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Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
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- It dispenses no funds to the public.
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- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

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Management Strategies for Rangeland and Introduced Pastures

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Oklahoma is blessed with an abundance of excellent forage resources. Many Oklahoma producers enjoy the benefits of operating livestock production systems on both rangeland and introduced-forage pastures. However, some producers may not be aware of the need for different management strategies for the two ecosystems. Improper management generally results in decreased profitability of the livestock operation and reduces the sustainability of the production system.

The net return per acre from rangeland ecosystems can be rewarding due to the lower input costs associated with extensive management practices. Net return per acre to the producer using introduced forages can also be rewarding due to the higher carrying capacity per acre generally realized when using introduced forages. Higher carrying capacity results in more beef gain per acre and reduced land costs per animal.

The cost of using either introduced forages or rangeland (native) plants can be high if not properly managed. This publication discusses the differences in rangelands and introduced-forage pastures and management strategies required for each.

Rangeland

Oklahoma's rangeland has evolved as a result of the collective influence of climate, fire, and grazing. Rangeland is comprised of native plants, including grasses, forbs, and shrubs. Forests also respond similarly to fire and grazing. Examples of some of the major rangeland vegetation types found in Oklahoma include tall-grass prairie, mixed-grass prairie, short-grass prairie, post oak-blackjack oak savannah, sand sagebrush grasslands, and mesquite grasslands.

Rangeland communities are usually diverse and made up of many species of plants and animals. Historically, Oklahoma was a haven for native grazing animals and other wildlife species. Today, most of the large native herbivores have been replaced by cattle or other domestic livestock.

Rangeland management is characterized by extensive, rather than intensive strategies. Foremost among the management strategies for rangelands is grazing management and prescribed fire. Herbicides are used particularly on areas with a history of poor management (i.e., lack of fire and overgrazing).

Introduced Pasture

Introduced-forage management is characterized by the use of inputs not normally associated with rangeland management. Most notable among these inputs is the use of fertilizer. Herbicides are generally used to a greater extent on introduced-forage pastures than on rangeland. Herbicide application, however, is generally a response to symptoms and does not alleviate the underlying management problems that produced the weed infestation in the first place.

Introduced forages used for forage/livestock production systems have generally been selected for one or more of the following attributes:

a) high dry matter yield potential
b) high nutritive value
c) the ability to withstand close and/or continuous grazing
d) the ability to grow during cool months when most Oklahoma rangeland plants are dormant

Producers who choose to take advantage of the high productive capability of introduced forages, by default, have decided to provide the necessary fertility inputs required by the various forages. Bear in mind that many of the lands currently in introduced pasture are areas that were once farmed, but experienced serious erosion during the 1930s. These lands were abandoned and allowed to go back to plant species adapted to eroded, infertile conditions. Much of this once-abandoned farmland was reclaimed by reseeding to forage grasses. These areas require special attention to fertility inputs.

Grazing Management

Proper grazing management is the key element of successful livestock production. The most important aspect of grazing management is to use the proper stocking rate. Overstocking livestock can lead to an overgrazed condition. Overgrazing results in a decline in desirable species coupled with an increase in weed infestation, and a reduction in both animal performance and carrying capacity of management units. The net result of overgrazing is decreased profitability of the operation. Understocking the operation (undergrazing), while not as detrimental to desirable forage species, generally results in somewhat decreased forage production and under- utilization (low harvest efficiency) of the forage base. Undergrazing will generally result in patch or spot grazing where livestock repeatedly graze forage regrowth when it is available, while ignoring areas of forage that become increasingly mature. Mature forage is both less palatable and of lower nutritive value to livestock. Undergrazing, thus, results in wasted forage and less than maximum net return per acre to the operation.

An important aspect in grazing management is to control the forage harvest to maintain forage in a relatively immature stage of growth. Immature forages are higher in crude protein and digestibility than those in more advanced stages of maturity. A compromise is necessary to balance dry matter yield and an acceptable nutritive value. A conceptual model of the interaction between forage nutritive value, dry matter yield, and forage stage of maturity is shown in Figure 1.

Dry matter yield is enhanced by allowing forage to advance in maturity. The rapid decline in forage nutritive value (primarily for grass species) makes dry matter yield alone a poor production goal. Yield of nutrients (e.g., crude protein) is a better goal for most forage production systems since, given adequate forage intake, nutrients are the key determinant to animal performance.

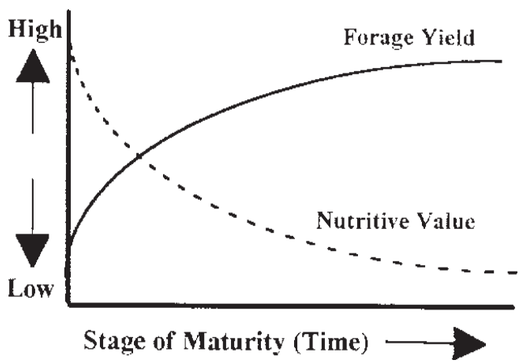

Figure 1. Effect of stage of maturity on forage yield and forage nutritive value.

Producers should consider the use of grazing systems designed to improve the control of forage harvest efficiency and maintain high nutritive value.

While maintaining forage in a relatively short, immature stage is important regarding animal performance, enough forage residue must remain to ensure the plant's ability to carry out basic metabolic processes and persist at the site. The level of residue required to maintain forage stands will differ according to species. A list of different forage species and recommended forage heights are listed in Table 1.

Overgrazed rangeland is dominated by early successional stage plants such as annual grasses and forbs. If the area has not been plowed, such that reseeding is required to establish vegetation, good grazing management can be used to improve forage conditions for cattle. However, rangeland that is dominated by early successional stage plants in combination with mid- and/or late-successional plant communities can provide desirable habitat for species of wildlife such as bobwhite quail, prairie chicken, and other species. If a change in range condition to a higher successional stage is desired, a deferment for part of the growing season combined with prescribed fire may be necessary to restore vigor to the plants.

Table 1. Suggested residue height of selected forages for optimum animal performance and stand persistence.

Species	Residue Height (inches)
Alfalfa	4 to 6"
Annual ryegrass	3 to 4"
Arrowleaf clover	3 to 4"
Bermudagrass	1.5 to 3"
Intermediate wheatgrass	4 to 6"
Native (rangeland)	
Shortgrass prairie	2 to 3"
Mixed-grass prairie	4 to 6"
Tallgrass prairie	6 to 8"
Oat	4 to 6"
Old World bluestem	3 to 4"
Pubescent wheatgrass	4 to 6"
Red clover	4 to 6"
Rye	4 to 6"
Tall fescue	3 to 4"
Tall wheatgrass	6 to 8"
Wheat	4 to 6"
White clover	2 to 3"

fundamentals of introduced forage pastures will also ensure that the dry matter production and forage nutritive value are adequate. Poor grazing management of either system and a lack of soil fertility in introduced forage pastures will result in a decline of desirable forage species, an increase in weed species, decreased livestock performance, and reduced net income.

Grazing deferment is not required, nor desired, on introduced forage pastures. Most introduced forage species have the ability to tolerate heavier stocking rates than rangelands and have the ability for rapid regrowth. Pastures, however, can be overstocked, even with grasses such as bermudagrass. Overgrazed conditions will reduce forage vigor, animal performance, and create weed problems, thus creating the need for an expensive herbicide application. Proper attention to stocking rate is just as essential on introduced forage pastures as on rangeland.

One problem in pasture grazing management is the low harvest efficiency and patch grazing that occurs under typical continuous stocking systems. Livestock producers should consider some form of rotational stocking system with cow/calf operations to encourage a compromise of forage utilization, animal performance, and forage persistence. Producers that use one pasture and continuous stocking, unless special management techniques are utilized, have little flexibility or control over the harvest efficiency of the forage resource.

Fertility

Fertility inputs are generally not used on rangelands. Proper use of fertilizer on introduced-forage pastures is critical for optimum forage production and animal performance.

The first step in the soil fertility program is to obtain a soil sample for analysis. A soil analysis is used to determine the levels of nitrogen, phosphorus, and potassium in the soil and the soil pH (soil acidity). Because of the potential for high dry matter yield, most introduced forages (grasses) have a high nitrogen requirement. Nitrogen is second only to moisture in relative importance for maximum plant growth and is positively correlated with both dry matter production and nutritive value. The data contained in Table 2 indicate the response of various forages to increased application rates of nitrogen.

Industrially supplied nitrogen sources, such as ammonium nitrate, ammonium sulfate, and urea are commonly used forms of nitrogen fertilizer. Additional sources of nitrogen include poultry litter and swine effluent. Animal waste products (i.e., poultry litter, swine lagoon effluent) can provide inexpensive sources of nitrogen if located close to forage production systems. Economy of animal waste must be based on a soil test.

An alternative method for supplying nitrogen is through the use of legumes. Legumes are plants (such as clovers) that have a symbiotic relationship with host-specific Rhizobia bacteria. In the symbiotic relationship, the legume serves as a host plant for the bacteria, while the bacteria fixes atmospheric nitrogen into a form readily used by the plant. Forage legumes have the ability to provide the equivalent of 50 to 200 pounds of actual nitrogen per acre to other non-nitrogen-fixing plants

Table 2. Estimated Annual Forage yields With and Without Nitrogen Fertilization (Tons Per Acre). (dry matter basis)

Forage Species	Nitrogen rate (lbs. per acre) 0	50	100	150*	200*
Bermudagrass	1.0	1.8	2.8	3.4	3.9
Weeping lovegrass (sandy soil)	1.0	2.0	2.9	3.6	4.0
Plains or Caucasian bluestem	1.0	1.9	2.7	3.3	3.7
Tall Fescue (eastern Oklahoma)	0.8	1.7	2.4	3.0	3.5
Native hay	1.0	1.5	1.6		
Sudangrass	1.5	2.5	3.5	4.3	5.0
Small grain	1.0	1.5	2.1	2.6	3.0
Alfalfa	3.0-5.0				

*Forage production at nitrogen rates of 150 lbs. per acre or greater may be limited by soil depth and lack of rainfall during the growing season.

under good growing conditions, thus reducing the need for nitrogen fertilizer. Legumes also contribute to the overall nutritive value of the forage and help to maintain animals on a high nutritional plane, even when nutritive value of grasses is declining.

Many soils are also low in phosphorus and potassium and must be amended to optimize growth. Where legumes are utilized, a near-neutral soil pH becomes increasingly important, and in many cases, lime must be applied to acid soils. Acid soils generally do not have direct negative effects on the growth of most forage plants; however, indirect effects can hamper plant production. Soil nutrients, particularly phosphorus, are most available at near-neutral pH levels. Many producers, therefore, apply crushed limestone (lime) to increase soil pH to enhance nutrient availability for optimum forage production.

When fertilizer and ag lime are applied according to soil test recommendations and proper attention is paid to grazing management, input costs to introduced pastures generally yield a good return on their investment. If fertility inputs are not applied properly and/or grazing management practices are not sound, introduced pastures can become a black hole into which a lot of money is poured, but little income is realized. Introduced forages yield no more than native forages if not fertilized.

Herbicides

Generally, the need for herbicide application indicates a history of poor management. Weed infestation,

in many instances, may be a symptom of overgrazing of rangelands. Overgrazing combined with a poor fertility program on introduced-forage pastures can also lead to weed problems. Prior to spending money on herbicide application, it is imperative that producers examine present management practices and determine what is creating the conditions that allow weed species to dominate the current management units. Until these deficiencies are identified and corrected, producers will be caught in a perpetual cycle of applying herbicides when that expense could be better spent on other inputs.

If the decision to use a herbicide has been made, it is essential that producers correctly identify the target species and follow the label directions regarding application and cleanup/disposal of the herbicide following use. It should be obvious that if the target weed species is incorrectly identified, the herbicide may be ineffective. Following label directions is critical because of safety concerns for both the operator and the environment. It is also a violation of the law to do otherwise.

Herbicides have been and continue to be used on rangelands. Many rangelands, due to past practices of overgrazing and exclusion of prescribed fire, have become dominated by woody species. Generally, herbicides cleared specifically for rangelands and/or mechanical treatments (root plowing, chaining, roller chopping, disking, or shredding) are used to kill woody species. Defoliation of the woody species allows sunlight to reach the rangeland soil and provide opportunity for native grasses and forbs to reestablish themselves. A prescribed burning program in combination with proper grazing management will keep most woody species in check.

For less serious weed problems, grazing management or prescribed fire can be used for weed control. In many instances, herbaceous species may be effectively controlled by congregating cattle in a small area to provide heavy grazing pressure on weeds in late winter and early spring.

The above comments apply equally to herbicide use on introduced-forage pastures. A critical assessment of past management strategies that have contributed to the weed problem should be conducted and a decision made to correct inappropriate or incorrect actions. The target weed species should be correctly identified and label directions followed regarding herbicide use. Typically, more herbicides are used in Oklahoma on introduced-forage pasture. Again, grazing management and fertility can be used in many instances to achieve good control of certain herbaceous weed species.

Many producers consider the use of herbicides a routine management practice. Under a good management program of proper soil fertility and the appropriate stocking rate for the forage species and season of use, herbicide use on most grazing lands should not be necessary.

Prescribed Fire

Rangelands and forests evolved under the influence of both grazing and fire. The role of fire in maintaining rangelands has been misunderstood by the public in general; thus, over time the use of fire has been reduced. This is unfortunate because prescribed fire is an effective means for controlling unwanted and undesirable plant species on rangelands and forests. Applied appropriately and under specific conditions, prescribed fire is a safe and inexpensive management tool that is available to the rangeland manager.

Prescribed fire is used to accomplish specific goals. The fire is used at a certain time of the year and under specific levels of relative humidity, air temperature, and wind speed to help control target weed species. Although generally responsible for improvements in both forage quantity and nutritive value, fire during a dry season can eliminate standing dormant forage that could be useful for emergency grazing. If soil moisture is not adequate at the time of the fire or replaced soon after, areas that are subjected to prescribed fire may actually produce less forage than unburned areas. Soil moisture is a critical aspect of the fire prescription and should be carefully considered in conjunction with other elements of the fire plan, even in eastern and central Oklahoma where moisture is normally adequate.

Besides the beneficial effects of controlling undesirable plant species, prescribed fire also enhances growing cattle performance. Data from many studies in the southern Great Plains indicates that stocker cattle gain an additional 10% or more when grazing burned pastures compared to cattle on unburned areas (Table 3).

Prescribed fire eliminates standing dead forage and provides livestock with green forage of higher nutritive value. Fire releases nutrients from dormant standing forage (phosphorus and potassium) for a brief period of time resulting in somewhat increased nutritive value of subsequent forage. The blackened surface generally greens up earlier than non-burned areas, thus providing earlier grazing. In summary, the beneficial effects of controlling unwanted weeds and the economic benefit

Table 3. Steer gain response to prescribed fire on tallgrass prairie, Stillwater, OK 1985 to 1990.

	Unburned	Burned
Early season (May to mid July)		
Daily gain (lbs)	2.04	2.24
% difference		+10
75-day gain difference (lbs)		+150
Total season (May to October)		
Daily gain (lbs)	1.81	1.97
% difference		+9
150-day difference (lbs)		+24

realized from the increase in cattle performance warrants careful consideration of using prescribed fire as a management tool on rangelands and forests.

Prescribed fire is not used in introduced forage pastures to the same extent as rangelands. However, some producers have discovered that burning standing dormant forage can be beneficial to pastures. Some previously mentioned benefits include the earlier green-up of pastures compared with unburned pastures and a short-term release of phosphorus and potassium. An additional application for prescribed fire would be to clean up a hay meadow so that the first hay cutting was clean of dormant forage and other undesirable components of the pasture. Prescribed fire also helps reduce the level of insect problems in pastures such as spittle bugs in bermudagrass.

Producers who have not used prescribed fire in the past may want to consider the benefits provided by this inexpensive management tool. For more information see OSU Circulars E-926 Grazing Management on Rangeland for Beef Production and E-947 Invasion of Oklahoma Rangelands and Forests by Eastern Redcedar and Ashe Juniper and various OSU Extension Fact Sheets on prescribed fire.

Complementary Forage Systems

Almost every farm or ranch in Oklahoma has the potential to develop both introduced pastures suited to intensive management and rangeland suited to extensive management in what is known as a complementary forage system. The use of both types of forage systems increases flexibility, spreads producer risk, and enhances the potential for profitability from livestock production systems. Introduced forages, in general, increase the carrying capacity of the farm or ranch. Cool-season introduced forages improve the seasonal distribution of forage with the ability to provide fall-through-spring forage of good nutritive value. Warm-season introduced forages provide pasture for livestock to spend part of the summer on, thus allowing rangelands to recover from grazing events. Rangeland plants, on the other hand, offer good animal performance during spring through early summer and provide a buffer for fall and winter during periods of drought when cool-season introduced forages may be in short supply. Rangeland also provides habitat for wildlife where as introduced forages generally do not. Introduced forages can increase carrying capacity while protecting our remaining range resources. Provides alternative source of grazing at key times.

Wildlife Habitat

Recreational leasing for hunting is rapidly becoming a major source of income for Oklahoma ranchers. Wildlife require food, cover, and water for survival. Native plant communities provide the best wildlife habitat for the greatest number of species. Ranchers should realize that the use of introduced forages generally precludes other types of land use such as recreational leasing for wildlife.

Likewise, breaking up large areas (fragmentation) of contiguous land types (native forest, shrubland, or prairie) can result in decreased habitat and numbers of certain wildlife species. If alternative sources of income from wildlife use is desired, whether consumptive (sport hunting) or non-consumptive (watchable wildlife), ranchers should remember that introduced forages do not provide good wildlife habitat. Under these circumstances the use of introduced forages may reduce ranch income.

If there are presently areas of native plants species in association with introduced species on your property, you still have the potential for good wildlife production. The preservation of wildlife habitat should receive high priority when management practices are considered. Areas of native woody plants and forbs that are necessary for wildlife food and cover should be maintained, and these areas should receive limited herbicide or mechanical treatments.

Wildlife and livestock are usually compatible. For example, maintaining plum thickets on rangeland would have little effect on livestock carrying capacity, but would have a positive impact on bobwhite quail and white-tailed deer. We recommend a careful evaluation of your ranch's resources for alternative sources of income before any land use changes are made.

Summary

Both native (rangeland) and introduced forages have strengths and weaknesses for cattle production. Native plant communities are necessary for most wildlife. The use of both systems in a complementary manner can enhance the flexibility of the livestock production system and improve net income. There are similarities in management of the systems; however, there are important differences that should be noted by ranchers.

Differences in management practices relate to the intensive inputs (fertilizer, herbicides) associated with introduced- forage pastures. Introduced forage species are able to withstand heavier grazing pressure. Heavy grazing of an introduced forage is not the same as heavy grazing on native forage. Native forage stocking rates should be based on the productivity of the range site. Rangelands can tolerate heavy grazing pressure before July 10, but should be deferred so that native plants may recover from grazing. The use of prescribed fire is generally used more on rangeland than on introduced forage pastures. Understanding the subtle differences in management strategies between rangelands and introduced forage pastures can mean the difference in making a profit or losing money.

Common to managing both systems is the use of proper stocking rate and the need to provide forage of high nutritive value. Close attention to basic soil fertility