# DEVELOPING YEAR-ROUND FORAGE SYSTEMS 309
# FOR BEEF CATTLE IN EASTERN KANSAS

by

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# PREFACE

In grass, God in His Wisdom gave the world a plant that is admirably adapted to withstand the grazing of animals and be an efficient forage producer (Rechenthin, C. A. 1956).

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ACKNOWLEDGEMENTS

I would like to thank my wife, Marty, and my son, Tadlee, for the support and sacrifice that they willfully contributed throughout my graduate studies.

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# INTRODUCTION

The Flint Hills constitute a major segment of the true prairie (4,000,000 acres). Pastures are currently dominated by tall grasses and mid grasses. The tall grasses include big bluestem (Andropogon gerardi), indiangrass (Sorghastrum nutans), and switchgrass (Panicum virgatum). The mid-grasses include little bluestem (Andropogon scoparius), sideoats grama (Boteloua curtipendula), and kentucky bluegrass (Poq pratensis). Lesser amounts of short grasses occur and are dominant only on drouthy preclimax sites or on overgrazed areas.

Bluestem grasslands, such as the Flint Hills, when in climax or near climax conditions, are highly productive and are characterized by great stability under grazing. In the Flint Hills bluestem pastures, the equilibrium of the climax vegetation with the climate is not easily disturbed except by long continued abusive grazing or repeated burning over dry soil (Anderson and Fly 1955).

In recent years scientists including Bogle et al (unpublished), Launchbaugh and Owensby (1978), and McIlvain (1976), have stated that through planned management practices, such as, burning, intensive early stocking, complementary forages, and use of grazing systems, the production of beef can be increased without sacrificing the longevity of the pastures. In fact, some management practices have increased the productivity of desirable plant species in the sward (Owensby and Wyrill 1973).

By planning year-round forage systems the manager is taking the proper precautions to assure that he will have adequate forage supplies to meet his cattle's nutritional needs throughout the year. Planned grazing systems will help the producer to harvest the maximum amount of beef from his pastures, and maintain the plant species that are desirable for beef production.

In order to meet the increasing demands for beef, and to operate his forage resource at a level of production that is profitable, a manager must incorporate newer management practices.

# SOILS

## Flint Hills Soils

Soil is the basis of any forage system, without a good soil very little forage can be grown. In the Flint Hills different soils originated from several geological events. Lacustrine, glacial till, alluvium, residum, and loess are common parent materials. As described by Fly (1949), the residual soils have developed from massive limestones, interbedded gray and yellow shales, and highly flinty or cherty limestones of the lower Permian formations. In places a thin mantle of loess occurs on the divides. Under the native bluestem vegetation the soils throughout the Flint Hills have developed dark, well granulated silt loam or silty clay loam textured surface horizons that are slightly acid in reaction. Native fertility is moderate to high. Texture and consistency of subsoil, depth of soil, and degree of stoniness may vary widely with the character of the parent material and degree of slope. Broken rock and chert allow moisture and plant roots to penetrate deeply. However, wide variations exist in the ability of the soils to support regional climax vegetation.

The rolling topography of the Flint Hills provides many different range sites as illustrated in Figure 1. The depths of the soils range from a few inches in some upland sites to several feet in the lowland sites. The soil depth to the first root restricting layer is directly related to the water supplying capacity of that soil and the amount and/or type of plant life that will be supported there. Hence, short prairie grasses, like buffalograss (Buchloe dactyloides) are found on claypan sites; while tall prairie grasses like big bluestem (Andropogon gerardi) will be native to loamy upland sites. Therefore, the different vegetation growing in an area can be used as an indicator of the soil type for that area, and also as an indicator of how a forage site should be managed.

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Figure 1. Soil, Range, and Forage Sites of the Flint Hills (Geary County Soil Survey Manual 1961).

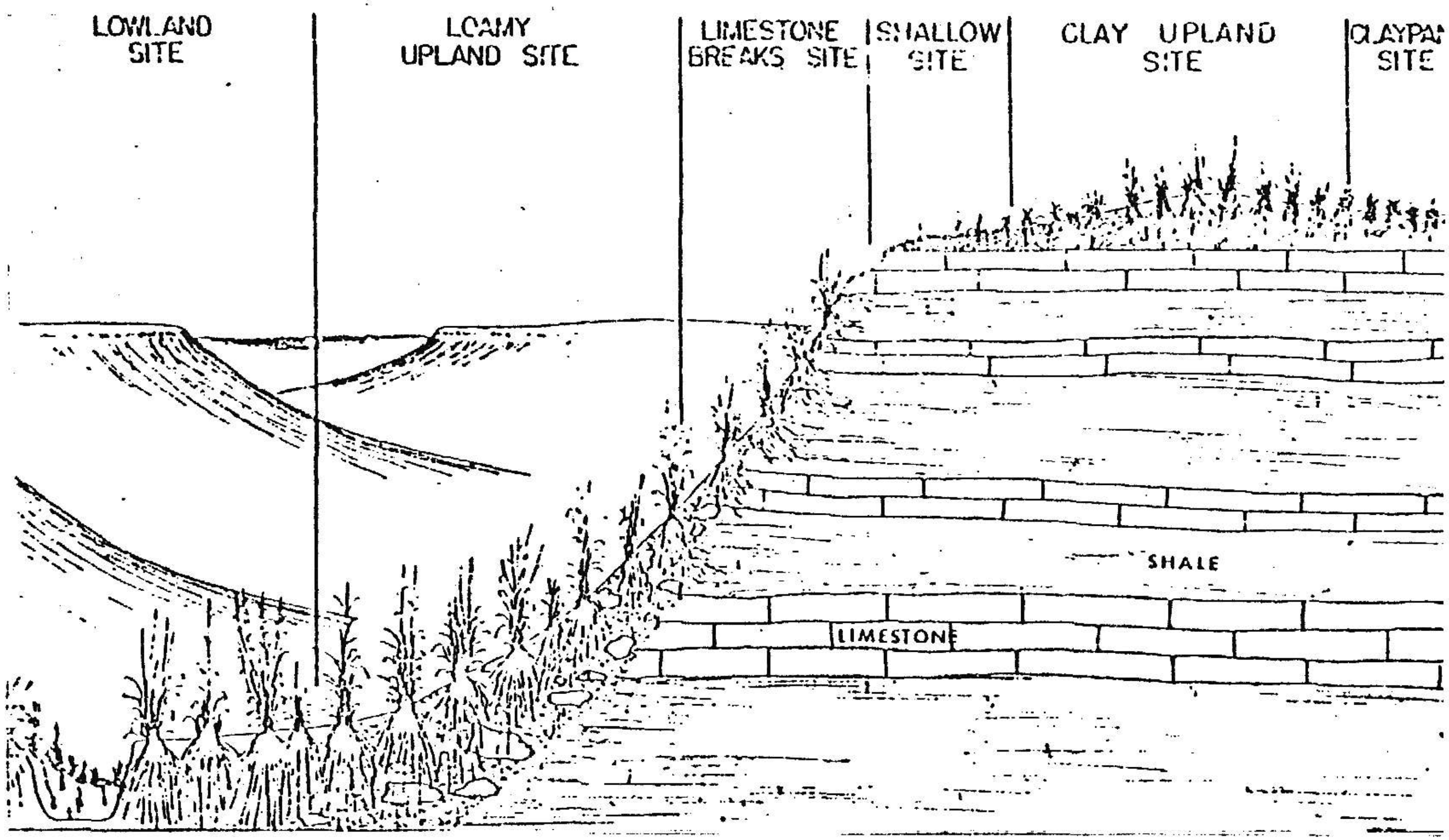


Table 1 lists several soil types found in eastern Kansas with average yields of some different forages grown on those soils. Producers having soils similar to these can estimate what his yields would be if he renovated his pasture, or to compare his present production.

Table 1. Forage Production (Tons/Acre) on Selected Soil Types in Eastern Kansas

| | Smolan silt loam | Parsons silt loam | Grundy silty clay loam | Woodson silt loam | Bates loam |
|---|---|---|---|---|---|
| Smooth Brome | 1.76 | 1.78 | 3.24 | 2.23 | --- |
| Tall Fescue | 1.80 | 1.77 | 2.72 | 2.52 | 1.85 |
| Reed Canarygrass | 3.25 | 2.90 | 2.32 | 2.47 | 1.76 |
| Native Grass | 1.97 | 2.52 | --- | 1.88 | --- |
| Alfalfa | --- | 3.56 | --- | --- | 3.95 |

Land Management

McVicar (1974) describes good land management as organizing and using all the land on the farm or ranch according to its capability. For lands in pasture this means proper land use with attention to erosion control, water conservation, maintenance of desirable soil reaction, and addition of proper plant nutrients.

Water Conservation. The forage manager has a vital interest in the behavior of water as it is deposited, collected, stored, or lost from the soil. Downstream ranchers and farmers are dependent upon water yields for irrigation, and urban dwellers for domestic water supplies. Conversely, excessive runoff creates erosion hazards and flood damages.

Water intake rates may be influenced by management, surface and subsoil conditions, the kind and amount of vegetation present, and intensity of rainfall (Rauzi and Kuhlman 1961).

The manager will help determine the amount of vegetation that will cover the soil and at what time of the year it will occur. He can do this by burning the pasture, or by his grazing program. Owensby (1973) states that burning rangeland will affect water intake and runoff. Removal of the plant materials by fire leaves a bare soil with a compacted surface layer which only permits capillary infiltration, this infiltration is much less than the saturated flow experienced by soils with vegetative cover. The black and bare soil will allow more soil moisture to evaporate than a soil that has some type of cover on it.

The timing of the burning is very critical, for instance, range that is burned in the winter will leave a bare soil until spring growth occurs. A bare soil exposed to the elements during this time may undergo considerable changes caused by erosion. If the range is burned in the late spring, about May 1, the forage will rapidly regrow and provide a canopy to reduce the raindrop impact on the soil and the consequent erosion.

Rauzi and Hanson (1966) reported that water intake rates were inversely related with grazing intensity. Total water intake on the lightly grazed watershed was 2.5 times greater than on the heavily grazed watershed and 1.8 times greater than on the moderately grazed watershed.

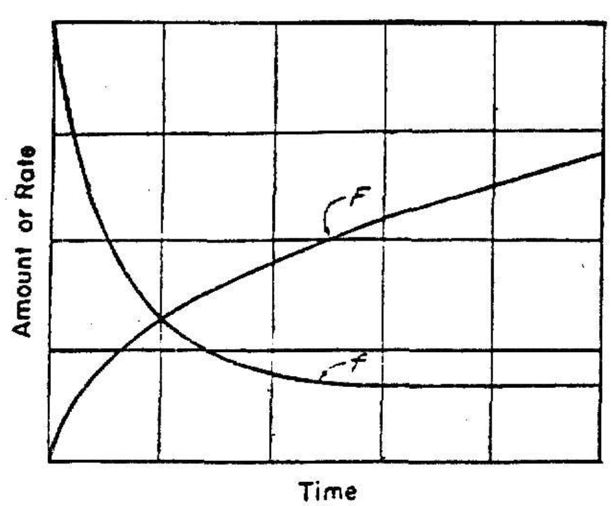
Infiltration is the "downward entry of the water into the soil" (Soil Science Society of America 1952). This involves two associated phenomena: the passage of water through the soil surface (intake) and the movement through the soil mass (percolation). The size of the surface pores will determine the amount of water that can infiltrate through them. If the surface soil has an abundance of macropores it will allow relatively fast infiltration. If the surface soil pores are predominantly of the micropore type infiltration will be slow.

The amount of water that can percolate through the subsoil will depend on such factors as the amount of water presently in the subsoil, and the texture of the subsoil. Generally, a subsoil with little soil moisture or a high clay content will have a high soil moisture tension and, thus, a high attraction for water. A subsoil that is full of water, or has a texture with less specific surface area then the surface soil will exert less tension than those previously mentioned.

During the course of wetting, changes in the soil progressively lower the actual rate of infiltration. Rain drop impact puddles and seals the surface to reduce intake capacity. Soil colloids swell upon wetting, thereby reducing the size of the pores through which the water can percolate. When muddy water enters the soil the suspended particles are filtered out clogging passageways and further reducing permeability.

The rate at which water can be transmitted in the soil depends upon the hydraulic pressure gradient of that water, or the change in watershed divided by the distance between the surface and the wetting front. As the distance to the wetting front increases, the hydraulic head decreases and the rate of intake and transmission of water correspondingly decrease. This relationship is graphically illustrated in Figure 2 Cook (1962).

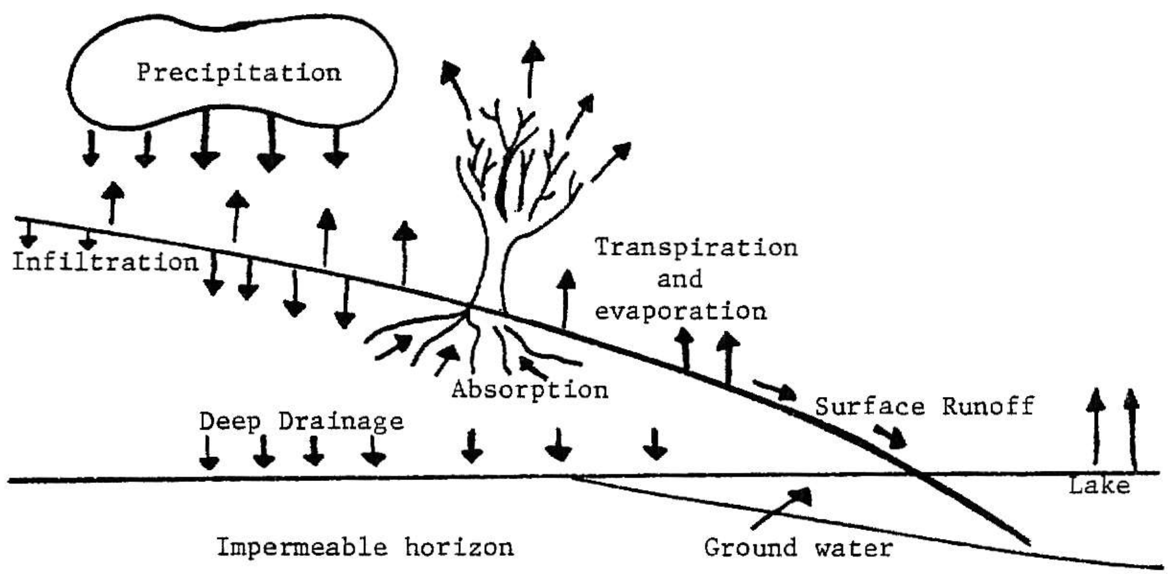
Fig. 2. Infiltration Curves. F, Mass or Cumulative Amount of Infiltration; f, Infiltration Rate (Cook 1962).



Water moves laterally through a soil by a hydraulic tension gradient. The water will move from an area of low tension to an area of high tension; this movement is called hydraulic conductivity.

Water moves from the soil into the roots of plants by the same type of tension gradient, and then through the plant and out the stomata into the atmosphere where it forms precipitation and recycles through the hydrologic cycle.

Figure 3. The Hydrologic Cycle. A Diagram Showing Disposition of Precipitation by Surface Runoff, Infiltration and Deep Drainage, and its Removal From the Soil by Evaporation and Transpiration (Kramer 1966).




Plant Nutrients

Flint Hills soils have a pH that is conducive to good plant growth. The potassium and phosphorus for most of the soils are adequate. Nitrogen is the most limiting element (Fly, 1949).

Forages on Flint Hills soils show significant yield increases with the application of fertilizer N. Degree of response will vary among sites with their variation in vegetation. Response is also related to the amount of fertilizer added. Lamond et al (1976) found that single applications of N (60#/acre) resulted in forage increases of bromegrass up to 100% with little residual effect, depending on the type of N applied. Nitrogen applications of 120 to 180 pounds per acre further increased yields of bromegrass but it is questionable if these higher rates are profitable. Fransen et al (1976) showed substantial increases in native pasture with relatively low (30#/acre) rates of N fertilizer. They also state that work done in northeast Kansas with higher rates of fertilizer N did not prove to be profitable.

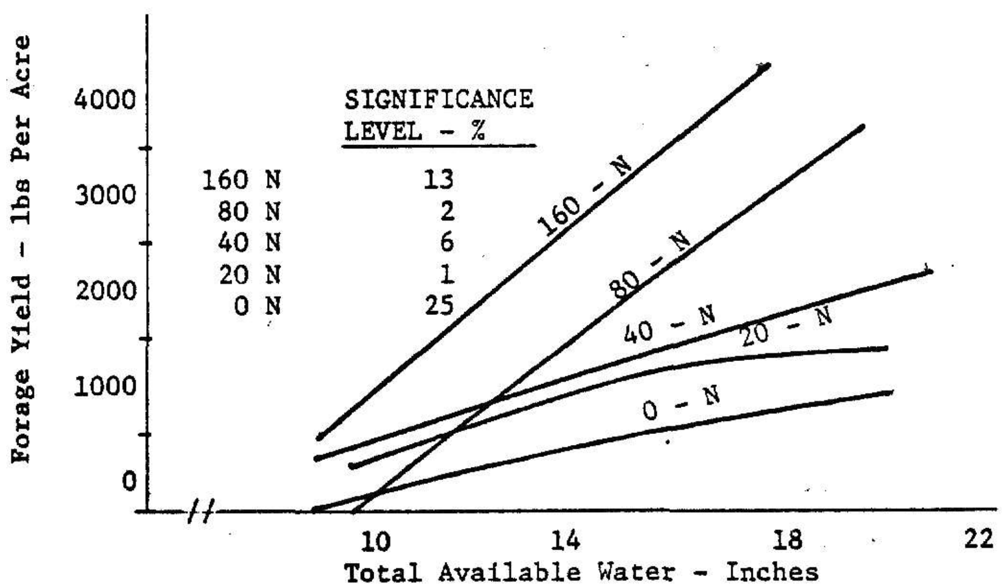
Usually when phosphorus is applied alone there is little effect on forage yield. However, with high N levels or after years of N fertilization phosphorus will become limiting (Wight and Black, and Lorenz and Rogler 1972). Forbs and shrubs will respond more than grasses to P applications.

In addition to yield response, the effects of fertilization on species composition is of major importance. The timing of the fertilizer application determines which plants will benefit most. If N is applied after spring growth of cool season grasses, the warm season grasses will benefit more. If application rates are high enough that there is residual fertilizer, then the cool season grasses will benefit the next spring. This could be detrimental to the warm season species unless early grazing is used to reduce the competitive advantage of the cool season species.

Palatability of fertilized range grasses is greatly enhanced by N fertility as evidenced by preferential grazing of fertilized plots by nearly all classes of livestock, including wildlife. This feature of forage fertilization necessitates management systems where grazing is restricted to fertilized or non-fertilized pasture units. Given free choice, animals will nearly always graze or overgraze fertilized areas and ignore non-fertilized areas. Thus, fertilizer can be used to increase animal utilization of unpalatable species such as red threeawn (Aristida longiseta), or to lure animals to ungrazed areas so that a more complete utilization of the pasture can be obtained.

Fertilization and water-use efficiency. Use of fertilizer, particularly N, has significantly increased the efficiency with which soil water is used. Because of the close relationship between Water-Use Efficiency (WUE) and forage yields, WUE response to fertilization has been as large as forage response. The data of Smika et al (1965) in Figure 4 graphically demonstrate the relationship between forage production and available water as it is affected by N fertility.

Figure 4. Effects of Available Water on Native Grass Production With Different Rates of N Fertilizer Applied Annually. Adapted from Simka et al (1965).




Not only does fertilization improve WUE but it also has the potential of increasing the amount of precipitation that becomes available for plant use. The stimulated root systems of fertilized vegetation extracts more water from the profile than non-fertilized vegetation. Thus, whenever overwinter precipitation fully recharges the profile, fertilized range will have more water available for plant use because it will, in effect, be drawing water from a larger soil-reservoir than non-fertilized range. Also the efficiency of overwinter recharge increases as the soil profile becomes drier (Wight and Black 1972).

Drouth stress tolerance is neither increased or decreased by N fertilization. In fact, when precipitation is available the next year, the carryover N will create high yields (Launchbaugh 1979).

Whether forage fertilization pays is the main question asked by ranchers. The economic feasibility of fertilization practices cannot be determined by research alone, but is subject to the fluctuations of prices in the livestock industry and needs of individual ranching situations. More information is needed for the price of beef per price of N relationship to make effective management decisions. Where economically feasible, N fertilization is an effective and practical tool. It offers the opportunity to increase forage production without buying more land.

Recent increases in the price of oil products, including N fertilizers have rekindled interest in legume-grass mixtures. Legumes growing in association with a grass generally increase the protein content of the grazed forage. Most legume-grass mixtures have higher digestability. Wagner's (1954) studies have shown that legume-grass mixtures increased the protein content of the forage comparable to applying 160# N/Acre. Furthermore, mixtures had a better distribution of production through the years. Schmidt et al (1965) indicate legume-grass mixtures have dry matter yields equaling those of grass stands fertilized with 125 to 175# N/Acre. The biggest problem with legume-grass mixtures is keeping the legume in the stand.

# PLANTS

## Major Plant Species

Our principle forages are largely in the two botanical families, the grasses, Gramineae, and the legumes, Leguminoseae. This distinction between the two families is based on the structure of the embryo. The major rootstem axis of the embryo carries lateral members known as cotyledons or seed leaves; monocotyledons (grasses) have only one cotyledon while dicotyledons (legumes) have two (Metcalf 1974).

Grasses. Grasses are either annuals or perennials. Almost all are herbacous (non-woody) plants. According to Rechenthin (1955), two primary reasons that grasses are efficient forage producers are: (1) the location of the meristematic tissue and growth habits of the plants, and (2) the ability of the plant to produce new shoots from the buds at the nodes, known as tillering.

(1). The grass stem has all its nodes and leaves in embryonic form when it emerges from the seed. Growth starts first in the basal node and leaf, pushing the rudimentary stalk upward. As that node and leaf approach full size, growth starts in the next node, then the next, and so on, until the stem reaches its full length.

The basal nodes of perennial grasses are very short. The sheaths and blades of these nodes are thrust upward, well ahead of the embryonic stem, or growing point. The sheaths and blades of the basal nodes overlap each other, forming a bundle or tube, the older more mature leaves on the outside providing a protective cover for the immature leaves and the growing stem on the inside. In some grasses, there may be 8 to 10 very short basal nodes, and the growing stem is not thrust above ground and exposed to grazing until considerable growth has occured.

An animal may graze off the leaves that are above the ground without removing the meristematic tissue at the base of the leaves, or the growing point. Herein lies one fundamental difference between grasses and legume plants which makes grasses the more efficient forage producer.

The number of short basal nodes influences how soon the growing stem is thrust above ground, within reach of the grazing animal. Little bluestem (Andropogon scoparius) for example, has 12-15 short nodes when they are mature, which may be mid-growing season. The growing point is not within reach of a grazing animal until shortly before the seed head is produced.

(2). The second important characteristic of grasses that makes them efficient forage producers is their ability to tiller. Growth harmones generally are produced in the new growing buds, preventing tiller development. However, removal of the growing stem stimulates production of new leaves from the bud scales at the nodes.

Grasses having many short basal nodes as, sideoats grama (Bouteloua curtipendula) and little bluestem (Andropogon scoparius) have many buds from which to tiller. Adventitious roots are developed at the nodes to supply the needs of the newly developed lateral branches into which the axillary buds develop.

Certain grasses have the ability to produce stolons and rhizomes, another characteristic closely associated with the ability to tiller, making them tolerant to grazing. Buffalograss (Buchloe dactyloides) and big bluestem (Andropogon gerardi) produce surface runners, or stolons, from the axillary buds on the nodes. The growing points of these grasses remain at or near the ground level, and they have a high ratio of vegetative stems to fruiting stems. They are very tolerant to grazing, even though quite palatable when growing (Rechenthin 1955).

Legumes. Forage legumes are mainly herbacious, perennial plants. Most legumes produce high quality forage but need proper management to survive grazing because of: 1) the location of the meristematic tissue and growth habits of the plants, and 2) the ability of the plant to produce new shoots after defoliation.

Most forage legumes emerge by epigeal emergence. Cotyledons are literally pulled upward through the soil, from the site of seed placement, and born aloft above the soil surface by the elongating hypocotyl. As the cotyledons are pulled free of the soil, the hypocotyl quickly straightens itself and the two cotyledons unfold to expose the plumule (embryonic leaf), which then begins to photosynthesize and grow. Death will occur at this time if the plant is grazed off below the cotyledons. The shoots develop from the apical meristem or tip of the stem. Some branching occurs from axillary buds located in the axils of leaves. Thus, the meristematic regions are not out of reach of grazing animals.

Once mature, alfalfa (Medacago sativa L.) sprouts new shoots from the crown area while birdsfoot trefoil (Lotus corniculatus L.) produces shoots from the crown in spring and axillary nodes the rest of the year. Each time these legumes are defoliated they must produce new regrowth which depletes stored carbohydrate reserves. Thus, if legumes are defoliated too often, their persistance will be decreased.

Non-Structural Carbohydrate Reserves.

Plants capture light energy and change it into chemical energy and ultimately sugars. This energy is used in two ways; (1) immediate growth and respiration energy, and (2) for future metabolic needs (Owensby 1979). Carbohydrates are translocated from sources (the photosynthesizing tissues) to sinks (the rapidly growing or storage organs) in perennial plants.

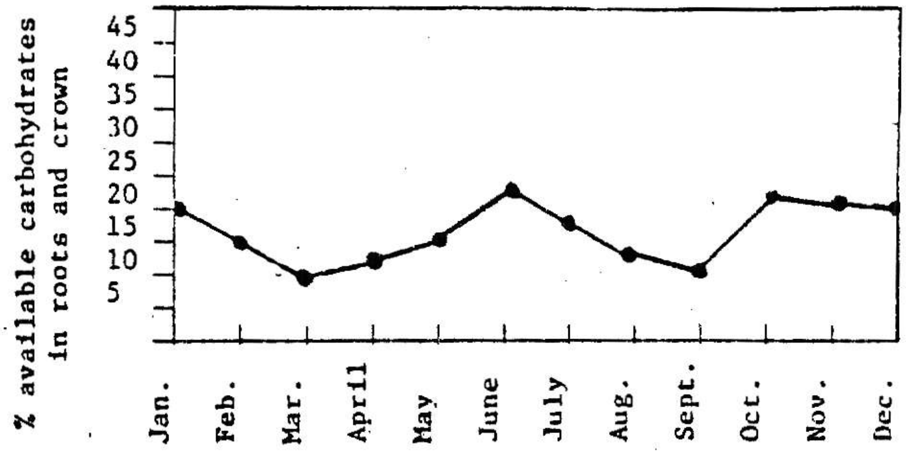
The most common form of translocated carbohydrate is sucrose, although other carbon compounds may be transformed (hydrolyzed) and resynthesized into other forms of storage products primarily starches (Sosebee 1977). Plants often store the carbohydrates as starches because it reduces the osmotic potentials of the sugars.

Grasses. The storage organs for carbohydrates in grasses include (1) roots, (2) rhizomes, (3) stem bases, (4) stolons, and (5) temporarily in the leaves and stems of the plant. The primary storage organ is the stem bases for bunchgrasses, and the rhizomes and stolons for sodgrasses. All of these areas are beyond the reach of grazing animals, which is advantageous for the plants survival.

Primary uses of stored carbohydrates include (1) beginning growth after dormancy, (2) sustaining respiration during dormancy, and (3) beginning regrowth after grazing. Cool season grasses produce earlier in the growing season, and then have some regrowth in the fall. The amount of production varies among species but the carbohydrate reserve cycles are similar. A carbohydrate reserve cycle for a typical cool season grass is shown in Figure 5. Seasonal variation in carbohydrate reserves of a typical warm season grass would be similar to that of Figure 6 provided the plants were not overgrazed or clipped. Figure 7 shows the cycle of carbohydrate reserves if the plant is clipped or grazed.

From Figure 5 we can see that burning native range on May 1 will eliminate some cool season grasses because they have used most of their carbohydrates for regrowth.

Figure 5. A Typical Carbohydrate Reserve Cycle of a Cool-Season Grass. Adapted from Kinslinger and Hopkins (1961).




Legumes. Seasonal variation of carbohydrate accumulation in alfalfa roots follows the pattern shown in figure 8 when stands are left uncut or are cut three times annually. In early spring, when the temperatures are high enough to facilitate growth, carbohydrate reserves are used for regrowth. During the bud and flower stages, carbohydrates rapidly accumulate in the roots. Just before or at seed development carbohydrate percentages level off or may start to decrease. Dobrence and Massengale (1966) attribute the decline to the utilization of carbohydrates in seed filling and development. However, it appears that the slight decline in carbohydrates at this time may also be attributed to the new crown bud formation. Thus, there appear to be two primary sinks for photosynthetic assimilates and accumulated carbohydrates during seed development. The closeness of sinks to source would suggest that photosynthetic products are the primary source for seeds and that accumulated compounds in the roots are the primary source for new basal shoots.

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Figure 6. Carbohydrate Balance and Herbage Yield of a Typical Grass Species Throughout the Annual Cycle (Cook 1962).

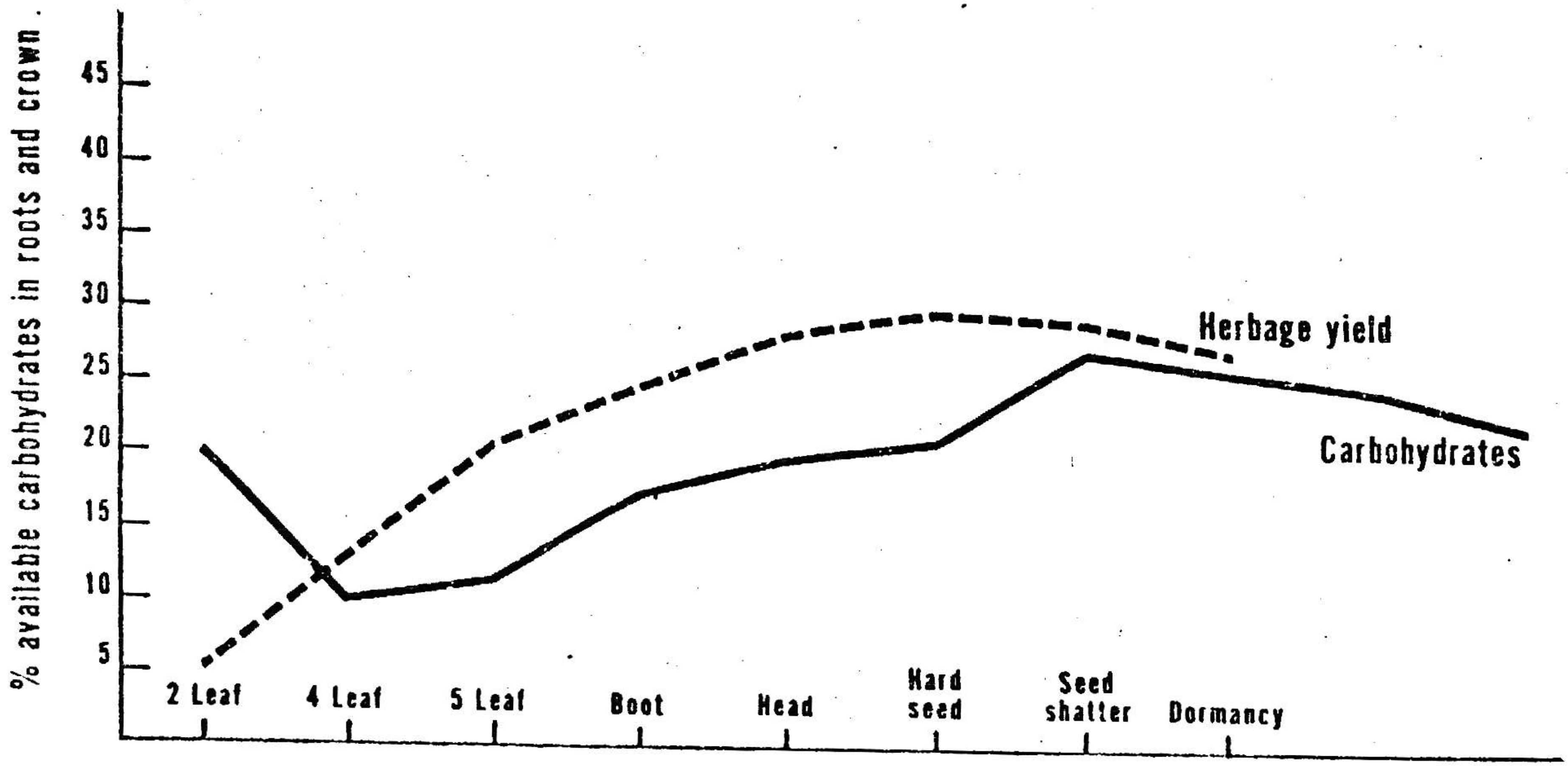


Figure 7. Carbohydrate Balance and Herbage Yield as Affected by Clipping and Fall Regrowth (Cook 1962)

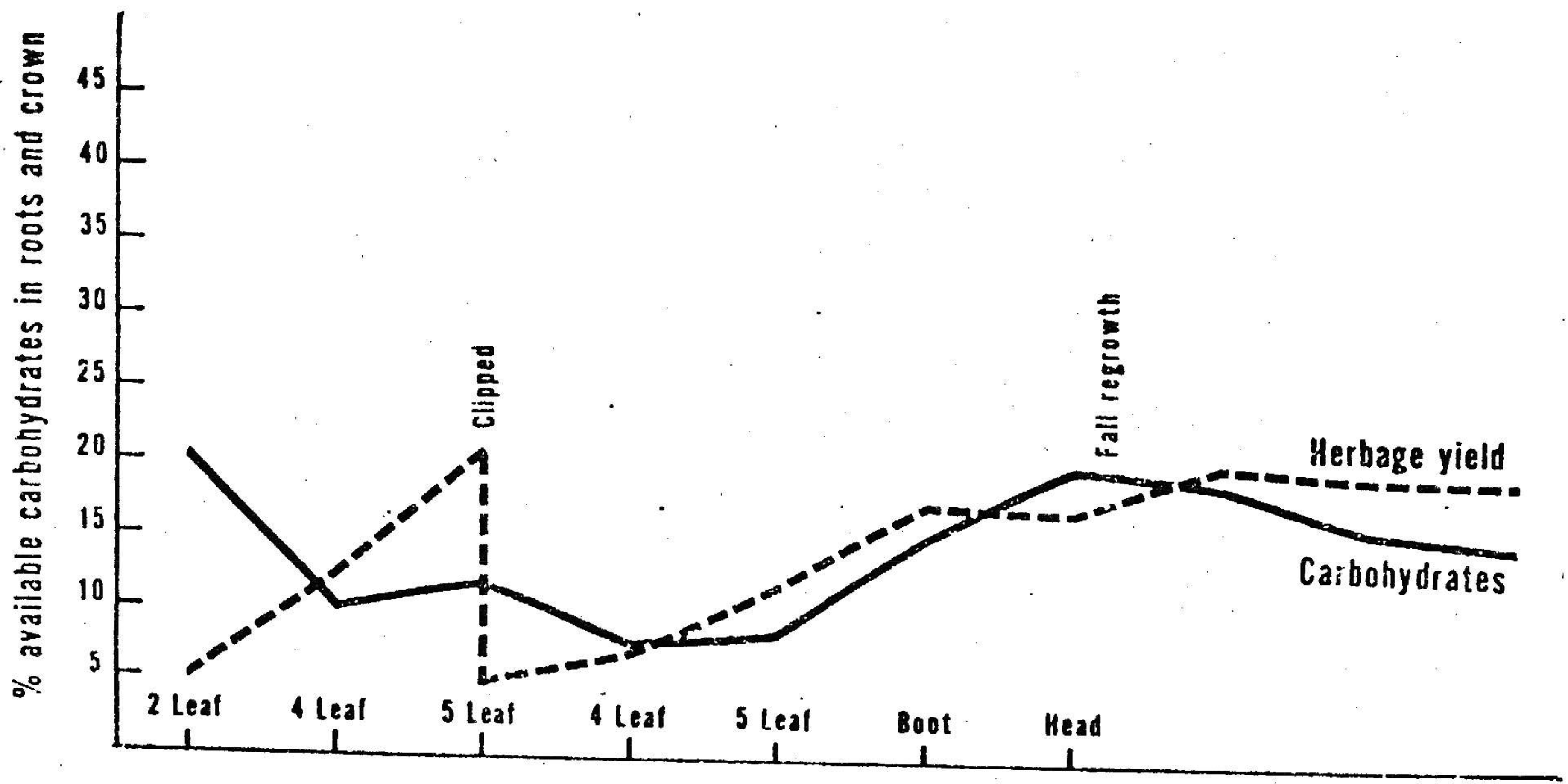
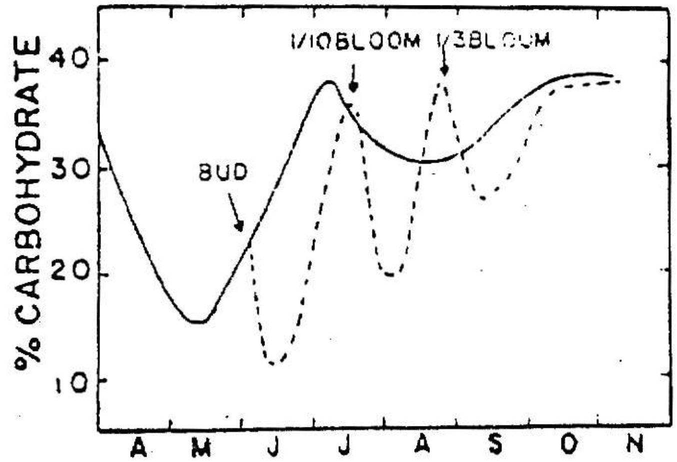


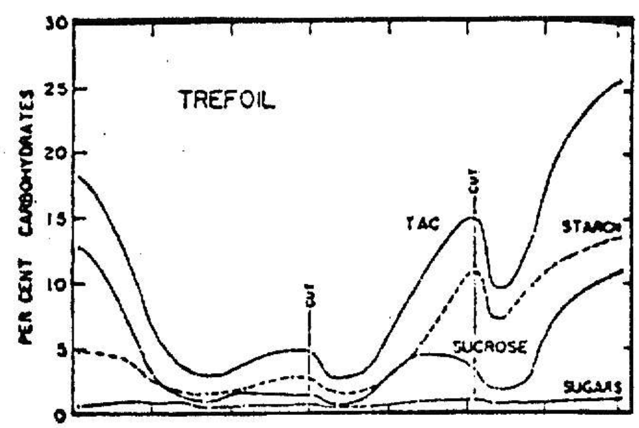
Figure 8. Seasonal Variation of Carbohydrate Accumulation in Alfalfa Roots (Smith 1967).




When tops are removed during the growing season, the level of carbohydrates follows the typical "U" shaped pattern after defoliation. Each of the three cuttings indicated in Figure 8 resulted in reductions in accumulated carbohydrate levels due to removal of photosynthetic area. In each case carbohydrate levels rose to the level of that of the uncut alfalfa or higher before the next harvest. When alfalfa is cut more frequently, carbohydrates are not replenished to high levels, plants become smaller, stands become thinner, and yields decrease (Brown et al 1972).

Birdsfoot trefoil (Lotus corniculatus L.) and alfalfa (Medicago sativa L.) are similar in several aspects of general appearance, but trefoil has several growth responses that differ from those of alfalfa. Some of these differences greatly alter recommended cutting or grazing practices. Smith (1967) observed that uncut Vernal alfalfa produced three growths during a season in Wisconsin, each growth arising from the crowns at near maturity of the previous growth. In contrast, uncut Empire birdsfoot trefoil produced virtually no new growth from the crown area after the first growth matured. Instead, new branches arose from upper axillary buds on the old shoots in a vine-like manner. Carbohydrate reserves in trefoil roots were reduced during the spring and remained at a low level during summer, whether cut or uncut. Accumulation occurred only when vegetative growth ceased in autumn, as shown in Figure 9. In contrast, root reserves in alfalfa were reduced during the spring and after each cutting and were restored as the topgrowth approached maturity. The cyclic pattern of alfalfa is typical of most perennial legumes (Smith 1967).

Figure 9. Carbohydrates Composition of Roots of Birdsfoot Trefoil Expressed as Percent of Dry Weight (Nelson et al 1968).



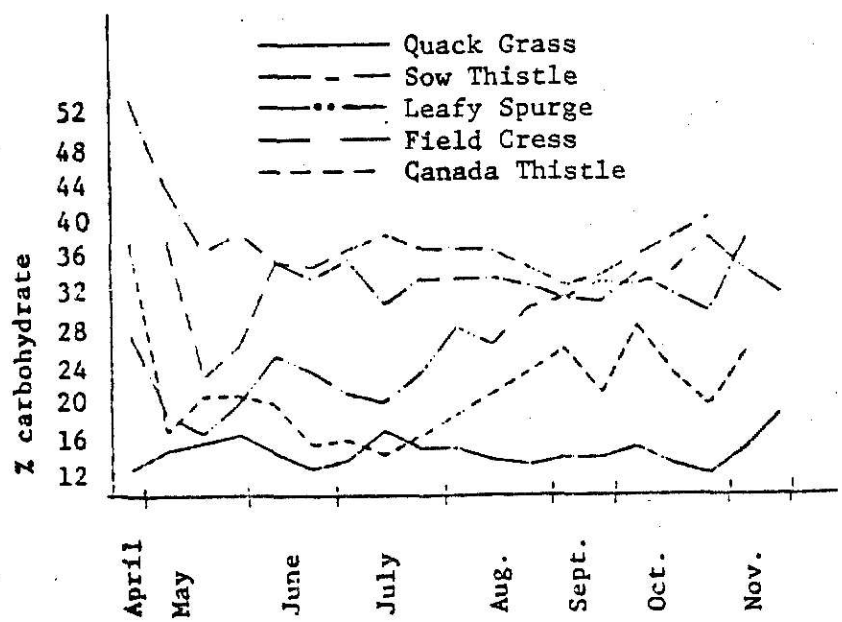

Cutting height. Cutting height is important to yield and survival of perennial forages, especially when carbohydrate root reserves are depleted from frequent cutting or other causes. A higher stubble leaves more photosynthetic area that provides additional energy for initial regrowth after cutting.

Beardsley and Anderson (1960) cut field plots of Empire and European birdsfoot trefoil and Ranger alfalfa mixed with timothy at several frequencies, leaving a stubble of about 5, 10, or 15 cm. They concluded that birdsfoot trefoil can be harvested frequently, but not closely, whereas alfalfa may be harvested more closely, but not as frequently, from a standpoint of stand longevity. Since birdsfoot trefoil has lower carbohydrate root reserves through most of the growing season, some photosynthetic area should be left after cutting or grazing.

## Management Aspects of Plant Defoliation

Defoliation effects on plant species. A manager can use the knowledge of carbohydrate reserve cycle as a tool to perpetuate or eliminate species growing in a sward (Welton 1929). If a manager wants to favor a species, he removes the top growth at a time that will allow the plant to restore its carbohydrate reserves. For example, grazing warm season grasses intensively from May 1 through July 15, and then resting the pasture allows maximum production of immature succulent growth but also allows the plants to restore their carbohydrate reserves (Owensby 1979). Removal of the top growth at a time when plants should be storing carbohydrates will decrease that species in the sward. Figure 10 shows some carbohydrate reserve curves of some perennial weeds. These curves illustrate that burning native range early in the spring can eliminate some unwanted grasses and forbs.

Figure 10. Carbohydrate Reserve Cycles of Some Perennial Weeds (Welton) 1929).



Defoliation effects on root growth. Removal of the plant canopy at any time will decrease the root growth, and nutrient absorption of the roots, in almost all plants (Crider 1954). Oswalt et al (1959) have shown marked reductions in nutrient uptake following clipping. Davidson and Milthorpe (1965) found severe defoliation of orchardgrass caused almost complete cessation of root extension; it reduced root respiration by two thirds and phosphorus uptake by four fifths. Root activity did not resume until new leaf surface had obtained considerable size. Crider's (1954) work with effects of defoliation on root growth is highly regarded. In his studies, grass roots were particularly affected by top removal whether grown in the field or laboratory. The percentage of root growth stoppage varied in proportion to the amount of foliage removed. Removal of half or more of grass foliage, whether the grasses were cool or warm season, bunch, rhizomatous, or stoloniferous caused root growth to stop for a time after each removal. Roots continued to grow in a single and repeated clipping trials of all species only when 40% or less of the foliage was removed. Drastic effects were seen with top removal of 50% causing complete and prolonged root-growth stoppage and poor shoot development (Crider 1954).

Crider (1954) also found that clipping the foliage of half the individual culms of bunchgrass stopped root growth for only those parts. Thus, when a grazing animal grazes only half of an individual culm of a bunchgrass it is to the advantage of the bunchgrass.

The continuance of a good root system is important because roots have one or more of the following roles: (1) absorption of nutrients and water, (2) anchorage and support, (3) propagation, and (4) storage of food reserves. They also play a prominent part in the welfare of other plants through (5) soil development (Cook et al 1962).

Complementary Forages

The objective of complementary forage systems is to provide young, nutritious forage throughout the grazing season. Some of the benefits of a complementary forage system are improved carrying capacity, increased longevity of the forages, and better nutrition for the herd. The actual development of complementary systems will be discussed in greater detail in the section on management. The following plants can be used to develop complementary systems for Kansas.

Cool season grasses. Barnett et al (1978) state that few crops possess a greater apparent potential for increased production than do the cool season, perennial forage grasses. These grasses can complement native range by providing forage early in the growing season and again later in the fall of the year. Vallentine (1968) states that calf weaning weights can be increased substantially by providing cool season forage early in the year for spring calving cow herds.

Smooth Brome (Bromus inermis) is the most commonly grown cool season species in eastern Kansas. Smooth brome spreads by strong, creeping rhizomes, resulting in good sod formation. Fertilized smooth brome can provide more forage on improved pastures, waste areas, and forest lands of eastern Kansas (Dicken 1976).

Proper management of smooth brome is required for continued production. Derscheid et al (1967), and Teel (1962) state that smooth brome can be grazed early in the growing season while its growing point is still out of reach of the grazing animal. Once jointing or stem elongation starts, grazing should be discontinued until boot stage. If the plant is grazed between these stages and the growing point is grazed off, the regrowth of the plant will be slow.

To be highly productive smooth brome must receive adequate moisture and a yearly fertilizer application. In the Flint Hills there normally is enough moisture for profitable smooth brome production. Dicken (1976) states that one acre of fertilized brome will produce as much as four acres of native pasture with a stocking rate of 1 to 1&1/2 500 pound steers or 1/2 to 3/4 of a cow and calf per acre, depending on livestock weights, grass production potential, and length of grazing season. Properly managed brome fields can last 20 years.

Tall fescue (Festuca arundinacea) is the second most popular cool season grass in eastern Kansas. Tall fescue is primarily grown in the southeastern part of the state, but it appears to have potential further north in the state.

Tall fescue offers grazing early in the growing season, with limited grazing in mid-season. With proper fertilization, tall fescue can provide adequate grazing into the winter until snow covers the vegetation. This late fall production is its strongest attribute for use in a complementary system. Hyde and Kilgore (1973) describe a system of continuous grazing of tall fescue. This system requires large amounts of fertilization and is more suitable to mature cattle. Yearling cattle do not gain well on fescue during June, July, and August. Yearling cattle gains of 250 to 300 pounds per acre can still be realized by grazing fescue at other times.

Tall fescue has some disadvantages, primarily low palatability and the possibility of causing fescue foot. The lower palatability of fescue can be remedied if there is no other forage available to the grazing animals. The cause of fescue foot is undetermined but is thought to be related to grazing the fescue during times of dead residue. Having mineral blocks available to the grazing animals will help prevent this problem. If the manager notices that some of his animals are showing symptoms of fescue foot he should immediately remove them from the pasture.

Winter wheat. Winter wheat often can be used for early winter and early spring grazing. The producer may utilize winter wheat by: (1) grazing until approximately April 15 and then letting the plants produce grain for harvest, (2) making hay or silage at the boot stage, and (3) complete graze-out of the crop in spring.

From 3-7 acres of wheat may be required to carry an animal unit during the early winter (Nov.-Dec.) depending on the conditions of the seedbed, rainfall, and growth. From 2-4 acres may be required to carry an animal unit during the early spring (Feb.-Mar.). The greatest carrying capacity is in April when 1/2 acre will carry an animal unit (Anderson 1956). Owensby and Posler (1977) state that since grazing after jointing (approximately April 15 to May 11) will reduce grain yields substantially, this grazing should be considered as the graze-out period. After wheat is grazed out, this same land can be used to plant a summer annual, if there is sufficient soil moisture or if irrigation can be provided.

Wheat is rich in protein and minerals during active stages of growth and also contains sources of essential vitamins (Anderson 1956).

The culture of wheat for pasture is essentially the same as for grain except that heavier seeding and fertilizer rates are used for pasture. The crop is also sown somewhat earlier if more fall pasture is desired, although hessian fly might be a hazard (Anderson 1956).

Summer annuals. Summer annuals offer grazing during the hot summer months when most other forages decline in forage value. Summer annuals can be used for pasture, green chop, silage, and hay. Research has shown that the proper type of summer annual should be selected for each method of use (Kilgore 1975). Nuwanyakpa et al (1979) state that because of differences in their anatomy and growth characteristics, there is a reward to the producers who carefully select the proper crop to match their livestock needs.

Sorghums and millets are valuable in the development of year round forage systems, especially for a cow-calf operation. Owensby (1979) has indicated that growing animals would gain better on other feeds during this time of year, such as irrigated alfalfa pasture, or in a feed lot.

Prussic acid poisoning is a potential problem in some of the sorghums. The short, young, dark green growth or regrowth of some of the sorghums is the portion of the plant that is potentially dangerous to livestock. The height at which the summer annuals can be safely grazed differs among types. A good rule of thumb is to start grazing sudangrass when the plants are 18 to 24 inches tall with little danger of poisoning (Kilgore 1975).

Alfalfa. Alfalfa is properly termed "Queen of Forages" because of its use over centuries, and because it provides more protein per acre than any other crop for livestock (Hanson and Barnes 1973). Alfalfa can be grazed, dehydrated and pelleted, used for making hay, or ensiled.

Alfalfa will tolerate pasturing when rotationally grazed. Stands weaken rapidly if grazed continuously. If grazed in pure stands a bloat preventative such as poloxalene should be used. Accord (1969) describes how beef yields of 1736 pounds per acre were obtained by rotationally grazing irrigated alfalfa. Cope (1974) indicates yields of 1900 pounds per acre were achieved in his research. He also indicates that irrigated alfalfa can complement graze-out small grain pastures. Some suggestions for high beef production on irrigated alfalfa pastures are; (1) have calves weighing 450 to 550 pounds when turned in on the pasture in spring, more if in mid-season, (2) treat periodically for flies, (3) divide pasture into 5 or 6 pastures and graze each for 4 to 5 days, (4) allow the alfalfa to recuperate for 25 to 30 days before grazing again, (5) irrigate according to plant needs, usually every 14 to 21 days, (6) feed 1 gram of poloxalene per 100 pounds of beef cow, (7) do not graze alfalfa earlier than 1/10th bloom, prior to this time it is too high in soluable protein and the potential for bloat is much greater, (8) allow the plants to mature to full bloom once in the season to restore carbohydrates, (9) turn the animals in on the fresh forage in the evening after they have been feeding most of the day to help prevent the possibility of bloat (Accord 1969, and Cope 1974).

Alfalfa may also be grazed in mixtures with both cool and warm season grasses if a proper rotational grazing program is used. The alfalfa plant is erect in growth which facilitates easy grazing of the nutritious plant.

Birdsfoot trefoil. Birdsfoot trefoil is more tolerant to acid, infertile and poorly drained soils than alfalfa. It also has the advantages of being drouth tolerant, and is a non-bloating legume. Some problems of persistance of the stands have been noted, but birdsfoot trefoil will persist well if allowed to reseed during the year. Birdsfoot trefoil has been reported to be more difficult to establish, slower to recover after grazing, and lower yielding than alfalfa (Sears 1979).

As was previously mentioned birdsfoot trefoil sends out its regrowth from nodes on its branches rather than from shoots from a crown such as alfalfa. Some varieties such as Dawn and Empire grow more prostrate than other varieties of trefoil. This prostrate growth characteristic makes them less accessable to the grazing animal. This characteristic helps to preserve trefoil in the sward (Dobson 1976).

# ANIMALS

Grazing animals are selective eaters. They will continually select diets that are higher in nutrition than samples that are clipped from the same areas by a research.

If there is a relatively low stocking rate the grazers will only select the nutritious forage and leave the forages of lesser quality. As the stocking rate is increased the grazers will consume more of what is to them a less desirable forage, even though the nutritional quality of that forage may be high.

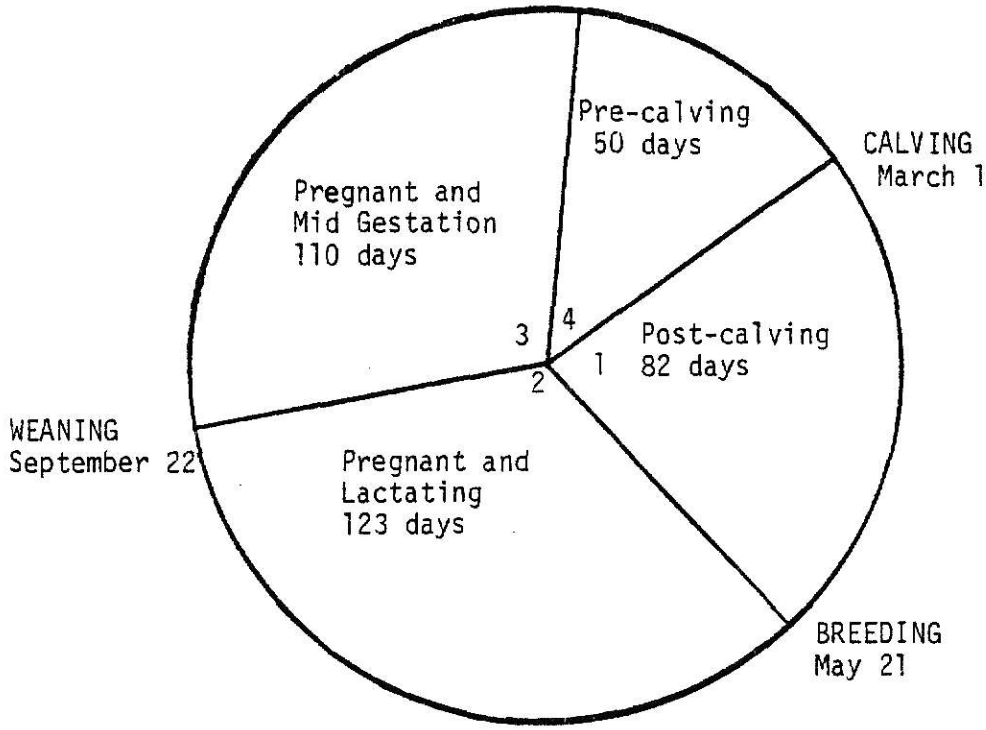
Quality of forage is not the only factor that determines what and where animals will graze. Bell (1973) explains that easily accessable grazing is always used first, rather than the forage on steep, rough, terrain. Distance from water, extremes in temperatures, direction of prevailing winds, and other factors influence grazing habits of livestock.

## Nutrient Requirements of Beef Cattle

Cow-calf. The beef cow and calf have different nutritional requirements throughout the year. According to Corah (1977), these nutrient demands vary with: stage of production, age, condition, weight, and breed of animal. Various environmental factors also affect nutrient demands of a cow herd.

Stage of production. One of the best ways to evaluate the cow year is to begin with calving and end with production of the next calf. The beef cow should produce a big healthy calf every 365 days. Figure 11 gives the breakdown of the cow year for a spring calving cow.

Figure 11. Cow Year for a Spring Calving Cow.




Period 1 is the highest nutrient demand period. During this 82 day period, the cow is lactating at her highest level. In the first 15 days after calving the energy in the milk is equal to all the energy in the 280 days of gestation (Garrett 1976). If the cow is poorly fed during this period, it will reduce milk production, calf growth, percent of cows cycling during breeding season, and conception rates (Corah 1977).

During period 2 the cow should be in the early stage of pregnancy while also lactating. However, the cow's nutritional demand is not as high as in period 1 (Corah 1977). The calf is starting to graze, thus decreasing the demand from the cow and increasing the demand for forage (Launchbaugh 1979).

Period 3 following weaning of the calf, is referred to as mid-gestation. Nutritional demand of the beef cow is lowest during this period. It is at this time when some of the rough low quality forages can be used (Corah 1977).

Period 4 is the second most important period during the cow year. During this period 70-80% of the fetal growth occurs. The cow should be fed well enough to gain weight. Providing good nutrition at this time will increase percentage calf crop and conception rates at breeding (Corah 1977). Pruitt et al (1979) found that feeding 3 pounds of alfalfa and 6 pounds of grain sorghum was sufficient to satisfy the needs of spring calving cows.

The age of the animal. Heifers about to produce their first calf should be handled separately from the rest of the cow herd. Schalles et al (1979) found that heifers with high first winter gains a year later produced calves 15 pounds heavier at 90 days, and 35 pounds heavier at weaning than heifers with low first winter gains. The difference did not result from milk production, and may reflect fewer calving problems and superior mothering ability.

The heifers should not be too fat the second year; a weight goal of 850-900 pounds at calving is optimum. To achieve this goal the heifers should be fed separately from the rest of the herd so they do not get "bossed" around by the older cows.

Condition. This simply means if the cows are too fat they should be fed less. Results of a Kansas State University study conducted by Dr. Bob Schalles (unpublished) are shown in Table 2. Cows that were initially in fat condition could be fed less, lose more weight, and still rebreed as early and at as high a level as the cows fed higher levels that were thinner at the start.

Table 2. Feeding According to Condition (Schalles unpublished).

| Condition | Level of Daily Feed | Weight Change | Conception Date | % Conception |
|---|---|---|---|---|
| Fat | 3 lbs Alfalfa | -115 | June 21 | 93.7 |
| Average | 3 lbs Alfalfa<br>3 lbs Milo | -37 | June 18 | 89.5 |
| Thin | 3 lbs Alfalfa<br>6 lbs Milo | +5 | June 27 | 93.3 |

Growing Cattle. Growing cattle require increasingly more forage as they get older. A good rule of thumb is to allow 0.1 AUM for every 100 pounds of body weight. Growing animals also require a higher quality forage to gain a reasonable amount over the grazing period. Swartz (1979) says that growing calves require 14-15% crude protein in their diet to make sufficient gains.

## Cow Herd Management

In order to increase the efficiency and profitability of many cow herds, tradition needs to be broken. Too many managers let their bulls run with the cow herd the full season. In many operations, the entire cow herd is managed as one large unit instead of several smaller herds. Productivity of the cow herd is seldom known. If these same managers were growing a field crop, they would know how many bushels per acre were produced. Similarly, with the cow herd, the producer should know how many pounds of beef per acre and how many pounds per animal he is producing.

Calving. Swartz (1979) states that if a manager wants to evaluate his operation he should start with the sequence of calving. The most desirable length of calving season is 60 days. This should be a producers goal. The following steps are necessary for achieving a 60 day calving season. (1) Breed replacement heifers 1 estrous cycle prior to the cow herd but for only 45 days. (2) Pregnancy check the regular cow herd at weaning time and cull any open cows because any that have a late calf will continue being late. (3) Cull any cow or heifer that has difficulty calving. (4) Cull any cows weaning light calves. (5) Keep good records to evaluate the progress of the cow herd, including what estrous cycle cows were bred, and calf weaning weights. (6) Proper identification by ear tagging will help a manager remember his cow herd better.

Figure 12. A Typical Identification Tag of a Beef Cow.

I D Code

4 Sire

58 Number of the calf

N Year

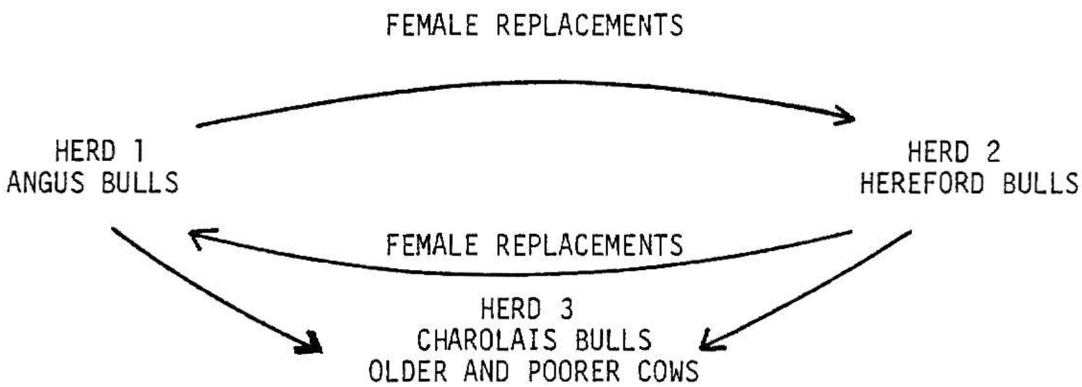

The timing of the calving, either spring or fall, is a very important consideration for the beef cow producer. This decision should be based upon the availability of forage supplies to carry the cows through their peak demand periods.

If the calving is around November, the calves will be able to graze when the succulent and nutritious spring growth occurs. However, if calving occurs in the spring, forages in mid-summer may be inadequate for calf needs when it starts to graze for itself, unless complementary forage can be provided. A calf cannot compete adequately for forage with a grazing cow when the forage supply is inadequate.

Bull selection. Selection of genetically superior bulls with good breeding potential cannot be accomplished by simply choosing one that looks good. The bull should have a scrotal circumference of 32 cm. or more. Before a bull is purchased it should be watched to see if it has proper sex drive. Seman should be evaluated to determine sperm content. At the age of 2 years a bull should have maximum sperm production, after 5 years of age its performance usually starts to decline (Swartz 1979).

Breeding program. A good commercial breeder should use a crossbreeding program. Using two breeds of cattle will increase weaning weight by 5%, three breeds can increase average weaning weight by 21%. These systems require more intensive management but the returns are greater. Figure 13 illustrates a 3 breed crisscross terminal breeding system.

Figure 13. A Crisscross Breeding System for Beef Cows.




All heifers that are obtained from the Hereford bulls will be bred to the Angus bulls, and visa versa. Once the cows have had one calf from the opposite bull they are moved to the Charolais bulls, where they will stay until they are culled.

# MANAGEMENT

## Components of Management

The American Management Association lists the following steps as essential for good, efficient management.

Planning. In order to plan effectively the manager must set objectives, evaluate his resources, consider alternatives, select the course of action, use planning aids, and make long range plans.

Setting objectives that are obtainable requires the manager to evaluate his goals, his available time, and his management ability.

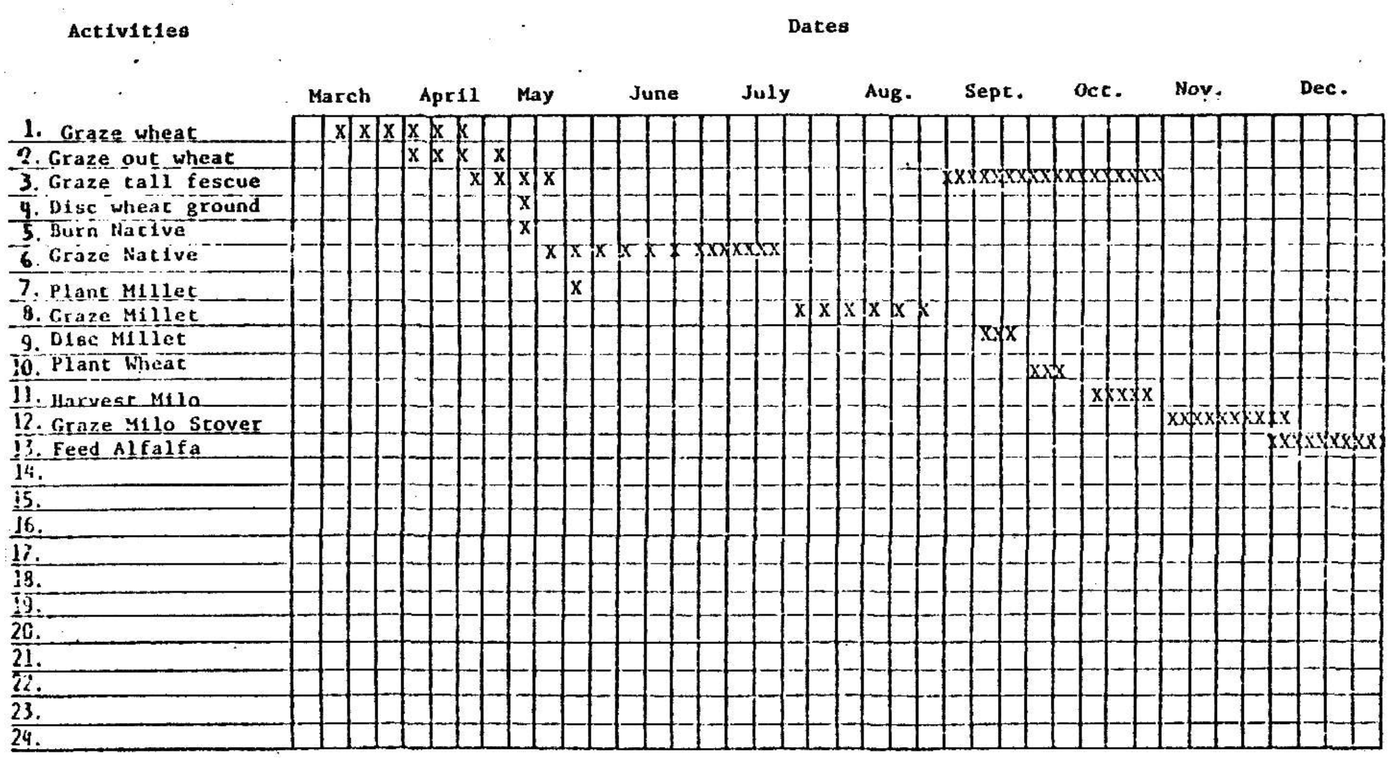
The resources a manager has will be a major limiting factor of the type of system he will have. Such things as buildings, cattle, fences, water, soils, credit, location, and available forages will determine the production potential of a ranch.

Considering alternatives requires a manager to compare his chosen plan with other possible systems. It also includes the ability to change in case of unexpected events, such as drouth, disease, market fluctuations, and wildfire damage.

After evaluating the possibilities, the manager must choose the system that best fits his operation and select the course of action. This will include choosing the forages to produce and the type of cattle operation he can manage.

Planning aids are very helpful in choosing and scheduling the production events, the livestock forage requirements, the forages that are possible to grow, and the times the forages produce. Charts that include this information enable the manager to plan events such as producing forages and moving cattle. The Gantt chart (Figure 14) enables the manager to list the various production events in chronological order.

Figure 14. A Gantt Chart (American Management Association 1977).



Long range planning extends 2, 3, or even 5 years into the future. These plans could be the manager's ultimate goals or perhaps a step to an even more far reaching goal.

Organizing. Organizing establishes the framework and the conditions within which the work of the plan can be accomplished. There are three activities in organizing; analyzing the work, defining the work, and delegating the work. Analyzing the work requires deciding the work needed to accomplish the goals. Defining the work requires decisions of who is accountable or responsible for getting certain projects done. Delegating the work is actually giving the authority to someone to get the task accomplished.

Controlling. This function completes the other two functions. Controlling is monitoring the progress of the operation to make sure the results achieve the objectives as closely as possible. Controlling may require changing the plans to allow for unexpected events, such as crop failure.

The manager determines the future of the soil, plant, animal, and management complex. If the manager does not utilize proper management principles, it will seriously affect the success of his business.

## Planning a Forage System

Determine the animal needs. A beef cow herd will have different nutritional requirements throughout the year. A manager must know these needs to provide proper forages at all times. Table 3 summarizes the beef animal requirements in Total Digestable Nutrients (TDN) and in the Animal Unit Month (AUM). AUM is the amount of feed necessary to feed a 1,000 pound cow for one month. Table 4 summarizes the monthly forage requirements for the cow herd. These charts allow a manager to determine where

Table 3. Beef Animal Requirements (Posler 1979).

| Period | Days | TDN/Day | AUM |
|---|---|---|---|
| I - Post calving | 83 | 12-14 | 1.2 |
| II - Lactating and Pregnant | 123 | 11-12 | 1.05 |
| III - Mid-gestation | 110 | 7-8 | 0.7 |
| IV - Precalving | 50 | 10-11 | 1.0 |
| Calf Requirements | | | |
| I - 1.60 lb. ADG | | 1.1 | 0.1 |
| II - 1.60 lb. ADG | | 3.2 | 0.3 |
| Growing Steers | | | |
| 400 lbs. - 1.65 ADG | | 6.9 | 0.65 |
| 500 lbs. - 1.65 ADG | | 8.6 | 0.8 |
| 600 lbs. - 1.65 ADG | | 10.1 | 0.95 |
| 800 lbs. - 1.65 ADG | | 12.8 | 1.20 |
| Replacement Heifers | | | |
| 400 lbs. - 1.65 ADG | | 7.3 | 0.7 |
| 500 lbs. - 1.65 ADG | | 9.2 | 0.85 |
| 600 lbs. - 1.65 ADG | | 10.9 | 1.0 |
| 800 lbs. - 1.65 ADG | | 13.7 | 1.3 |
| Finishing Steer Calves | | | |
| 400 lbs. - 2.1 ADG | | 7.3 | 0.7 |
| 500 lbs. - 2.1 ADG | | 9.1 | 0.85 |
| 700 lbs. - 2.1 ADG | | 12.2 | 1.15 |
| 900 lbs. - 2.1 ADG | | 14.5 | 1.35 |
| Finishing Yearlings | | | |
| 500 lbs. - 2.9 ADG | | 10.6 | 1.0 |
| 600 lbs. - 2.9 ADG | | 12.3 | 1.15 |
| 800 lbs. - 2.9 ADG | | 15.2 | 1.4 |
| Bulls | | 15.2 | 1.4 |

Table 4. Livestock Forage Requirements (Posler 1979).

| Livestock | | Computed AUMs of forage required | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kind | No. | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
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| | | | | | | | | | | | | | |
| TOTAL AUMs required as forage | | | | | | | | | | | | | |

1. Upper left corner = AUM requirement for that month.
2. Upper right corner = % forage utilized in the ration that month.
3. Lower half = AUMs of forage for that month.

adjustments in his herd are needed to balance with his available forage, or where to produce added forage for use during times of need throughout the year.

Inventory of forage resources. Once a manager knows the monthly animal needs, he then must determine ways to satisfy the AUM requirements. There are many possible forage plants to grow and numerous ways to combine them into systems. Table 5 lists some possible forages that can be grown and the approximate seasonal distribution of production in Kansas. The AUM are estimates of the quantity of forage produced with low, medium, and high management ability. Table 6 is a forage planning worksheet that allows the producer to list the types of forages to be produced at different times of the year, and to calculate the AUM the forages will provide. By comparing the animals needs with the forage produced at various times, the manager can plan to utilize the excess or feed in times of deficit.

## Components of a Forage System

Complementary forage systems. Complementary is defined as mutually supplying each others lack (deficiency) Bogle et al (unpublished). Thus, as applied to season-long livestock production, using complementary forages is the proper integration of roughages having different seasonal quality and quantity characteristics into season-long roughage systems that most efficiently and economically meet the grazing animals nutritional needs. Each forage is a counterpart of another, and they become mutually dependent.

The advantages of using a complementary system are many. The cattle can graze round nutritious growth throughout most of the grazing season. The rate of gain is higher, and the gain per acre is better than with a single pasture. McIlvain (1976) believes that development of complementary

Table 5. Forage Resources for Grazing (Posler 1979).

| Forage | % Produced by Months | | | | | | | | | | | Total (AUM/Acre) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Low | Med | High |
| Shortgrass Range | | | 10 | 35 | 35 | 10 | 10 | | | | | 0.4 | 0.8 | 1.2 |
| Tallgrass Range | | 5 | 30 | 33 | 18 | 10 | 4 | | | | | 1.5 | 2.5 | 3.5 |
| Interm. Wheatgrass | | 8 | 33 | 33 | 16 | 8 | 2 | | | | | 1.5 | 2.5 | 3.5 |
| Ky. Bluegrass | 5 | 10 | 30 | 30 | | | 20 | 10 | | | | 0.9 | 1.8 | 2.5 |
| Sm. Bromegrass | 5 | 15 | 30 | 20 | | 8 | 17 | 5 | | | | 2.0 | 2.5 | 3.0 |
| Sm. Bromegrass + N | 5 | 15 | 50 | 10 | | 5 | 10 | 5 | | | | 3.9 | 4.7 | 6.0 |
| Tall Fescue | 5 | 5 | 35 | 30 | | 17 | 8 | | | | | 2.0 | 2.5 | 3.0 |
| Tall Fescue + N | 5 | 15 | 35 | 15 | | 8 | 17 | 5 | | | | 3.8 | 4.7 | 6.0 |
| Tall Fescue (Defer.) | 5 | 5 | 30 | 20 | | | | 20 | 20 | | | 3.5 | 4.5 | 5.7 |
| Alfalfa-Brome | | | 30 | 30 | 15 | 10 | 15 | | | | | 3.0 | 5.0 | 7.0 |
| Bermudagrass + N | | | 15 | 30 | 20 | 15 | 20 | | | | | 8.0 | 12.0 | 16.0 |
| Irrig. Past. | | | 23 | 23 | 15 | 15 | 8 | 8 | 8 | | | 6.0 | 9.0 | 12.0 |
| Wheat (Grain) | 40 | 20 | | | | | | 15 | 20 | 5 | | 0.3 | 0.7 | 1.5 |
| Wheat (Graze Out) | 10 | 25 | 35 | | | | | 5 | 15 | 10 | | 1.5 | 2.0 | 3.0 |
| Rye | 15 | 25 | 20 | | | | | 15 | 15 | 10 | | 1.5 | 1.8 | 2.1 |
| Spring Oats | | | 33 | 67 | | | | | | | | 1.0 | 1.3 | 1.6 |
| Summer Annuals | | | | | 45 | 45 | 10 | | | | | 2.0 | 3.5 | 5.0 |
| S. Annuals (Defer.) | | | | | | | | 30 | 45 | 25 | | 1.8 | 3.2 | 4.5 |
| Sorghum Stubble | | | | | | | | 20 | 40 | 30 | 10 | 0.8 | 1.4 | 1.8 |
| Cornstalks | | | | | | | | 20 | 50 | 20 | 10 | 1.0 | 1.7 | 2.0 |

1/ Adapted from data by Barnett, Murphy, Posler and Owensby (Kansas State), Wedin (Iowa State), Moline, et al. (Nebr.), Murphy et al. (Missouri), and McMurphy (Oklahoma State). Compiled by G. L. Posler, Department of Agronomy, KSU.

Table 6. Forage Systems Worksheet (Posler 1979).

| Type of Pasture | Acres | AUM/A | Total AUM | AUM available by months for each type pasture indicated | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Jan | Feb | Mar | Apr | May | Jun | July | Aug | Sept | Oct | Nov | Dec |
| | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | |
| TOTAL AVAIL. GRAZING | | | | | | | | | | | | | | | |
| TOTAL REQUIRED | | | | | | | | | | | | | | | |
| EXCESS OR DEFICIT | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| HAY | | | | | | | | | | | | | | | |
| SILAGE | | | | | | | | | | | | | | | |
| OTHER | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |

systems is the most promising way to bring about significant increases in grazing land carrying capacity. He also reported great success using 3 parts range to 1 part double cropped forage.

A complementary system has some versatility in that the crop land can be adjusted to fit the grazing forage that a producer has. Some examples of complementary systems should be helpful to producers as they design their own systems. Chyba (1974) had considerable success with a simple complementary system, consisting of native range and smooth brome. Cows initially grazed native pasture from May 1 to December 4, at which time they were allowed to spend one day (24 hours) on brome pasture. A rotation of five days on native, one day on brome pasture continued through December. In January four days were spent on the native, one day on brome. Days on native were reduced to three days in February and two days in March. The month of April the rotation was discontinued and cows were allowed to graze brome full time until May 1 when they again grazed native range full time.

Another possibility for a cow calf operation would be to provide complementary forage such as millet or sudangrass for the calves but not the cow by using a creep gate excluder. The calves can graze as much of the complementary forage as they desire while they are growing.

A complementary system for growing cattle could include a cool season forage, then double intensive early stocking of native range as described by Launchbaugh and Owensby (1978), then to irrigated alfalfa. After this they could be fed to market weight in a feed yard.

<u>Grazing systems</u>. A grazing system consist of one or more planned grazing treatments which use livestock to bring about changes in the kind or amount of vegetation. These changes are determined by measuring vigor, reproduction, and composition of key species. In native range of the Flint Hills some

key species would be big bluestem, indiangrass, and switchgrass. In complementary forages the key species is the variety planted, or in a mixture, the species that needs to be favored.

No one system is best because each producer has a different operation and different forages. There are many grazing systems to choose from, each with research data to substantiate that it is an adequate system for the production of beef cattle. Of more importance than defense of one system or another is the understanding of factors which influence the results. Such factors as stocking rate, relative resistance of plants to grazing at different seasons, uniformity of pastures, frequency of grazing, and time between deferment periods will influence longevity of the forage, and performance of the grazing animal. Knowledge of different systems will help a manager to broaden his perspective of what is possible to fit into their operation.

Continuous grazing is a free choice forage system that requires very little from the manager. Basically you turn the cattle loose at the beginning of the season and gather them up at sale time. This is oversimplified but the management requirement is minimal.

Deferred grazing allows a period of rest for pastures or ranges. This was the first step in planned grazing management (Bell 1973). During a 12 year study at Manhattan, livestock gains were slightly higher and gains per acre were much higher from a system of deferred grazing on Flint Hills bluestem range complemented with smooth brome than from native range alone (Launchbaugh and Owensby 1979).

Harlan (1960) states that deferment tends to increase forage yields on depleted ranges, but it may have little or no advantage for top condition ranges.

Rotational grazing is a systematic schedule of moving livestock from one grazing unit or pasture to another, usually where more than two pastures are used. Such a system involves a rather fixed number of cattle moved at a rather fixed time (Bell 1973).

Reardon et al (1976) states that pasture rotation allows better forage plants to become more numerous and vigorous while the pastures are being grazed at a heavier grazing pressure.

Some drawbacks of using a rotational system are; weight losses due to the livestock having to graze the pasture closely before they can be moved to the new pasture. If native pasture is the only forage used the nutritional value of forage will be lower at the end of the season so gains will be lower. In a complementary system the producer would not have to suffer these losses. The economics of providing new fences, water developments, fertilizers, planting cost etc. should be included when considering rotational grazing.

In rest rotational grazing, the grazing on various parts of an allotment during succeeding years, and deferred parts are allowed complete rest for one or more years (Soc. of Range Management 1974).

The type of system to develop depends on how intensive an operation the manager is capable of managing. If the manager has very little time, and cattle are a sideline to his regular business, he probably will not be able to intensify his operation much. A manager who has been in the cattle operation for many years could probably benefit from making some new goals and studying newer methods of management. Each individual must evaluate his present situation and decide if he should spend additional time and money to intensify his operation.

# SUMMARY

This study was initiated to evaluate the relationships in the Soil, Plant, Animal and Management complex. The results indicated many advantages can be obtained by fulfilling the needs of each facet of the (SPAM) complex.

1. The soils of the Flint Hills need to have plant cover throughout the year to reduce erosion, excessive evaporation, and mineral loss. If soils have adequate depth, fertility, and permeability they can support plant life and thus produce forage for grazing cattle.
2. Plants require proper management to assure timely defoliation, and an optimum amount of nutrients. Various plants can be combined to form complementary forage systems which can provide young nutritious forage for grazing animals throughout the grazing season.
3. Animals have different nutritional needs throughout the year. The quality, quantity, and type of forage provided the animals during these wet demand periods will effect the rate of gain, calving percentage, conception rates, and general health of the animals.
4. Good management is needed to assure that all the requirements of the (SPAM) complex are provided. There are various planning charts available to help the manager accomplish his goals.

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DEVELOPING YEAR-ROUND FORAGE SYSTEMS

FOR BEEF CATTLE IN EASTERN KANSAS

by

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B.S., Kansas State University, 1971

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AN ABSTRACT OF A MASTER'S REPORT

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ABSTRACT

A year-round forage system involves the interaction and interdependancy of the Soil, Plant, Animal, and Management (SPAM) complex.

The soils component of a system greatly influences the kind and amount of forage produced to accommodate animal needs. Fertilized soils produce more and higher quality forage than unfertilized soils.

Grasses and legumes make up the major plant families of eastern Kansas grasslands. These plant species require different management because they exhibit different growth characteristics. Various species can be combined to produce complementary forage systems, allowing beef cattle to graze young, nutritious forage throughout an extended grazing season.

The nutritional requirements of beef cattle vary depending on age, stage of production, condition, breed, and environmental characteristics. Thus, adjusting forage resources to meet animal needs at different times is essential. Excellent cowherd management includes a shortened calving season, proper bull selection, a selective breeding program, and planned grazing systems.

Management involves Planning, Organizing, and Controlling: Planning requires the manager to set obtainable objectives, evaluate his resources (SPAM), select the course of action, use planning aids, and make long range plans. Organizing establishes the framework and conditions within which the work of the plan can be accomplished. Controlling is monitoring the progress of the operation to make sure the results achieve the objectives as close as possible. Controlling may require changing plans to allow for unexpected events.

To develop a forage system, the manager must determine the animals' needs, inventory the forage resources, and then balance the animals'

needs with available forages throughout the grazing season. This can be accomplished best with complementary forages and planned grazing systems.