FORAGE AND PASTURE MANAGEMENT

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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 and in an environmentally sustainable manner. Although not a complicated issue, it is the critical component of livestock production that is the least understood. An additional goal of forage production, whether with introduced or native species, is to maintain adequate ground cover and plant vigor, reduce the incidence of weed infestation, and maintain or improve environmental parameters such as water and air quality to reduce topsoil loss due to erosion. Adequate understanding of the soil-plant-animal interaction is necessary to achieve these production and environmental goals.

1. Introduction

Sound forage establishment and management practices are critical to realizing a profit in hay and/or forage-based livestock production. It is critical for managers to understand that there are fundamental differences in managing introduced and native forages. In regions where precipitation levels are higher, introduced species dominate forage-based livestock production systems. Below 750 mm of annual precipitation, however, fewer introduced species are used due to the lack of moisture. Native plant communities, known as rangelands, dominate the more arid regions. While the use of introduced forages requires appropriate grazing management, fertilizer inputs, and more frequent use of herbicides, good grazing management and prescribed fire to suppress woody species encroachment generally represent the management strategies used on rangelands.

The information contained in this publication is designed to improve the potential for success of forage production and management for both introduced species and rangelands. Although these systems typically comprise introduced species, pastures consisting of restored native species may provide complimentary attributes, extending the year-round production of high quality forages and enhancing the value of the forage

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system for wildlife habitat and livestock production. Where management strategies are different they will be noted in the text.

2. Species

2.1. Temperate Areas

Cool-season annual forage grasses play an important role in temperate regions and, in the central US for example, extend over more than 21 million. Much of the southern Great Plains from Kansas to north Texas in the US is planted to winter wheat (*Triticum aestivum*) for growing beef cattle during late fall through spring.

Other cool-season annual grasses provide forage for grazing livestock. In many temperate regions, winter-planted oat (*Avena sativa*) is widely used as winter forage for growing beef cattle, cow-calf production systems, dairies, and other grazing livestock. Rye (*Secale cerale*) and annual ryegrass (*Lolium multiflorum*) account for a significant area of winter forage on sandy soils where wheat is not as well adapted, and are generally overseeded into warm-season perennial grass sods mainly in the humid temperate regions. Barley (*Hordeum vulgare*) is grazed or harvested for hay and/or silage in the northern portion of the temperate regions.

Cool-season perennial forage grass species have been of great interest in sub-humid temperate regions recently. Smooth bromegrass (*Bromus inermis*), due to its survival of the 1930s US drought, became a popular introduced cool-season perennial forage grass. Since 1943 with the introduction of 'Lincoln' smooth bromegrass, this cool-season perennial grass has played an important role in winter forage production in various regions.

Other important cool-season perennial forage grasses include intermediate and pubescent wheatgrass (*Thinopyrum intermedium*, Figure 1), tall wheatgrass (*Thinopyrum ponticum*), crested wheatgrass (*Agropyron cristatum*), orchardgrass (*Dactylis glomerata*), and creeping foxtail (*Alopecurus arundinaceus*). Wheatgrass as a class demonstrate good cold tolerance, drought tolerance (especially crested wheatgrass), good to acceptable dry matter production and nutritive value. Crested wheatgrass is one of the earliest cool-season species to produce forage following winter and thus is credited for reducing hay use in its area of adaptation.

Although many of the bluestem species are native to Eurasia, many of the species have been used in the Great Plains region of the US. Tall wheatgrass is the most productive of the wheatgrass group and, though coarse at maturity, can produce forage of good nutritive value when well managed. Additional work in the southern Great Plains has recently focused on obligatory summer-dormant cool-season perennial grasses that have a greater persistence due to their ability to avoid and/or survive summer drought.

Orchard grass is used to a limited degree in temperate sub-humid regions but does not have the drought tolerance of tall or intermediate wheatgrass. For use in areas receiving less than 750 mm annual precipitation, 'Paiute' orchard grass may have the best drought tolerance of all the currently available orchard grass varieties. Russian wild rye

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(*Psathyrostachys juncea*) is another drought tolerant, grazing tolerant cool-season grass. Once established, Russian wild rye provides excellent forage especially for fall grazing.

Figure 1. A field of pubescent wheatgrass growing in a region receiving 660 mm of precipitation annually.

Legumes play an important role in forage systems in many regions of the world. Alfalfa (*Medicago sativa*) is one of the most important forage crops grown in the US and Europe. The majority of the hectares planted to alfalfa are found in the temperate sub-humid and temperate semiarid regions. Most alfalfa is produced for hay or silage although some grazing-type alfalfa varieties have been released. In the colder climates, the ability to withstand extreme temperatures may be as important in determining persistence as the ability to withstand grazing.

Other legumes of some importance include birdsfoot trefoil (*Lotus corniculatus*), sweetclover (*Melitotus alba, Melitotus officinalis*), red clover (*Trifolium pretense*), and white clover (*Trifolium repens*). These legumes, with the exception of sweetclover, do not have good drought tolerance, and production is generally limited to areas receiving more than 900 mm of precipitation. Sweet clover, although introduced from Eurasia, has become naturalized in the temperate regions of the world and is both drought- and winter-hardy.

2.2. Sub-tropical Areas

Bermudagrass (*Cynodon dactylon*) is a warm-season perennial grass that spreads mainly by rhizomes and stolons and tolerates a wide range of soil types and soil pH values, thus making it adapted to most of the tropics and subtropics (Figure 2). Limited cold tolerance in early common and hybrid cultivars of bermudagrass led to the development and release of several cold-tolerant varieties such as ‘Midland’ and ‘Tifton 44’. These cultivars provide useful warm-season perennial grasses for the transition between the warm and cool-season areas of temperate regions. Although bermudagrass is commonly

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thought of as being only adapted to the more humid regions of the southeastern US, Coastal and Midland bermudagrass may persist in regions that receive as little as 600 mm of annual precipitation.

Other popular introduced subtropical grasses include bahiagrass (*Paspalum notatum*), dallisgrass (*Paspalum dilatatum*), and where cold tolerance is not an issue, stargrass (*Cynodon nlemfuensis*). Bahiagrass is persistent under lower fertilizer inputs than many other forage species. This fact alone has accounted for widespread acceptance of the forage despite reduced drought tolerance and dry matter production when compared with bermudagrass.

Figure 2. Yearling *Bos taurus* x *Bos indicus* cattle grazing bermudagrass.

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Old World bluestems are warm-season perennial bunchgrasses that generally have better drought tolerance than bermudagrass and are found in more arid regions than is bermudagrass. The Old World bluestems that are primarily used include ‘Plains’ (*Bothriochloa ischaemum*), which is a blend of 30 accessions, ‘WW Spar’ (*Bothriochloa ischaemum*), ‘WW Ironmaster’ (*Bothriochloa ischaemum*), which is best adapted for high pH soils, ‘King Ranch’ (*Bothriochloa ischaemum*); ‘Caucasian’ (*Bothriochloa caucasica*) bluestem; and ‘WW-BDahl’ (*Bothriochloa bladhii*). Though Caucasian bluestem, with adequate moisture, may be the most productive of the Old World bluestems, its relative lack of drought tolerance limits its use in the more arid part of temperate sub-humid regions. King Ranch bluestem can also be productive in the southern part of temperate regions, but its lack of cold-tolerance limits its use in the northern part of the region.

Weeping lovegrass (*Eragrostis curvula*) is another warm-season perennial bunchgrass well-adapted to sandy soils, and with good cold-tolerance. Weeping lovegrass has earlier growth than bermudagrass or native grasses, has a good response to fertility, and demonstrates good drought tolerance. If well-managed, weeping lovegrass can provide good quantities of forage with excellent nutritive value. Once mature, or if unfertilized, weeping lovegrass forage is of relatively low nutritive value. In southern Africa *Cenchrus ciliaris var Gayndah* is quite an important species whenever pasture cultivation is considered. It has a high leaf production, strong perennial characteristics, is heat and drought tolerant, grows well with as little as 300 mm/year and can tolerate moderate cold and frost.

Crabgrasses (*Digitaria* spp.) are introduced warm-season annual grasses that are well-adapted to much of the southern portion of the region. Once considered a weed, crabgrass provides good nutrition during summer months when many warm-season perennial grasses are low in nutritive value.

Other warm-season annual grasses in the region include the various grain and forage sorghums (*Sorghum bicolor*), sudangrass (*Sorghum bicolor*), sorghum-sudan hybrids and pearl millet (*Pennisetum glaucum*). This class of warm-season annual grasses can be quite productive (>10 Mt ha^{-1}) and are well-adapted to areas receiving 400-650 mm of annual precipitation. Most of the forage sorghum, sorghum-sudan hybrids, and pearl millet are produced for harvest and conservation as hay or silage, however, many are routinely grazed by dairy animals or growing beef cattle (see also: Growth and Production of Sorghum and Millets). Careful attention should be paid to growing conditions and, if those are only sub-optimal, producers should be aware of the potential risk for nitrate toxicity or prussic acid poisoning. Managers should also be aware of the consequences that introduced (exotic) species might have on the environment if not well controlled.

2.3. Alternate Warm and Cool Season Areas

A plan to use a combination of both warm-season and cool-season forages is usually required to best match nutrient availability with livestock nutrient demand and to minimize winter feeding costs if the environment will support such a strategy. Most livestock producers depend too heavily on hay for winter feeding programs. This is generally the most expensive method to feed livestock during winter because of the costs involved in harvesting, baling, storing, and hauling hay.

Livestock are much more efficient at harvesting forage compared to hay harvesting equipment. 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.

Thus, many producers in subtropical regions will overseed cool-season annual forages into their warm-season perennial grass pastures to extend the grazing season and reduce their dependence on hay feeding. Many pastures are overseeded in the fall to the small grains and ryegrass. Pastures to be overseeded are generally grazed short approximately 6-8 weeks prior to the first historic frost date. Pastures are then lightly disked and small grains drilled into the warm-season perennial grass sod, or in the case of ryegrass, simply broadcast over the pasture. Many producers also use overseeded forage legumes

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such as alfalfa, clover, medics (*Medicago* spp.) and hairy vetch (*Vicia villosa*).

Legumes 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 share some of the fixed N with other non-N-fixing species such as grasses through various recycling mechanisms. This N input 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 grass forage systems. If not presently using forage legumes in the pasture program, one may wish to consider the addition of these plants into certain fields.

3. Land Husbandry and Establishment

3.1. Adaptation

Not all forage species grow well on every type of soil or in all parts of every region. The person in charge of establishment should determine whether or not the forage species under consideration is adapted to the site. Some forage species may have higher moisture requirements or may have less cold tolerance than others. In many regions of the world there may be a moisture gradient that demands one species where moisture availability is greater and another species where moisture is limiting. To understand how moisture availability can affect the choice of forage species, white clover (*Trifolium repens*) is hereby used as an example.

White clover has less drought tolerance than bermudagrass or Old World bluestem. If a ranch location was in an area where precipitation levels are less than 750 mm annually, white clover will be a poor species choice and doomed to failure. Even if used in the appropriate part of the region that receives adequate precipitation, however, site selection will still play 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 to support growth. Thus, while planted in the right part of the region, a poor site choice on the ranch could result in failure.

Unfortunately, much of the information regarding the suitability of forages for one soil type or another comes from anecdotal evidence and not research trials. Many times anecdotal accounts are informative, but producers should enlist the aid of agricultural professionals and land owners with experience in grass species to ensure a good match between forage species and site. Local county agricultural extension agents may provide informed insights into which forages are best adapted to local conditions.

A few helpful tips to establishing forages should be mentioned at this juncture. First, producers can learn a great deal about the forage potential of their property by obtaining and studying the soil map. Soil data, if available, can provide important first information regarding the types of species that may or may not be successfully grown on the site.
A second recommendation is to identify those areas that may prove to be potential problem sites. Certain areas are prone to flooding and may not be suitable 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

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areas upstream. Likewise, waterlogged areas are not good for cattle to spend the winter. Conversely, an area that is particularly droughty may also be a poor location. In a low site prone to periodic flooding, or with poor drainage, one should choose a species that is tolerant of saturated soils. Species such as white, berseem (*Trifolium alexandrinum*), or Persian (*Trifolium resupinatum*) clover are legumes that do well under more poorly drained conditions, as may do tall fescue which tolerates periodic flooding better than many other grass species. One should be alert to establishment site and should plant appropriately adapted forage species and cultivars.

3.2. Time of Planting

Although warm-season forages are generally planted in the late winter to early spring and cool-season forages in late summer to late fall and early winter, however, circumstances beyond the manager's control may cause the window of opportunity for planting to be shortened. Therefore, the need for good planning and 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 could delay the process. Some producers have gotten to the point of planting seed, but found out, much to their dismay, that the seed they 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. Careful attention to the following checklist will help ensure critical aspects of establishment are in place so planting may be accomplished in a timely manner.

- Decide on forage species based on system requirements and adaptability.
- Select the appropriate site for forage establishment based on forage species needs and adaptability.
- Obtain soil samples from the site and have them tested by a certified commercial laboratory at least for soil pH, phosphorus (P), and potassium (K).
- Inquire as to availability of seed and seed cost. If a legume is to be established, make sure the inoculants are available or purchase pre-inoculated seed. Legumes have the ability to fix atmospheric nitrogen (N) due to a symbiotic relationship with host-specific *Rhizobium* bacteria. If the appropriate bacteria is not on the seed at planting time, the legume plant will not be able to fix N, and thus require N fertilizer as other grass species.
- Locate equipment that will be required for establishment well in advance.
- Begin seedbed preparation in anticipation of planting. Remember 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/or lime to correct deficiencies in soil pH, available P, and/or available K as required based on soil test recommendations into the seedbed while working the ground.
- Plant good quality seed at the proper rate to the proper depth. Plant into a moist seedbed if possible.
- In most cases, top-dress with N following the germination of grass seedlings.
- Be alert for pests such as insects or weeds that may require pesticide application.

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Biographical Sketch

Dr. Larry Redmon is a Professor with the Department of Soil & Crop Sciences at Texas A&M University and serves as the State Forage Specialist for the Texas AgriLife Extension Service and offices in College Station. Major program thrusts include reducing winter feeding costs through the use of year-round grazing, increased use of forage legumes in pasture systems, the importance of forage analysis, the use of appropriate stocking rates, and wildlife forages.

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