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Forages

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. Sometimes, the existing forage base is adequate for a given enterprise and fine-tuning of the program is all that is required. In some cases, however, a different forage may be needed to augment existing resources.

Each year, people who do not have crop and/or forage experience get involved in forage management. This can also include livestock producers whose main focus in the past has been breed type, reproduction, etc. Even those with extensive ranching experience, however, may encounter situations regarding forages that they are unfamiliar with.

It is critical for managers to understand the **basic fundamental differences** of managing introduced and rangeland forages. In the eastern part of Texas, 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, with the exception of some irrigated acreage. This is primarily due to the lack of moisture, although temperature has a 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 more frequent use of herbicides, good grazing management and prescribed fire alone generally represent the management strategies for rangelands. The information in this publication should aid in improving the potential for success of forage production and management of introduced species and rangelands. Where management strategies are different, they will be noted in the text.

Adaptation

Not all forage species will grow well on all soils 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 moisture availability and moisture holding capacity of the soil. Some forage species have higher moisture requirements or less cold tolerance than others. In Texas, there is a moisture gradient in the state (Fig. 1) as you travel from east to west. Southeast Texas may receive 55" or more of precipitation on an annual basis, central Texas 24" to 36", and the panhandle and trans-Pecos regions only 8" to 15".

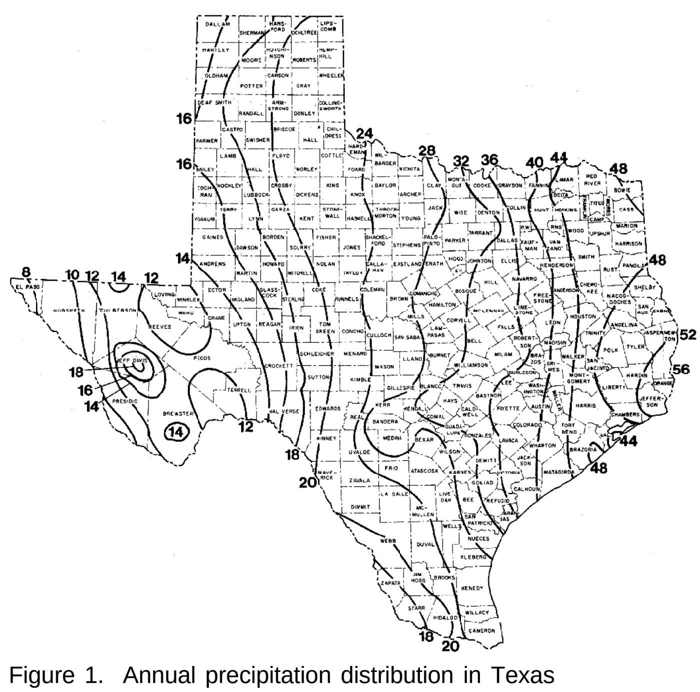

Figure 1. Annual precipitation distribution in Texas

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 can provide informed insights about 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, if available for the county of interest, are available free of charge from local Natural Resource Conservation Service (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. Conversely, areas that are particularly droughty may not prove to be a good location for a hay meadow.

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 that do well under poorly drained conditions. 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.

Species

A plan to use a mixture of both warm-season and cool-season grasses is usually required to match 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 1,000-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, livestock producers depend heavily on warm-season grasses such as bermudagrass, bahiagrass, and dallisgrass. In north and northwest Texas Old World bluestem, weeping lovegrass, and native plant communities (rangeland) are the predominant perennial forages. Most 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 can also use various forage legumes where adequate moisture is available. Legumes such as clover, annual lespedeza, field peas, and hairy vetch grow in a symbiotic relationship with host-specific bacteria that have the unique ability to capture atmospheric N and convert it into a plant available form. Thus, legumes do not require N fertilizer and can provide N to non-nitrogen-fixing grasses via nutrient recycling and this can reduce the level of N 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 pasture systems.

Timing

Although warm-season forages are generally planted in early spring and cool-season forages in early fall, the window of opportunity for planting can actually be extremely short. Therefore, 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 could not find the seed they wanted. 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.
- ❐ Check on seed availability. If a legume is to be established, make sure inoculant is available.
- ❐ Locate equipment required for establishment.
- ❐ Select site based on forage species needs.
- ❐ Obtain soil sample from site.
- ❐ Begin to prepare seedbed in anticipation of planting. 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 lime well in advance of planting. Incorporate P and K as required based on soil test recommendations.
- ❐ 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. If

establishing bermudagrass from sprigs or tops, purchase sprigs of a known variety and plant the same day the sprigs are dug Always plant into a moist seedbed if possible.

- ❒ Topdress with N following germination of grass seedlings but prior to seedlings attaining 4” in height.
- ❒ Be alert for pests such as insects or weeds that may treatment with a pesticide application.

Fertility

Several specific nutrients are required for adequate growth of forages. The availability of these nutrients, or soil fertility status, varies 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 helps minimize applying fertilizer not needed, and helps you apply the nutrients you do need in the appropriate amounts. Fertilizers such as 12-12-12 generally do not match the complete fertility requirements of most Texas soils or crop needs. 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 the potential production from his forage system.

Nitrogen fertilizer provides growth and additional crude protein and is the most limiting factor to growth after moisture. Nitrogen should be applied based on the yield goal of forage grasses. In other words, only apply the level of N that will produce the quantity of grass that you need for your production system.

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 N fertilizer will not be realized and legume growth will be reduced. A soil test is the only way to know what the soil nutrient status for these important elements is.

Finally, many East Texas soils require limestone to raise the soil pH to 5.5 to 6.5. This soil pH ensures optimum growth of forage grasses, while 6.0 to 7.0 is required for legume production. Limestone should be evaluated based on its Effective Calcium Carbonate Equivalence or ECCE value. A higher ECCE number indicates a better quality limestone that will have a quicker neutralizing effect and may prove to be a better value compared with lower quality limestone. Consider the following calculations for a 1-ton ECCE limestone 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

Although the lower quality limestone appears to be a better buy, it requires a higher application rate negating what appeared to be a lower cost. One should always shop for the best value in limestone.

Seedbed Preparation

There is no substitute for good seed-soil or seed-sprig contact and this usually means preparing a proper seedbed. Proper seedbed preparation also eliminates unwanted competing species. 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. In most cases, seedbed preparation involves disking the soil to a depth of 4” to 6". Limestone, if required, should be incorporated into the seedbed well in advance of planting. Phosphorus and potassium can be incorporated into the seedbed just prior to planting as the soil is disked one last time. Under most circumstances, common equipment found on many farms will usually suffice to prepare an adequate seedbed.

Seed or Sprigs

Seed or sprig cost is a small portion of the overall establishment cost of a pasture. Therefore, do not attempt to save money by purchasing “cheap” seed or sprigs 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 local seed dealers regarding the appropriate inoculant for the legume being established. With regard to bermudagrass sprigs or tops, make sure the appropriate variety is purchased and that sprigs/tops are fresh. Sprigs or tops should be kept moist until planted, but should be planted the same day they are purchased to ensure maximum viability and potential for establishment success.

Equipment

A drill is an excellent method of establishing seeded varieties; 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 for forage establishment. 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 you may not have any fall grazing the year of establishment.

Management

Grazing Management

Grazing management involves controlling ***where***, ***when***, and ***how much*** livestock graze. Close attention to grazing management (primarily stocking rate) is critical if the goal is to maximize profit or minimize loss. Many times, livestock production systems are overstocked. Overstocking is characterized by low quantities of desirable forage and increasing levels of undesirable plants. Too many animals for a given forage resource reduces animal performance, encourages weed infestation, and results in more off-farm purchases such as herbicide and supplemental feed.

The objective of grazing management is to efficiently use the forage base while maintaining adequate livestock performance. No single grazing system will meet the requirements of all producers. 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 use efficiency. An important point to remember is that ***grazing systems generally have less impact on animal performance than do stocking rate or soil fertility***. There has not been a grazing system devised that will lessen the negative impacts of an overstocked pasture or a poor soil fertility program. 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 agricultural Extension agent or forage specialist for more details on grazing systems.

Stocking Rate

There are many important aspects to successful livestock production. 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 for making timely management decisions. No single management practice affects profitability of livestock more than stocking rate.

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. Carry capacity in terms of the animal unit (AU) concept.

Concept	Abbreviation	Definition
Animal Unit	AU	1,000 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	9,360 lbs. of dry forage

Calculations

A livestock producer has 50 head of 1,000-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 1,000 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 1,000-lb. cow is used as the base animal unit to which other livestock are compared. The AUE for cattle that do not weigh 1,000 lbs. is calculated as:

AUE = (BODY WEIGHT) ÷ 1,000

Table 2 illustrates 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 simple once the concept and terminology are understood. The ability to calculate stocking rate and make timely management decisions is vital to optimizing 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 0.5 = 50 AUs

Then, calculate the stocking rate as before.

Total Land Area ÷ [(# AUs) x (grazing season)]
= Stocking Rate

100 ÷ (50 x 6) = 0.33 acre per AUM or
2.0 acres for the season.

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 due to their selection over time for grazing tolerance and response to fertilizer. Introduced forages may typically have up to 75% available for use and rangeland forages 50% available for use. 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 and Introduced Forages

Introduced forages are generally non-native species that have been selected for production potential and grazing tolerance. Introduced forage grasses common to Texas include both common and hybrid bermudagrass, bahiagrass, dallisgrass, 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 forages commonly used in Texas. Residue is the average height of the forage remaining in the pasture after a grazing event. This information can prevent overgrazing of pastures. A suggested level of utilization is also contained in Table 3 to estimate available forage for use by the grazing animal.

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 5,000 lbs. of forage DM per acre over the growing season. In this particular example, a producer may wish to know how many 500-lb. stocker calves they could 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.

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.	0.30	8
400 lbs.	0.40	10
500 lbs.	0.50	13
600 lbs.	0.60	16
Cows	1.00	26
Bulls	1.25	32
Horses	1.25	32
Sheep	0.20	5
Goats	0.17	4
White-tailed deer	0.17	4

Table 3. Suggested forage 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	2 - 3	75[1]
Intermediate wheatgrass	4 - 6	50
Oat [2]	4 - 6	75
Old World bluestem	3 - 4	65
Pubescent wheatgrass	4 - 6	50
Rye[2]	4 - 6	75
Tall wheatgrass	6 - 8	50
Wheat[2]	4 - 6	75
White clover	2 - 3	75

[1]Can be higher given adequate precipitation and N.
[2]During spring rapid growth phase, can be shorter if growing conditions and fertility are adequate.

Example 3: Calculation of available forage for grazing:

(Average DM in lbs. per acre) x (# Acres) x (% Utilization Factor)

5,000 x 100 x 0.75 = 375,000 lbs. of Forage DM

Next, estimate the number of animal units that could be stocked on the pasture given the above forage production. 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

375,000 ÷ [(120 days) x (13 lbs. DM per day)] =

Stocking Rate 375,000 ÷ 1,800 =240 Head

In this example, a bermudagrass pasture was assumed to produce 5,000 lbs. of forage DM per acre and it was estimated that a stocking rate of 240 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

240 Head x 0.5 =120 AUs

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

(Total Land Area) ÷ (# AUs)= Stocking Rate

100 ÷ 120 = 0.8 acre per AU

To make allowances for expected gain of growing animals, calculate the number of AUs based on the applicable AUE at the beginning of the grazing period. Estimate the level of gain expected for each animal and project an ending number of AUs based on the applicable AUE for the end of the grazing period. Use an average AU to determine the appropriate stocking rate.

Harvest Management

Harvest management refers to harvesting forage at the appropriate stage of maturity. As forage plants mature, forage nutritive value declines due to the increase in cell wall relative to cell contents. With warm-season grasses, increasing maturity leads to increased lignin levels, which are indigestible. 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 (prehead) 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.

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.

Stocking Rates and 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. The concept of ecological site makes rangeland management quite different from management of introduced forages.

Forage Production and Standing Crop

Rangeland stocking rates for the following year are many times 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 (desirable plant) areas. The exclosure is a small cage (4’ x4’ minimum size) that excludes animals from grazing the area of interest and allows forage to accumulate for later sampling. The exclosure should be moved to a different location each year during the winter. The more years of standing crop information that are available, the better 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 that do not normally represent the mother cow herd.

The stocking rate would be calculated using information contained in Table 1:

Example 6. Calculation of stocking rate:
For a 1,000- lb. cow, AUE = 1.0 (Table 2)
(100 head) x (1.0 AUE) = 100 AUs
(Total Land Area) ÷ [(# AUs) x (grazing season)]
1,000 acres ÷ [(100 AUs) x (12 months)] = 0.83 acre per AUM
or 10 acres per AUY

Next, use forage standing crop to calculate how many stocker cattle this 1,000 acres of rangeland can carry. From clipping data, it was determined over the past 10 years the average peak forage standing crop was 6,360 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
(6,360 lbs.) x (25%) x (1,000 acres) =
1,590,000 lbs. Available Forage

Example 8: Calculation of AUs based on available forage:
Available Forage ÷ [(# Days in Grazing Season) x
(Daily Forage Demand)] = # AUs
1,590,000 lbs. ÷ [(365 days) x (26 lbs. per day)] =
168 AUs (cows) for 1 year
1,000 acres ÷ 168 AUs = 6 acres per AUY

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

	Continuous	Rotation
Rangeland forage standing crop	6,360 lbs./ac.	6,360 lbs./ac.
Available for harvest	50%	50%
Amount available for harvest	3,180 lbs./ac.	3,180 lbs./ac.
Harvest efficiency (% of 6,360 lbs DM)	25%	25%
Forage supply for animal	1,590 lbs./ac.	2,226 lbs./ac.
Stocking rate	2.04 AUM/ac.	2.85 AUM/ac.
Stocking rate	5.88 ac./AUM	4.21 ac./AUM
Cows per 1,000 acres per year	170	238

A slight twist on the calculation would be to assume livestock smaller than the standard AU. Assume calves with an AUE of 0.5 (500-lb. calves) to be grazed year-long.

1,590,000 lbs. ÷ [(365 days) x (26 lbs. per day)] = 168 AUs
168 AUs ÷ 0.5 AUE = 336 500-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 if using livestock smaller than 1AU (Example: AUE = 0.5)
170 head of calves X 0.5 = 85 AUs

Weed Management

Weed infestation generally occurs due to poor management. Poor grazing management, usually overstocking 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. Lack of fertility also contributes to weed problems. 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.

Even under the best of management, however, some weed control may be necessary for hay and/or livestock operations. Most producers think only of herbicides for weed management. There are, however, several strategies that should be considered. The following is a brief discussion of suggested weed management strategies.

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 can more effectively compete with weeds.

Biological: Biological management does not necessarily mean using technologically advanced bacterial agents, although this strategy has been successful with certain weed species. More likely, biological weed management in Texas pastures means using livestock to put grazing pressure on weeds 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. Continued defoliation can drain the plant of its energy stores before an adequate root system is developed and destroy the plant. Obviously, grazing should not be used if target plants are toxic. Proper plant identification is critical for effective management of weed species, regardless of the management option used.

Another type of biological control involves the use of vigorous forage plants that can minimize germination of undesirable plants. One such example is the use of winter pasture, whether the choice is annual ryegrass or clover. Good stands of either can effectively suppress late winter, early spring weeds, thus minimizing the need for a herbicide application. It should be noted, however, that while winter pasture forages can reduce weed competition, if not removed in a timely manner, these same species can delay emergence of warm-season forage grasses. In some cases, the warm-season grass may even be destroyed.

Prescribed fire: Prescribed fire is generally used to suppress woody species. In many instances prescribed fire is used following a herbicide treatment to extend the effective treatment life of the herbicide. Continued use of prescribed fire, especially warm-season fire, can open up wooded areas into savannas that provide better livestock and/or wildlife habitat. Although prescribed fire is not used extensively 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. The first step in using herbicides is to correctly identify the problem plant. Correct identification of the target plant helps ensure the selection of the most cost effective herbicide.

The second step is to follow the label directions. Strict adherence to label directions is required by law. Following the label directions will also ensure a safe, effective, and economical herbicide use. 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 application of the product.

Mechanical: Mechanical methods can be effective in regions of the state where 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). Mowing or shredding can actually make the management of some species like persimmon more difficult by reducing the level of foliage available to move herbicide into the plant, which may have developed a tremendous root system.

The information contained in Table 5 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.

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

Item	40-HP Tractor with 6 foot rotary mower	40 HP-Tractor with 30 foot 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, Texas. Agr. Ext. Ser.

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, managment, and utilization, contact your local county agricultural extension agent. These offices have technical information that can provide detailed information regarding establishment and management of many forage crops.

For more information regarding forage management, please see our website at: http://soilcrop.tamu.edu.

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