Texas Agricultural Extension Service
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Forage Establishment, Management, and Utilization Fundamentals

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Sound forage establishment and management practices are critical to reducing input costs associated with hay and/or livestock production. In many instances, the existing forage base is adequate for a given enterprise and fine-tuning of the management is all that is required. In some cases, however, a different forage species may be desired to augment existing plant resources.

Each year, people who do not come from a farm or ranch background become involved in forage management. This can also include livestock producers whose main focus in the past has been breed type, reproduction, etc. These people may have little or no understanding of what is required to establish or maintain forages. In many instances, these same people do not know where to turn for information. Even those with extensive farming or ranching experience, however, may encounter situations regarding forages that they are unfamiliar with.

It is critical for managers to understand there are **basic fundamental differences** in managing introduced and rangeland forages. In the eastern part of the state, introduced species dominate forage-based livestock production systems. As you move west of the IH35 corridor from Denton to San Antonio and then west of IH37 from San Antonio to Corpus Christi, however, you will notice few introduced species are used. The main reason is primarily due to the lack of moisture, although temperature has contributing effect. Native plant communities, known as rangelands, have developed and dominate these more arid regions. While the management of introduced forages demands appropriate grazing management, fertilizer inputs, and the more frequent use of herbicides, good grazing management and prescribed fire alone generally represent the management strategies for rangelands. The information contained in this publication is designed to improve the potential for success of forage production and management in Texas for both introduced species and rangelands. Where management strategies are different, they will be noted in the text.

Establishment

Adaptation

Not all forage species will grow well on every type of soil or in all parts of the state. The person in charge of establishment should determine whether or not the forage species under consideration is adapted to the site. Of primary importance is the location in the state. Some forage species may have higher moisture requirements or may have less cold tolerance than others. In Texas, there is a moisture gradient in the state; that is, there is less precipitation received as you travel from east to west. In fact, areas of southeast Texas may receive 60” or more of precipitation on an annual basis, central Texas may receive 30 to 35”, and the panhandle and trans-Pecos regions only 10-18”. To understand how moisture can effect your choice of forage species, let’s use white clover as an example. White clover has less drought tolerance than bermudagrass or Old World bluestem. If the ranch location was in west central or west Texas, white clover could be a poor species choice doomed to failure. Even if used in the appropriate part of the state, however, site selection plays a critical role in forage species success. White clover may not persist if planted on a droughty, upland sandy site simply because there may not be enough available moisture, even in east Texas to support growth. Thus, while planted in the right part of the state, a poor choice of soil type or location on the ranch could cause the failure of certain forages.

Unfortunately, much of the information regarding the suitability of forages for one soil type or another comes from anecdotal stories. Many times these accounts are informative, but producers should enlist the aid of agricultural professionals to ensure a good match between forage species and site. Local county agricultural extension agents and the Natural Resources Conservation Service (NRCS) can provide informed insights into which forages are best adapted to local conditions.

A few helpful tips should be mentioned at this juncture. **First, producers can learn a great deal about the productive capability of their property by obtaining and studying the Standard Soil Survey for their county, if one is available.** These surveys are available free of charge from local NRCS offices. Using aerial photos in the back of the survey, a producer can locate their property and determine what soil types comprise their ranch. Detailed information regarding each of the soil types is contained in the surveys and will give a good indication of the soil texture, water holding capacity, depth of soil, inherent fertility, etc. The Standard Soil Survey can provide important first information regarding the types of species that may or may not be successfully grown on the site.

Identify those areas that may prove to be potential problem sites. Certain areas that are prone to flooding, for example, may not be good areas for a hay meadow or for a winter pasture. Wet areas could prevent hay harvest at the appropriate time and weed pressure may be greater due to a continued influx of weed seed from areas upstream. Likewise, waterlogged areas are not good areas for cattle to spend the winter, either. On the other hand, areas that are particularly droughty may not prove to be a good location for a hay meadow or winter pasture.

If planting in a low site that is prone to periodic flooding, or has poor drainage, choose a species that is tolerant of saturated soils. Species such as white, berseem, or persian clover are legumes species that do well under wetter conditions as may 'Jiggs' bermudagrass. In northeast Texas, tall fescue tolerates periodic flooding better than many species. Be alert to the site on which you intend to establish forages and plant accordingly.

For more information regarding forage species adapted to your area contact your local county agricultural extension agent or Natural Resource Conservation Service office for additional information.

Species

A plan to use a mixture of both warm-season and cool-season grasses is usually required to optimize nutrient availability with livestock nutrient demand and to minimize winter feeding costs. Most livestock producers in Texas depend too heavily on hay for winter feeding programs. This is generally the most expensive method to winter livestock because of the costs involved in harvesting, baling, storing, and hauling hay (somewhere between $30-$35 per 1000-lb round bale of bermudagrass). Livestock are much more efficient at harvesting forage. Therefore, the goal of the livestock producer should be to have animals grazing forage of acceptable nutritive value as many months of the year as possible. Hay should only be used in tactical situations such as drought, snow or ice cover days, etc. As soon as the situation creating the need for hay is over, hay feeding should end and animals should return to grazing.

In Texas, producers have the luxury of using warm-season grass species such as bermudagrass, bahiagrass, dallisgrass, johnsongrass, Old World bluestem, weeping lovegrass, and native plant communities (rangeland). These same producers can also utilize small grains and annual ryegrass to provide grazing livestock good nutrition for much of the winter. Increased attention is also being placed on certain cool-season perennial grasses in various parts of the state.

Texas producers also enjoy the opportunity to use various forage legumes such as alfalfa, clover, annual lespedeza, various field peas, and hairy vetch. Legumes grow in a symbiotic relationship with host-specific bacteria that have the unique ability to capture atmospheric nitrogen and convert it into a plant available form. Thus, legumes do not require nitrogen fertilizer and can share some of the fixed nitrogen with other non-nitrogen-fixing species such as grasses. This can reduce the level of nitrogen fertilizer required in the pasture., Forage legumes are usually of good to excellent nutritive value and can improve the seasonal distribution and nutritive value of grass forage systems. If you are not presently using forage legumes in your pasture program, you may wish to consider the addition of these plants into certain fields.

Timing

Although warm-season forages are generally planted in the late winter to early spring and cool-season forages in late summer to early fall, the window of opportunity for planting can actually be extremely short. Therefore, the need for good preparation beforehand is critical. Seedbed preparation usually requires the most time and generally depends on a certain level of moisture to adequately work the soil. Sometimes, the seedbed is ready to be worked, but a breakdown of the tractor or tillage equipment delays the process. Some producers have gotten to the point of planting seed, but found out, much to their dismay, that the seed the wanted was not available or cost more than they were willing to spend.

Therefore, producers anticipating forage establishment should plan well in advance. The secret is to be aware of potential problems that might prevent planting at the right time and deal with those issues beforehand. The following checklist will help to ensure that all is ready when the opportunity to plant presents itself.

- ❑ Decide on forage species based on system requirements.
- ❑ Inquire as to availability of seed and seed cost. If a legume is to be established, make sure inoculant is available.
- ❑ Locate equipment that will be required for establishment.
- ❑ Select site for forage establishment based on forage species needs.
- ❑ Obtain soil sample from site.
- ❑ Begin to prepare seedbed in anticipation of planting. Remember that it may take several trips across the field to prepare the final seedbed. Allow adequate time to account for possible delays due to weather, equipment failure, etc.
- ❑ Incorporate P, K, and lime as required (based on soil test recommendations) into seedbed while working the ground. Apply anhydrous ammonia if desired just prior to planting grass species.
- ❑ Plant good quality seed at the proper rate to the proper depth. If planting a legume, make sure seed is properly inoculated with the appropriate *Rhizobium* bacteria. Plant into a moist seedbed if possible.
- ❑ Topdress with nitrogen following germination of grass seedlings if anhydrous ammonia was not used.
- ❑ Be alert for pests such as insects or weeds that may require pesticide application.

Fertility

Several specific nutrients are required for adequate growth of forage plants. The availability of these nutrients, or soil fertility status, vary from site to site because of differences in precipitation, inherent differences in parent materials of the various soils, and past cropping history. A ***soil test*** is the only reliable way to know what fertilizer is required for your field. Think of the soil test as the dipstick for your soil. You would not normally add oil to a crankcase without checking the dipstick to determine a) if you need oil and b) how much to add. The soil test help minimize applying fertilizer not needed, and helps you apply the nutrients you do need in the appropriate amounts. Balanced fertilizers such as 12-12-12 generally do not address the fertility requirements of any Texas soil or crop need. If a soil test is not used to determine fertility requirements, either too much or not enough fertilizer will be applied to the pasture. Either way, the producer is not optimizing production from his forage system.

Nitrogen fertilizer provides growth and additional crude protein and is the most limiting factor to growth with the exception of moisture. Nitrogen should be applied based on the yield goal of forage grasses. In other words, only apply the level of nitrogen that will produce the quantity of grass that you need for your production system. A simple analogy would be putting only enough gasoline in the tank to get to a certain destination and back. You don't need much more than that, and for sure don't want to have less than what is required. Balancing forage needs with forage requirements is known as forage budgeting. This is similar to balancing a checkbook. All that is needed is to know the number of animals in the herd, their body weight, how long they will be in the system, and an idea of how much forage is produced in the pastures on an annual basis. Reconciling the forage supply with the demand helps determine whether additional nitrogen fertilizer is required.

Phosphorus and potassium are additional nutrients required by plants in relatively large quantities. Legumes are especially sensitive to deficiencies in these nutrients, particularly phosphorus. If phosphorus and/or potassium are deficient, the expected response of grasses to nitrogen fertilizer will not be realized and legume growth will be reduced. Back to the automobile analogy, you can fill the fuel tank, but if there are only three wheels on the vehicle, you won't go very far. Therefore, it is important to maintain P and K at sufficient levels. Again, a soil test is the only way to know what the soil nutrient status for these important elements is.

Finally, many of our east Texas soils require lime to bring the soil pH to approximately 6.0. This soil pH is required for the best growth of forage grasses, and 6.5 to 7.0 is optimum for legume production. Lime should be evaluated based on its Effective Calcium Carbonate Equivalent or ECCE value. The higher the number, the better the lime and the more quickly the lime will have a neutralizing effect on the soil acidity. Many times a less expensive lime material is attractive when compared to a better, but more expensive lime source. Consider the following calculations for a 1-ton ECCE lime application recommendation:

Lime #1 ECCE value of 65 @ $25/ton applied
1 ton required/.65 (ECCE value) = 1.54 tons x $25/ton = **$38.50/acre**
Lime #2 ECCE value of 98 @ $32/ton applied

1 ton required/.98 (ECCE value) = 1.02 tons x $32/ton = **$32.64/ac**

Not only is the lime material with the higher ECCE number a better value but will react with the soil quicker. Be sure and shop for the best lime value.

Seedbed Preparation

There is no substitute for good seed-soil contact and this usually means preparing a proper seedbed. Specialized equipment may be required to prepare fine seedbeds for forage species such as alfalfa, while annual ryegrass can be established with little or no seedbed preparation. Most species fall in between these two extremes and, in may cases, common equipment found on many farms will usually suffice.

Seed

Seed cost is a small portion of the overall establishment cost of a pasture. Therefore, do not attempt to save money by purchasing "cheap" seed of unknown quality. Purchase the highest quality seed with as little weed contamination as possible. Also bear in mind that legume seed may need to be inoculated if not pre-inoculated. Check with your seed dealer regarding the appropriate inoculant for the legume you are establishing.

Equipment

A drill is an excellent method of establishing grass pastures; however, seed can also be broadcast using a fertilizer spreader. Don't feel that you have to purchase equipment. There is usually equipment that can be rented or borrowed that will allow you to get your forage established. Plan ahead, however, to make sure that the equipment will be available and in good working condition when you need it.

Pest Management

After establishment, weed or insect damage can be so severe as to eliminate the stand. Be alert and apply pesticides as needed according to label directions.

Early Grazing Management

Allow forage to attain 6" to 8" in height before grazing. A simple test to determine if the forage is well established is to attempt to pull up several plants by hand. If you are unable to uproot the plant, livestock will probably be unable to uproot the plant. Realize that with small seeded grasses and legumes, you will may not have any fall grazing the first year of establishment.

Management

Grazing Management

Grazing management involves controlling ***where*** livestock graze, ***when*** they graze, and ***how much*** they graze. Close attention to grazing management (primarily stocking rate) is critical if the producer wishes to maximize profit or minimize losses. Many times, livestock production systems are overstocked. Too many animals reduce animal performance, encourage weed infestation, and result in more off-farm purchases such as herbicide and supplemental feed. Although most livestock operations with <50 head operate at a net loss, the financial drain is increased when an inappropriate stocking rate is used.

The objective of proper grazing management is to match forage nutritive value and availability with the nutrient requirements of grazing livestock for the optimum production of red meat, milk, and fiber. Many times the only management change required is to develop a controlled breeding season that matches seasonal forage availability with the nutrient requirements of gestating or lactating females and that of growing animals. If producers are not currently utilizing a controlled breeding season, this may be a logical place to initiate an improved grazing management strategy.

No single grazing system will meet the requirements of all producers; that is, there is no "one size fits all program" that will work for everyone. Certain tracts of land lend themselves to one type of grazing system better than others, and management philosophies and experience levels of producers will likewise dictate how livestock will be manipulated.

Generalized grazing systems that facilitate livestock movement, however, have been developed that provide improved control over forage removal. An important point to remember is that ***grazing systems generally have less impact on animal performance than do soil fertility or stocking rate***. There has not been a grazing system devised that will lessen the negative impacts of a poor soil fertility program or an overstocked pasture. Some form of rotational stocking system would probably benefit most commercial livestock producers, while producers of registered livestock may wish to use a moderately stocked, continuously stocked system. Consult with your local county extension agricultural agent or forage specialist for more details on grazing systems.

Stocking Rate

There are many important ingredients in a successful livestock production system. One of the most important tasks is to keep detailed records on both livestock stocking rate and performance and forage production. Forage production and stocking rate records are critical in making timely management decisions. No other single management practice affects profitability of livestock more than stocking rate. This publication discusses how to determine the proper stocking rate for your land.

Some Working Definitions

In order to discuss stocking rate and its effect on animal performance, it is necessary to establish some definitions. **Stocking rate** is defined as the number of animals on a given amount of land over a certain period of time. Stocking rate is generally expressed as animal units per unit of land area. **Carrying capacity** is the stocking rate that is sustainable over time per unit of land area. A critical factor to evaluate is how well the stocking rate agrees with the carrying capacity of the land. A term that is used to help understand and estimate forage requirements is the **animal unit** (AU) concept (Table 1).

Table 1. Carrying capacity in terms of the animal unit (AU) concept.

Concept	Abbreviation	Definition
Animal unit	AU	1000-lb cow with calf
Animal unit day	AUD	26 lbs. of dry forage
Animal unit month	AUM	780 lbs. of dry forage
Animal unit year	AUY	9360 lbs. of dry forage

Calculations

A livestock producer has 50 head of 1000-lb cows on 200 acres for 12 months. The stocking rate of this operation would be calculated as follows:

Example 1: Calculation of stocking rate:

Total Land Area ÷ [(#AUs) x (Grazing Season)]
200 acres ÷ [(50AUs) x (12 months)] = 0.33 acres per AU month (AUM) or 4 acres per AU year (AUY)

Because cattle and other grazing animals are not the same size, it is often necessary to convert to animal unit equivalents. The term **animal unit equivalent** (AUE) is useful for estimating the potential forage demand for different kinds of animals or for cattle that weigh more or less than 1000 lbs. Animal unit equivalent is based upon a percentage (plus or minus) of the standard AU and takes into account physiological differences.

Once again, assuming a forage dry matter demand of 26 lbs per day, the 1000-lb cow is used as the base animal unit to which other livestock are compared. The AUE for cattle of 900 lbs. or less, is calculated as:

AUE = (BODY WEIGHT + 100) ÷ 1000

or, for animals of 1100 lbs or more,

AUE = (BODY WEIGHT-100) ÷ 1000

Table 2 illustrates several different kinds and classes of animals, their various AUEs, and estimated daily forage demand.

Another calculation can be used to demonstrate the usefulness of the information contained in Table 2. Suppose a producer has 100 head of stocker calves that weigh approximately 500 lbs, the size of the pasture is 100 acres, and the grazing season is 6 months long. The stocking rate would be calculated as before with the exception that the total number of AUs must first be calculated using the AUE information from Table 2.

Calculating stocking rate is relatively simple once the concept and terminology are understood. The ability to calculate stocking rate and make timely management decisions is vital to maximizing net return from the livestock operation.

Example 2: Calculation of stocking rate using AUEs:

First, estimate the total number of AUs based on AUEs:
(# Head) x (AUE) = Total AUs
100 head x 0.6 = 60 AUs

Then, calculate the stocking rate as before.

Total Land Area ÷ [(# AUs) x (grazing season)] = Stocking Rate
100 ÷ (60 x 6) = 0.27 acres per AUM or 1.7 acres for the season.

Table 2. Animal unit equivalent (AUE) and estimated daily forage dry matter (DM) demand for various kinds and classes of animals.

Animal type	AUE	DM demand (lbs per day)
Cattle		
Calves		
300 lbs.	0.4	9
400 lbs.	0.5	12
500 lbs.	0.6	15
600 lbs.	0.7	18
Cows	1.0	26
Bulls	1.25	32
Horses	1.25	32
Sheep	0.2	5
Goats	0.17	4
White-tailed deer	0.17	4

Introduced Versus Rangeland Forages

Although the concepts of stocking rate determination are similar for introduced and rangeland forages, there is one major difference in estimating stocking rate: **allowable use** (percent utilization of available forage) **is lower for rangeland forage.** This can not be emphasized enough; introduced forages can be utilized to a higher degree than rangeland forages. Introduced forages may typically have up to 75% available for use and rangeland forages 50% available for use. Working through some examples for both types of systems should help clear up any misunderstanding. Utilization does not equal consumption by the animal for any kind of forage. Utilization includes decomposition, waste, and consumption by insects and other herbivores.

Stocking Rates on Introduced Forages

Introduced forages are generally non-native species that have been selected for rapid growth and grazing tolerance. Introduced forage grasses common to Texas include bermudagrass, bahiagrass, dallisgrass, johnsongrass, weeping lovegrass, Old World bluestem, various cereal grains, and annual ryegrass. Most introduced forage grasses will tolerate a heavier degree of grazing pressure than rangeland forages because of their rapid regrowth capabilities. Although many introduced forages are tolerant of close grazing, not all of the forage produced can be removed; some residue must be left for the plant to carry out basic metabolic functions.

Table 3 contains suggested residue levels for some forages commonly used in Texas. This information will help prevent overgrazing of pastures. A suggested level of utilization is also contained in Table 3 for aid in estimating available forage for consumption by the grazing animal.

Table 3. Suggested residue height of selected introduced forages for optimum animal performance and stand persistence.

Species	Residue Height (inches)	Utilization (%)
Alfalfa	4 - 6"	50
Annual ryegrass	3 - 4 "	75
Arrowleaf clover	3 - 4"	50
Bermudagrass	1.5 - 3"	75[1]
Intermediate wheatgrass	4 - 6"	50
Oat	4 - 6"	75
Old World bluestem	3 - 4"	65
Pubescent wheatgrass	4 - 6"	50
Rye	4 - 6"	75
Tall wheatgrass	6 - 8"	50
Wheat	4 - 6"	75
White clover	2 - 3"	75

[1] Can be higher given adequate precipitation and N.

Using the information in Tables 2 and 3, producers can quickly estimate the animal forage demand, and thus, the stocking rate for their livestock production system. For fine tuning of stocking rates on specific ranches, however, forage production information from long-term record keeping will be necessary because long-term data takes into account fluctuations in precipitation. Moisture is generally the most limiting factor relative to forage production.

This concept is best illustrated using another example. Assume a livestock operation that has 100 acres of bermudagrass and long-term production records indicate the pasture is capable of producing 5000 lbs. of forage DM per acre over the growing season. In this particular example, a producer may wish to know how many head of 500-lb stocker calves they may expect to stock in the pasture. First, estimate the total amount of available forage DM based on historical records and the percent utilization factor from Table 3.

Example 3: Calculation of available forage for grazing:

(Average DM in lbs per acre) x (# Acres) x (% Utilization Factor)
5000 x 100 x 0.75 = 375000 lbs of Forage DM

Next, estimate the number of animal units that could be stocked on the pasture given the above forage production potential. In other words, calculate the stocking rate in AUs.

Example 4: Calculation of stocking rate (# head) based on available forage:

(Total Forage DM) ÷ [(# Grazing Days) x (Daily Forage Demand for 1 AU or AUE of the animal in question)] = # of Head
375000 ÷ [(120 days) x (15 lbs DM per day)] = Stocking Rate
375000 ÷ 1800 =208 Head

In this example, a bermudagrass pasture was assumed to be capable of producing 5000 lbs of forage DM per acre and it was estimated that a stocking rate of 208 head of 500-lb stocker calves could be used for a typical 120-day growing season. To express this production scenario as a stocking rate, you would return to the equation used in Example 2.

Example 5: Calculation of AUs from AUEs:

Head x AUE = Total AUs
208 Head x 0.6 =125 AUs

Now simply use the equation developed in Example 1 to calculate the stocking rate.

(Total Land Area) ÷ (# AUs)= Stocking Rate
100 ÷ 125 = 0.8 acres per AU

Stocking Rates on Rangeland

Rangeland is the most abundant type of land in Texas and contributes heavily to the beef cattle and recreational leasing industry. Rangeland is the primary sources of wildlife habitat throughout the state. Rangelands are those lands that are dominated by native grasses, forbs, shrubs, or scattered trees. In order for rangeland to be sustainable for beef cattle production, the number of animals and their forage demand must be balanced with forage production. Forage production varies from year to year because of changes in precipitation. Thus, stocking rate should be based on average long-term end-of-season standing crop values for an operation to remain productive and sustainable.

Ecological Sites and Soils

An ecological site, previously known as a rangeland site, is an area of land with a combination of soil, climatic, topographic, and natural vegetation features that set it apart significantly from adjacent areas. Ecological sites are expressed in terms of soil depth, topography, slope, plant production, and species composition. Vegetation on a particular site will vary in composition and production from one region of the state to another and from year-to-year because of changes in precipitation.

Forage Production and Standing Crop

Stocking rates are based on the amount of forage that is standing at the end of the growing season in an ungrazed condition. End-of-season standing crop is not total production because much of the production has been lost to decomposition and insects. Actual forage production is often twice as large as the end-of-season standing crop. Forage production information is useful but is very time consuming to obtain. That is why end-of-season standing crop is used for estimating stocking rate.

Standing crop should be measured by clipping within grazing exclosures in key areas. The exclosure should be moved each year during the winter. The more years of standing crop information that can be assembled, the better the stocking rate decisions will be. Otherwise, producers must rely on guesses or information from Standard Soil Surveys which tend to underestimate standing crop.

Stocking Rates and Harvest Efficiency

The recommended stocking rates for rangelands are based on moderate utilization (economic long-term optimum) of the annual forage standing crop and assume uniform grazing distribution. It is also assumed that 50% of the annual peak standing crop can be removed from the ecological site without negatively affecting the plant community relative to species abundance or for beef cattle production. This is the origin of the “take half and leave half” rule-of-thumb that is often used. This is also the source of difference in stocking rate management between rangeland and introduced forages.

Of the 50% of rangeland that is assumed to be removed, the assumption is also made that one-half (25% of the total) is actually consumed by livestock and the other one-half (25% of the total) is trampled, laid on, consumed by insects or other animals, or disappears because of decomposition. These assumptions lead to a harvest efficiency of 25%. Another way to look at this is to assume that 25% of the total forage is actually consumed by the grazing animal. Plant requirements regarding remaining residue and waste by grazing animals set these limits. Harvest efficiency, however, can be increased by using rotational stocking (Table 4). This calculation should be adjusted for the presence of bulls, replacement heifers, or other grazing animals.

Assume 100 head of cows that average approximately 1000 lbs with calves on a 1000-acre rangeland pasture. The goal for this cow herd is continuous stocking for 12 months. The stocking rate would be calculated using information contained in Table 1:

Example 6. Calculation of stocking rate:

For a 1000- lb cow, AUE = 1.0 (Table 2)
(100 head) x (1.0 AUE) = 100 AUs
(Total Land Area) ÷ [(# AUs) x (grazing season)]
1000 acres ÷ [(100 AUs) x (12 months)] = 0.83 acres per AUM or 10 acres per AUY

Next, use forage standing crop to calculate how many stocker cattle this 1000 acres of rangeland can carry. From clipping data, it was determined over the past 10 years the average peak forage standing crop was 6360 lbs. per acre from the monitoring program.

Using these forage standing crop values, one can estimate how many cows could be stocked on this ranch. Using a 25% harvest efficiency for rangeland forages, the stocking rate is estimated as follows:

Example 7: Calculation of available forage for grazing:

(Average Standing Crop) x (% Utilization Factor) x (Total Acres) = Available Forage

(6360 lbs) x (25%) x (1000 acres) = 1590000 lbs Available Forage

Example 8: Calculation of AUs based on available forage:

Available Forage ÷ [(# Days in Grazing Season) x (Daily Forage Demand)] = # AUs

1590000 lbs ÷ [(365 days) x (26 lbs per day)] = 168 AUs (cows) for 1 year

1000 acres ÷ 168 AUs = 6 acres per AUY

A slight twist on the calculation would be to assume livestock smaller than the standard AU. Let us assume calves with an AUE of 0.6 (500-lb calves) that are to be grazed year-long.

1590000 lbs ÷ [(365 days) x (26 lbs per day)] = 168 AUs
168 AUs ÷ 0.6 AUE = 280 500-lb calves could be stocked on this same amount of forage.

Example 9: Calculation of AUs from AUEs:

(# Head) x (AUE) = Total AUs
170 head x 1.0 = 170 AUs
or for livestock smaller than 1AU
170 head X 0.6 = 102 AUs

Fertility

A sound fertility program for introduced forages can help with the following aspects of livestock production:

- Increase dry matter production
- Increase nutritive value of forage
- Increase forage stand life
- Decrease need for herbicide use
- Decrease off-farm supplemental feed purchase

Good fertility, coupled with good grazing management can provide the required nutrition for livestock at the least cost to the producer. Without adequate soil fertility, carrying capacity of the management units are reduced, the requirement for herbicides is increased, and there is a higher potential that supplemental feed for winter feeding programs will have to be purchased. All of these aspects reduce the potential for profit of the enterprise.

Harvest Management

Harvest management refers to harvesting forage at the appropriate stage of maturity. As forage plants mature, forage nutritive value declines. Therefore, to capture an optimum level of nutrients requires careful attention to the stage of maturity of the various forage species. Bermudagrass, for example, should be harvested for hay at approximately 15” tall. This height provides a good compromise between dry matter production and the level of nutrients contained in the plant at that stage of growth. Cool-season grasses, on the other hand, should be harvested generally in the early boot stage. Many hay crops are harvested to maximize production; however, nutritive value of these crops are generally low and generally will require some form of supplement to meet animal requirements during the winter. It is usually less expensive to fertilize appropriately and harvest at the correct stage of maturity.

Table 4 Example of impact of harvest efficiency on stocking rate.

	Continuous	Rotation
Rangeland forage standing crop	6360 lbs per acre	6360 lbs per acre
Available for harvest	50%	50%
Amount available for harvest	3,180 lbs per acre	3,180 lbs per acre
Harvest efficiency (% of 6360 lbs DM)	25%	35%
Forage supply for animal	1590 lbs per acre	2226 lbs per acre
Stocking rate	2.04 AUM per acre	2.85 AUM per acre
Stocking rate	5.88 acres per AUM	4.21 acres per AUM
Cows per 1000 acres per year	170 cows	238 cows

Harvest management is also an important aspect of grazing management. Some sort of rotational stocking is usually beneficial in improving animal use of the forage and helping keep the forage in a short, relatively immature stage of growth to enhance forage nutritive value.

Weed Management

Weed infestation generally occurs due to poor management. Introduced forage pastures, such as bermudagrass, have been selected for their ability to respond to fertilizer with significant increases in dry matter production. With proper fertility inputs, healthy forage stands usually can out-compete weed species. Under low fertility conditions, however, weed species generally have the competitive advantage.

Poor grazing management, usually overstocking, also contributes to weed infestation. ***Overstocking*** occurs when desirable forages are continuously and heavily grazed without the opportunity to recover. Overstocking can lead to an increased number of weed species in the pasture. A shift in plant species composition from desirable to less desirable species generally occurs, and this is referred to as an ***overgrazed*** condition. Since weed species are generally not as palatable to grazing animals, these species are ignored at the expense of more desirable species.

Usually the first indication of the need for a weed management strategy is the presence of weed flowers in the pasture. Unfortunately, by the time weeds become reproductive and flowers begin to appear, it is usually too late to apply herbicide. The weed has effectively removed most of the moisture and nutrients required for that particular growing season. Some management options such as shredding may be used to prevent ripening of seed; however, there is probably a large seed bank in the soil to begin with. A better strategy is to be proactive and scout pastures early in the growing season(s) to determine the level of infestation and whether or not management will be required.

Prevention: The best weed management program is actually one of prevention. As discussed previously, proper stocking rate and good fertility encourage vigorous stands of desirable forages that are able to compete with weed species in the pasture. The old adage "an ounce of prevention is worth a pound of cure" applies to weed management and is usually a more cost-effective management strategy. Even under the best of management schemes, however, some weed management will be necessary for most hay and/or livestock operations. The following is a discussion of weed management options.

Biological: Biological management does not necessarily mean using technologically advanced bacterial agents, although this strategy has been shown to be successful with certain weed species. More likely, biological weed management in Texas pastures would involve the use of grazing livestock to place pressure on weed species at key times during the season.

Rotational stocking or the use of electric fencing may be necessary to *encourage* livestock to graze certain plants that would not normally be consumed. This grazing management practice can be quite effective on annual weed species in the early part of their growing season when root reserves are low. Continued defoliation can drain the plant of its energy store before an adequate root system is developed and destroy the plant. Obviously, this program should not be used if toxic plants are the target species. Proper plant identification is critical for effective management of weed species, regardless of the management option used.

Prescribed fire: Prescribed fire is generally used to suppress woody species, and in many instances follows an appropriate herbicide treatment. The use of prescribed fire can extend the effective treatment life of the herbicide application. Continued use of prescribed fire, especially warm-season fire, can open up wooded areas into savannas that provide better livestock and/or wildlife habitat. Many producers also find the savanna ecosystem more esthetically pleasing to the eye. Although prescribed fire is not used much in east Texas, its value as a weed management tool should not be overlooked.

Chemical: Chemical management of weed species can be both safe and cost-effective if used appropriately. There are two important steps in using herbicides. As mentioned previously, the first step is to correctly identify the problem plant. This is important because some herbicides are more effective on certain weed species than others. Correct identification of the target plant helps ensure the selection of the most effective herbicide.

The second step in appropriate herbicide use is to follow the label directions. Strict adherence to label directions is required by law. Paying closing attention to label directions will also ensure safe, effective, and economical herbicide use. Chemical companies spend literally millions of dollars to develop their product labels. Herbicide labels contain directions for proper rate and timing of application, a list of susceptible species, and information regarding cleanup and disposal following use. Even if you have used certain herbicides for many years, the product label should be checked each year to determine if any changes have been made regarding the application of the product.

Mechanical: Last on the list is mechanical management. Mechanical methods can be effective in regions of the state where mesquite, huisache, blackbrush, and other woody species are problems (i.e., south Texas, north Texas). In regions of the state where introduced pastures are found, however, mechanical methods are generally less effective and more costly than options previously listed (Table 5). Mechanical treatments, primarily mowing or shredding can actually make the management of some species like persimmon more difficult.

Table 5. Economic comparison: mechanical and chemical weed control[1]

Item	**40-hp tractor w/6' rotary mower**	**40-hp tractor w/30' boom sprayer**
Labor cost/hour	$7.25	$7.25
Acres/hour	2.73	14.18
Costs		
Fixed cost/acre	$4.01	$0.79
Operating cost/acre	$1.77	$0.30
Labor cost/acre	$2.66	$0.86
Herbicide cost/acre	-0-	$5.75
Total Cost/acre	**$8.44**	**$7.70**

[1] Clary and Reeves, Tex. Agr. Ext. Ser.

The information contained in Table 1 may appear to indicate only a marginal advantage to the herbicide treatment. Usually, however, more than one mechanical treatment per season is required.

When even *two* trips across the field with a mower are considered, the economical advantage of using herbicides becomes quickly apparent.

Summary

The goal of forage production is to produce forage with the level of nutrients required for the kind and class of livestock in the herd at the least cost. Although not a complicated issue, it is the critical component of livestock production that is the least understood. For more detailed information regarding forage establishment, contact your local county agricultural extension agent or Natural Resources Conservation Service (NRCS) office. These offices have technical information that can provide detailed information regarding establishment and management of many forage crops.

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