 lb/day; MaxQ: 0.40 lb/day). By the end of the first spring
grazing season, goats had eaten only 26% of the endophyte-infected Kentucky 31 seedheads whereas 97% of the endophyte-free Jessup and 99% of the MaxQ tall fescue seedheads had been consumed. Visual health problems were not detected.

Pure stands of tall fescue can be stockpiled for deferred grazing in late fall and early winter by accumulating growth in August, September and October on a portion of the acreage. The accumulated forage should be strip grazed heavily in November, December and January.

**Orchardgrass** (*Dactylis glomerata*)

Orchardgrass requires medium- to well-drained soils and is well adapted to the upper northern portion, and the piedmont and mountain areas of the Southeast. In the lower piedmont and coastal plains, stands usually thin out after about three years. In the upper piedmont and mountains, stands are thinning by the fifth year due to disease and usually lack of good grazing management. Orchardgrass is a tall, erect, bunch-type grass without rhizomes or stolons. It grows from March to November. More than 60% of production is during March to June and September. It grows some throughout the summer when moisture is adequate. It is more susceptible than tall fescue to leaf deterioration from frost. Yields average 3 to 5 tons per acre. Orchardgrass is well-liked by goats.

Orchardgrass grows well with legumes, particularly ladino clover and red clover and is of high quality when immature (73 to 78% digestible and crude protein of 14 to 20%). Quality declines with maturity, however, (58 to 65% digestible at full bloom) and when the foliage is damaged by leaf diseases. It makes a better hay and more summer growth than tall fescue, and is easier to manage than tall fescue in mixture with ladino in the upper piedmont and mountains.

**Kentucky bluegrass** (*Poa pratensis*)

Kentucky bluegrass is best adapted to the upper northern portion, and the mountain and upper piedmont areas of the Southeast. It is the dominant grass found in old pastures throughout the mountain areas and is used almost exclusively for grazing. In areas where renovation is practical, orchardgrass is preferred because of higher yield. Kentucky bluegrass requires medium drainage and grows best on soils of medium to high productivity. Kentucky bluegrass has narrow, soft, smooth leaves and forms a dense sod because of its rhizomes. It volunteers readily in all new seedings of mountain and upper piedmont areas. General period of growth is March 15 to
November 1. The peak months of production are March to May and September. Kentucky bluegrass grows very little during the mid-summer months. An uneven seasonal production is its major weakness. Kentucky bluegrass is not as productive as orchardgrass or tall fescue. The yields of predominately bluegrass-white clover pastures range from 2 to 3 tons per acre. Kentucky bluegrass is very palatable and high in quality (75 to 80% digestible and 14 to 20% crude protein) when properly fertilized and in a vegetative stage. Its quality declines in mid-summer (59 to 63% digestible) or if allowed to head (52 to 58% digestible). Kentucky bluegrass-white clover pastures must be grazed fairly closely (from 4 to 6 inches back to 1 to 1.5 inches) in early spring to maintain the white clover. However, very close grazing in summer and fall reduces yields, causes soils to dry out, and accelerates runoff and erosion.

**Winter annuals**

**Ryegrass** (*Lolium multiflorum*)

Annual ryegrass is adapted to most soils. It has a bunch-type leafy growth but tillers profusely and volunteers (self reseeds) readily. Its peak season of growth is later in spring than cereal rye, and suppresses early summer growth of bermudagrass more than cereal rye. Annual ryegrass
yields range from 2 to 4 tons per acre with more than 50% in April to May. Annual ryegrass has very high quality (77 to 82% digestible and 14 to 20% crude protein). Its quality declines similarly to orchardgrass as plant matures.

It is very competitive in the seedling stage and may become a pest in cereals for grain, perennial legumes, and cool-season perennial grasses. Annual ryegrass works well for mixtures of winter pastures such as when seeded with crimson clover or other small cereal grains. It is also no-till planted into bermudagrass sods to extend the grazing season. Annual ryegrass is used primarily for grazing. In a three-year study conducted in North Carolina with replacement doelings control-grazed on annual ryegrass, cereal rye and triticale, annual ryegrass weight gains per acre were superior to those obtained with cereal rye or triticale.

**Cereal grains**

Cereal grains will produce 1,500 to 2,500 pounds of forage dry matter between early fall and April 1 if seeded early and top-dressed with sufficient nitrogen. Another 1,000 to 2,000 pounds of forage are usually produced after April 1. Cereal grains, particularly rye, barley, oats, triticale and wheat are seeded early and grazed throughout the growing season. Mixtures often work best for goat pastures because some cereals produce well in early autumn while others are more cold-tolerant and come on later in winter and early spring. All cereal grains are high in quality (70 to 80% digestible and 15 to 20% crude protein) when control-grazed and kept vegetative; dry matter intake is high. Barley matures earlier than wheat. In general, wheat will not produce as much forage during fall and winter as other small grains. Cereal rye produces more forage than barley on sandy land, whereas barley frequently is more productive on the clay soils. If grain harvest is desired, considerable grazing can be obtained between November 1 and February 15 without materially reducing grain yields.

**Cool season improved legumes**

Cool season legumes make most of their biomass in late winter, early spring and in the autumn of the year when temperatures and rainfall are generally more favorable. Cool season perennial legumes usually do not persist more than two to three years in the southeastern United States. Bloat is a problem with some legumes, so gradual introduction to new pastures, mixture with grasses, and bloat blocks are recommended.

**Perennials**

**Ladino clover** (*Trifolium repens*)

Ladino clover is widely adapted to imperfectly drained and well-drained soils, but not to deep and dry sandy soils. It persists about three years. Ladino clover is a rapid-growing perennial that spreads by fleshy, creeping stems that root at the nodes. It is a giant strain of white clover and it is more productive and more drought resistant than intermediate types of white clover. More than 50% of yield occurs from March to June, but it may grow some in each month. Annual yields are 3 to 4 tons per acre. Ladino clover will frequently volunteer successfully after the stand is thinned by prolonged drought, flooding, disease, insect infestation, or poor management. Ladino
clover grows well with orchardgrass or tall fescue. It will thrive better with the less competitive orchardgrass or endophyte-free fescue. Ladino clover is extremely high quality (greater than 80% digestible and 25% crude protein) and maintains quality with maturity. Pvioles are also very digestible. It contains high calcium, phosphorus, and magnesium. Ladino clover is primarily grown in mixture with adapted grasses for grazing, but mixtures also may be used for silage, hay, soil improvement, and wildlife. Get a soil test before planting. Ladino clover has medium to high lime, phosphorus, and potassium requirements.

**Red clover (Trifolium pratense)**

Red clover is best adapted to fertile, well-drained soils of the piedmont and mountains of the Southeast. Stands usually last about two to three years. Red clover is an erect, short-lived perennial legume, with numerous stems arising from a thick crown. Growth occurs from March to November, with about 50% yield in April to June. Annual yields range from 3 to 4 tons per acre. When grown for hay, red clover is usually grown in mixture with orchardgrass, but it is often mixed with tall fescue. Hay quality ranges from 60 to 65% digestibility and 12 to 16% crude protein, but declines rapidly with maturity (52 to 56% digestibility). In pastures the vegetative growth is more than 70% digestible and 18% crude protein. It also contains relatively high calcium, phosphorus, and magnesium. Both leaves and stems are consumed.
Birdsfoot trefoil (*Lotus corniculatus*)

Birdsfoot trefoil is a deep-rooted, short lived perennial that is adapted to cooler, temperate climates. Birdsfoot trefoil likes upland loams, well-drained soils and is tolerant of drought and moderate soil acidity. Birdsfoot trefoil has fine stems, bright yellow flowers, and small tap roots without rhizomes or stolons. It is subject to severe damage from *Rhizoctonia*, a root and crown fungal disease. It requires a special inoculum for first plantings and is slow to become established. It reseeds under proper management, contributing to its persistence, so pastures should be managed to permit seed formation. Its persistence and yield of animal products are greater if control-grazed. The plants grow 12 to 30 inches tall, depending on whether the variety is prostrate or semi-erect and yields 2 to 3 tons of dry herbage per acre in mixtures with grasses. Its nutritive value is equal to or greater than that of alfalfa. Birdsfoot trefoil is high in quality (70 to 78% digestible). Its quality declines slightly as plant matures. Birdsfoot trefoil is a good source of protein, calcium, phosphorus, and magnesium. Goats graze both leaves and the herbaceous stems, which remains highly digestible. Plants are highly palatable but contain tannins that prevent bloat and could be important to reduce gastrointestinal parasite loads. It grows well in association with orchardgrass and with Kentucky bluegrass whereas tall fescue is often too competitive.

Attaching Image 1 and Image 2

Annuals

Crimson clover (*Trifolium incarnatum*)

Crimson clover is adapted to most soils, except dry, sandy, and very poorly drained soils. It is well adapted to upland loams and low-lying medium, well-drained soils. In general, it is preferable to other winter annual legumes except hairy vetch, which usually proves superior on deep, sandy soils. Because crimson comes on earlier than hairy vetch or annual medics, mixtures of these produce steadier forage supplies through the winter and spring. Crimson clover is an erect winter annual with shallow tap root. Its general growth period is October to June. The peak


months of production are November, March, April, and May. Crimson clover matures and dies in early June, with 75% of its total production being March to May. Its yields average 1 to 2 tons per acre.

Crimson clover is frequently seeded with cereal grains and/or Italian ryegrass. It is also no-till planted into bermudagrass sods to extend the grazing season. Seeding crimson clover overseeded in the fall in sericea lespedeza pastures will provide grazing in the spring and not damage the lespedeza if the clover is grazed closely in April and May. Crimson clover is of very high quality (70 to 75% digestible with 16 to 22% crude protein) when immature, but declines (58 to 68% digestible) with maturity. It is a good source of phosphorus, calcium, and magnesium.

Inoculation is usually necessary at planting. Crimson may be grazed to 2 to 4 inches when growth reaches 6 to 8 inches. Natural re-seeding of some cultivars can be accomplished by managing to permit some plants to form seeds in late May to early June. The perennial companion crop will have to be closely grazed in the fall. Graze closely in early spring if seeded with warm-season perennial grasses or legumes because crimson is highly competitive with the perennial in early spring.

**Hairy vetch (Vicia villosa)**

Hairy vetch will grow on a wide range of soil types and grows better than crimson clover on extremely sandy soils. However, hairy vetch is not used frequently because it becomes a pest in cereals grown for grain, and other legumes offer more potential.

**Cool season improved herbs or forbs**

**Perennials**

**Chicory (Cichorium intybus)**

Forage chicory is a perennial which is suited to be grown on well-drained or moderately drained soils having medium to high fertility and a pH of 5.5 or greater. Chicory has good seedling vigor and a relatively deep taproot which provides tolerance to drought. It provides both spring and summer forage growth for goats. Unlike most forage crops, it is an herb rather than either a grass or a legume. Chicory produces leafy growth which, if managed properly, is similar in nutritive value and mineral content to alfalfa or cool-season grasses. During the winter, forage chicory is a
low-growing rosette plant with broad leaves. At this stage it looks very much like dandelion. With warm temperatures in the spring, it produces large numbers of leaves from the crown. After the establishment year, a few flower stems begin to develop in late spring from the crown and the shoots will reach heights of 6 feet if ungrazed. At this point it resembles curly dock except that it has blue flowers and a different type of seedheads. New Zealand led much of the breeding for improved forage characteristics of the variety 'Puna' marketed in the United States.

Chicory production and the life of the stand (5 to 7 years) is optimized under control grazing management. Depending on time of year and climatic conditions, a rest period of 25 to 30 days between grazing is best for chicory persistence and performance. A stubble height of 1.5 to 2 inches should remain after grazing or cutting. Spring-seeded chicory can be grazed after 80 to 100 days, depending on climatic conditions. In mixtures which include chicory, a cool season legume such as white clover is usually included because of its nitrogen fixing capability. Germination of stored seed can decline rapidly, therefore seed should be used promptly and not stored from year to year. Chicory also contains tannins that have been shown to reduce worm burdens in deer in New Zealand.

**Cool season miscellaneous plants**

**Annuals**

**Turnips, rape, kale, rutabaga** (*Swedes*)

These crops are members of the mustard family and belong to the genus Brassica. The forage brassicas are readily eaten by livestock and can be divided into two groups:

Leafy Brassicas include rape and kale which provide forage from leaves and stems. Root Brassicas include turnips and rutabagas which provide forage from leaves, stems, and roots.
Under favorable growing conditions, rape and turnips are ready for grazing earlier than kale and rutabagas, but yield less. Brassicas can provide much needed high-quality forage during periods when the perennial forage supply is limited (October to December). They should not be used as the sole source of feed because they contain more than 90% water, are very low in fiber content, and contain substances that may become toxic upon prolonged (several weeks) feeding of an all-brassica diet. Flowers of turnips have a high content of mustard oil which can be toxic to animals. Also, turnips may cause an off-flavor in milk. Immature rape can be high in nitrate, especially with high nitrogen fertilization. Brassicas will grow on a wide range of well-drained soils.

Establishing pastures for goats

Planting time

Establishing a successful forage crop depends partly on weather conditions shortly before and after planting. Delaying planting until the last possible dates found in the literature such as forage guides may reduce the chance of growing a good stand by 30 to 50%.

Perennial cool season forages can be best established by planting in the late summer or fall, with a few exceptions. Some points to remember about fall planting:

- Cool season grass seedlings are more tolerant of freezing temperatures than legumes
- In prepared seedbeds, grasses should have three to four leaves before freezing weather occurs. In a sod, one to three leaves will suffice.
- In prepared seedbeds, ladino clover should have five to seven true leaves present when frequent freezing weather occurs. In a sod, one to two true leaves will usually suffice.

Sod-seeding - fall and winter

Fall plantings can be made later in sod than in prepared seedbeds because the existing sod provides protection for the developing seedlings during the winter season. Delayed planting results in much less insect damage. When planting ladino clover in an established sod of tall fescue or other cool season grass or chicory, late winter or early spring (February to March) plantings are often a good alternative to fall plantings. Planting legumes in the winter hampers seedling diseases that often attack fall plantings. When planting tall fescue or orchardgrass in existing sod, it is best to plant in the fall.

Germination rate

Germination generally declines with the age of the seeds, but if seeds are stored in a dry cool place, germination should not decrease more than 10% the first year. In general, seeds that have low germination levels also produce seedlings with poor vigor. Legume seeds are often hardseeded and should be scarified to improve first-year germination.
Legume seed inoculation with rhizobia

Legumes should be inoculated with specific rhizobia (one that gets along with that particular species) prior to seeding. Rhizobia will establish nodules in the legume plant roots and fix nitrogen for the plant in exchange for nutrients. Without proper inoculation (remember to keep inoculant cool and away from the sun), legume seedlings will be weak and mature plants will be low in crude protein concentration.

Seeding rates

Seeding rates vary because of seed size, purity, percent germination and seedling vigor. Under adverse conditions, only 10% to 50% of the seeds planted will establish and develop successfully. Therefore, many seeds are needed to obtain a satisfactory stand.

Drill versus broadcast plantings

Planting rates for drilling are 20 to 50% lower than for broadcasting. Because drilling concentrates the seeds within a furrow, they occupy a smaller area of the ground and are better able to break through the soil crust. Seed placement, soil contact, and uniformity of stands are usually better with drilling than with broadcasting, especially when planting conditions are not optimum.

Planting depth

Seeds can be planted slightly deeper in sandy soils than in clay soils. Large-seeded grasses can usually be planted deeper than small-seeded legumes in similar soils. The smaller the seed, the shallower the seeding depth. On cultivated seedbeds, it is important to prepare a firm seedbed to conserve moisture and avoid variation in planting depth. Rolling to compact seedbeds after seeding will improve seed/soil contact and increase seedling survival. If the residue from the previous crop makes a mat on the ground, drag an implement such as a harrow or disk to cut and/or break the residue before sod-seeding. Then, make a furrow about ¾ inch deep, and most seeds will be covered with ½ to ¼ inch soil.

What is a good stand?

In general, a good stand provides 90 to 100% ground cover and will produce high yields when managed properly. The clover part of mixtures should make up to 30% of the stand on a weight basis for it to significantly contribute to the mixtures and forgo nitrogen fertilization.

Establishing mixed-plant communities as pastures

If given a choice, the daily ration of a goat is made up of 20% grasses, 20% "weeds" (many are forbs of very high quality) and 60% browse. Thus, plant diversity needs to be optimized to provide goats the forage quality and quantity necessary to meet their nutritional requirements. One approach is to plant a community of high quality perennial forages (a mix of grass, legume and forb such as orchardgrass or tall fescue with plantain, chicory, perennial sericea lespezea
and birdsfoot trefoil). Plant species selection is important as different nutrients (amino acids, fiber and sugars, minerals and vitamins) can be optimized when goats have access to a wider array of plants, and thus will be better able to mount an effective immune response when necessary. In addition, chemicals in certain plants such as condensed tannins have an effect on internal parasites. Goats should also have access to brush and shrubs during the hot and humid periods of the summer. Keep goats on browse as long as possible as the higher the goat grazes/browses, the lower the level of internal parasites will be. In addition, a browse or woodlot area will provide much needed shade during the summer months.

Renovation of pastures

Given that goats are the most versatile of livestock in terms of the variety of plants it consumes, many of them considered weeds although of extremely high quality, assessing the plant community and its productivity is a "must" before considering and investing the total renovation of a pasture. A pasture considered not sufficiently productive for beef cattle of horses because of "weeds" and brush invasion could be highly productive for goats. Therefore, total pasture renovation should be considered a last resort alternative. Drilling other forage species such as white clover, chicory, plantain or spreading crabgrass or prairie grass seeds on a very short stubble and incorporating them into the soil with a light implement should be sufficient in most cases to thicken a thin stand. In addition, soils samples should be taken to determine chemical composition and possible remediation. Under certain circumstances, adding lime to correct the pH is sufficient to alter the pasture plant community. In other cases, strategic nitrogen fertilization, grazing and or bush-hogging to allow other plants to grow will alter the plant community satisfactorily.

Year-round grazing systems

Producers need to be aware that there is no one grazing plan that fits all situations and many factors need to be considered. Soil types, topography, climatic conditions, type of livestock operation, labor resources, capital, available machinery, specific objectives, etc. will define the grazing system to be implemented. Other factors such as control of gastrointestinal parasites of goats will also influence the choice of some forages to incorporate into the grazing system. The seasonal distribution of cool-season and warm-season perennial and annual grasses, cool-season perennial legumes and perennial browse is shown in Figure 1. It can be easily seen that under southeastern conditions, cool-season and warm-season pastures complement each other. As a rule of thumb, only 25% of pasture land should be dedicated to warm-season forages in any grazing system. Grazing systems can include only perennial forages, only annual forages, or a mixture of perennial and annual forages. In general, white clover is the predominant legume found in present grazing systems, but sericea lespedeza, because of its beneficial effect in controlling intestinal parasites of goats, is starting to play an important role in certain areas. Nevertheless, sericea lespedeza is listed as an obnoxious, invading plant in some states.

The seasonal patterns of growth of a fescue (cool-season perennial) and hybrid bermudagrass (warm-season perennial) grazing system is depicted in Figure 2. In Figure 3, the hybrid bermudagrass was overseeded in the fall with a winter annual small grain forage (cereal rye or annual ryegrass or wheat or oat). The winter annual forage will provide feed at both extremes of
the bermudagrass growth season with a small peak in November-December and another one in March-April when bermudagrass is mostly dormant. The winter annual forage, however, will reduce the productivity of bermudagrass during the summer, but not necessarily of the combination bermudagrass + winter annual small grain.

Browse should be used as a forage resource during the hot and humid summer months, preferably for goats having high nutritional requirements such as does in late gestation, does in early lactation with nursing kids and weanlings. One of the beneficial aspects of browse is that it provides shade when the heat index can be an environmental stressor. Leaving trees in both cultivated pasture and cleared rangeland is important for the same reason. In addition, browse foliage nutritive value can be very high and changes little throughout the growing season. Nevertheless, additional research work is needed to assess the chemical composition and nutritive value of many browse plants.
Go-back land

Go-back land is land that was once cultivated or/and grazed and that is allowed to go back to whatever will volunteer on it. There is usually a progression of species, depending on previous use. The progression varies with location and usually vines and woody and weedy species readily proliferate and some grasses come in. Often woody species will end up predominating, because of loss of much of the topsoil due to erosion which gives a competitive advantage to the
deeper rooted woody species and also due to shading of the herbaceous plants by the taller woody species.

Because of their browsing behavior, goats are useful biological agents for the control of undesirable plants. Due to increased environmental concerns, restrictions for herbicide use and elevated costs of both mechanical and chemical weed control make brush control difficult. Using goats for brush control on go-back land to bring them back into production enables landowners to utilize the palatable brush as a feedstuff to produce a saleable commodity while suppressing invasive weeds. In time, goats will shift the botanical composition toward herbaceous grass species, resulting in greater forage production for cattle. Go-back land should be stocked as soon as plants leaf out such that they will be defoliated repeatedly throughout the growing season, without allowing them to store energy reserves in their roots. Plants without energy root reserves will eventually weaken and die.

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Unless otherwise noted, photos and line drawings are from the:

USDA, NRCS. The PLANTS Database. National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

A Listing of Some Plants Known to Cause Problems When Eaten by Livestock:


Poisonous Plants of North Carolina

Poisonous Plants of the Southern United States

Plants Poisonous to Livestock in the Western States, USDA Information Bulletin No. 415.