HAY AND FERTILIZER STRATEGIES

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Hay is a necessary evil of the livestock business. It is expensive to produce because of fertilizer costs, expensive to harvest because of necessary cutting, raking, and baling equipment, and requires labor and diesel to haul hay in to a storage area and haul out to feed. It has been written many times that the greatest expense for maintaining a beef cow throughout the year is the winter feeding period. Warm-season perennial grasses are the basis of pasture systems in Texas. However they are dormant from the first killing frost in autumn to initiation of new growth in spring.

In the low rainfall areas in the western part of Texas, cows usually graze dormant summer grasses during the winter with some form of supplementation. Warm-season perennial grasses that are native to the Southern Great Plains and evolved under periodic grazing by bison predominate in the western part of Texas (average rainfall 10 to 25 inches) because they are well adapted to the moderately fertile soils, low rainfall and periodic droughts. Fertilizer is seldom applied because moisture is usually the most limiting factor for growth. Good grazing management in terms of a proper stocking rate and some type of grazing system are critical for stand persistence of most native grasses. Forage **QUANTITY** is more of a concern than forage quality because of the limited rainfall.

In eastern Texas the native vegetation was primarily a soft-hardwood forest with native grasses growing small open areas. The Gulf Coast Prairie in southeast Texas is an exception. Introduced grasses that evolved under continuous grazing in South America and Africa are primarily used in this high rainfall area (35 to 50 inches annual rainfall). The common practice for over wintering beef cows is to feed hay with some supplementation and overseed warm-season perennial grasses with cool-season annuals. Cool-season annual grasses such as rye, wheat, oats, barley, triticale, and ryegrass are high quality but expensive because of land preparation, seed cost, and fertilizer inputs.

The predominant warm-season perennial grasses are sod-type and can withstand close continuous grazing. Common bermudagrass and bahiagrass are well adapted to the low fertility soils but growth is limited without additional plant nutrients. Soils are sandy and very low in fertility because nitrogen and potassium are leached out of the soil by the high rainfall. Forages usually require the addition of plant nutrients for significant plant growth. Increasing soil fertility may be adding commercial fertilizer or animal manure, growing legumes as a nitrogen source, recycling nutrients through grazing livestock, or a combination of these. Under high rainfall the introduced sod-type grasses grow rapidly but nutritive value decreases rapidly with maturity. Forage **QUALITY** is more of a concern than quantity in eastern Texas.

Central Texas has intermediate rainfall (25 to 35 inches average) and livestock enterprises usually consist of a combination of native and introduced grasses. Growth of introduced grasses is less than eastern Texas because of lower rainfall.

Factors Influencing Hay Quantity and Quality

This discussion will focus on the introduced warm-season perennial grasses since they are the primary hay crops in central and eastern Texas. Forage sorghums in Central Texas and millets in East Texas are annual grasses that are also grown for hay to some extent. They are expensive because of annual land preparation, seed, and fertilizer costs. The ranking of the different forage classes for nutritive value are: legumes > cool-season annual grasses > cool-season perennial grasses > warm-season annual grasses > warm-season perennial grasses (Fig. 1). Although their nutritive value is the lowest of all the forage classes, warm-season perennial grasses are grown because they are the best adapted forage class in the southern US. Warm-season perennial grasses (e.g. bermudagrass, bahiagrass, kleingrass, switchgrass, etc.) are well adapted to the hot and sometimes dry summers. Their main limitations are low nutritive value (protein and energy) and the need for some form of nitrogen (commercial nitrogen fertilizer, animal manure, forage legumes etc.) and other plant nutrients to enhance growth on the infertile sandy soils in the eastern half of Texas.

Essentially all hay meadows receive some fertilizer because soil nutrients taken up in previous hay crops were removed when the hay was harvested and hauled off the hay meadow. A soil test is always a profitable investment ($10-$15). Requested information on the form accompanying the soil sample is the grass to be fertilized and desired yield. In addition to a fertilizer recommendation it will also report the soil pH. A soil pH of around 7 is neutral, less than 6 is considered acid, and greater than 7.5 is considered basic or alkaline. When soil pH is 5.5 or less on sandy soils, plant nutrient uptake efficiency is reduced. Lime is recommended to raise the soil pH to improve efficiency of applied nutrients. Knowing the estimated amount of nitrogen, phosphorus, and potassium to be applied is better than a traditional fertilizer rate used in the past or a wild guess. Applying the right amount of nitrogen but only half the required potassium will limit the uptake of applied nitrogen fertilizer by the grass and reduce yields.

Plant age is the major influence on forage nutritive value within each forage class. Nutritive value is highest in new growth and decreases with plant maturity (Fig 2a and 2b). One reason is that leaves are more digestible than stems and the percent leaves in the available forage decreases as plants mature and become more stemy. The second reason is that cell contents are 98% digestible and include carbohydrates, protein, triglycerides, and glycolipids. Cell walls are mainly composed of cellulose, hemicellulose, and lignin but are only from 45 to 75% digestible. About 70% of young plant cells are the highly digestible cell contents and about 30% partially digestible cell wall. As the cell wall thickens with age, more lignin is added to the cell wall. In a mature plant cell the partially digestible cell wall increases up to 80% of the cell. A compromise between yield and nutritive value is cutting at about 21 to 24 days for horse hay or dairy cattle and at about 5 weeks for beef cattle.

There is also a seasonal effect on the nutritive value of warm-season perennial grasses. The nutritive value is highest in the spring, lowest in the summer and intermediate in the fall (Fig. 3). As temperature goes up, fiber digestibility goes down. Therefore the first hay harvest in late May has the highest nutritive value and hay harvested from late July to mid-September has the lowest nutritive value. Hay meadows should never be overseeded with annual ryegrass that grows till mid-May or arrowleaf clover that grows through June because they eliminate spring growth of warm-season grasses through plant competition. The early hay harvest with the highest nutritive value is lost. Another advantage of the late May harvest is that more forage is produced per pound of nitrogen applied in spring than any time during the growing season.

Reducing Hay Requirements

A general guideline for northeast Texas is to have 3 large round bales (5 x 6 ft) per cow for a 4 to 5 month winter feeding period. Reducing the winter feeding period is a way to reduce hay needs and input costs. About 90% of the nitrogen, phosphorus, potash, and most other nutrients that are in the forage consumed by livestock, passes through the animal and returns to the soil in the urine and feces where it can be taken up by plants. This recycling of nutrients must be maximized to reduce fertilizer needs. Livestock should spend as much of the year grazing on pasture as possible to enhance forage growth through nutrient recycling. The grazing season can be lengthened by planting ryegrass or ryegrass-clover and growing a standing hay crop in the fall. The following three-pasture system has the potential to reduce the winter feeding period to 1 to 2 months which reduces the amount of hay needed and enhances recycling of nutrients.

The three-pasture system (Fig 4) includes a hay meadow (about 40% of open pasture), a pasture to be overseeded with ryegrass or ryegrass-clover (about 40% of open pasture), and a sacrifice pasture used for feeding hay, and calving (about 20% of open pasture). An estimated proper stocking rate would be 2 to 3 acres/cow. The hay meadow is usually a hybrid bermudagrass and should never be overseeded with annual ryegrass or arrowleaf clover since they grow through May and delay growth of the warm-season perennial grass. This results in the loss of the early hay cutting when warm-season grass growth and nutritive value are the highest. With about 40% of the pasture land used as a hay meadow, one hay cutting about late May with a yield of 2½ large round bales per acre should be sufficient.

A soil test should be taken in March on the hay meadow to determine limiting nutrients. If drought reduces or eliminates the first hay cutting, a second hay cutting can be taken in early July. After sufficient hay is produced, the hay meadow can be grazed until mid-September. At that time any top growth should be removed by grazing or hay harvest and fertilized with about 60 lb of nitrogen/acre to produce a standing hay crop during the fall.

The pasture to be overseeded with ryegrass or ryegrass-clover can be bermudagrass, bahiagrass, native grasses, or just unimproved pasture. The first year a soil test should be taken in spring to be sure the soil pH is above 6.0. If not, lime needs to be applied in spring because lime requires from 4 to 6 months to raise the soil pH. Additional soil tests can be taken every other year in September to determine what, if any, nutrients are needed for clover production. Ryegrass and clover are planted in October. Grazing can usually begin sometime in February in East Texas. Because cool-season forages have higher nutritive value than warm-season forages, the most digestible forage for the year in this system occurs from February through April. Cows should calve in January and February so their peak nutrient needs (after calving) match the peak ryegrass-clover growing period in March and April. These calves can be weaned in July or August allowing the dry cow to gain weight before the first frost to improve body condition. Calving in winter during harsh weather may increase calf death losses.

The sacrifice pasture where hay feeding and calving takes place can be land that is not well suited for hay production or intensive management. It should be well drained because of hay feeding during wet weather. It should also have some trees if possible to provide some protection from cold-wet weather for calving cows and young calves. It should never need fertilizer because of recycling nutrients from the hay and any supplements fed. General management practices by month for this three pasture system are shown in Figure 4.

Cattle movements throughout the year are as follows: Cows calve during the winter on the sacrifice pasture. When ryegrass-clover reaches a height of about 6 inches, cows that have calved can be moved from the sacrifice pasture to the ryegrass-clover pasture. If winter pasture is limited, cow-calf pairs can limit graze the ryegrass-clover 2 hr/day or 4 hr every other day with access to good hay when not on winter pasture. Cows should be able to graze the ryegrass-clover full time from mid-March to mid-May. When the ryegrass-clover matures in May, it may take some time for the warm-season perennial grass to come back. This is especially true if rainfall is limited in April and May or the stocking rate is reduced to allow winter pasture growth to produce a good seed crop for volunteer reseeding of the ryegrass and clover. Cows can be moved back to the sacrifice pasture which accumulated grass while the cows were on ryegrass-clover pasture or the hay meadow after the last hay harvest.

Calves can be weaned anytime during the summer, depending on calf prices and rainfall. Cows are moved to the hay meadow in late summer to graze it short by mid-September to grow the standing fall hay crop. The cows are then moved to the pasture to be overseeded with ryegrass or ryegrass-clover to graze it short by October for planting or volunteer reseeding. If the soil is sandy a light disking (1-2 inch deep) on some or all of the winter pasture area will improve stands and early forage production. If a light disking is not done, cows can remain on the pasture after ryegrass and clover emergence to keep the warm-season grass grazed short until daily low temperatures reach about 40^0 F. The warm-season perennial grass will remain green until the first killing frost but cease to grow at these low temperatures. Cows are then moved to the hay meadow to graze the standing hay crop. When the upper 2/3 of the standing hay is grazed off, the cows are moved to the sacrifice pasture for feeding hay and calving. Any excess grass from the hay meadow and the ryegrass-clover pasture can be harvested as hay for winter feeding or sold.

The success of this system is dependent on fall rainfall to grow a fall standing hay crop and get ryegrass and clover established. Because of drought in the fall, as well as the rest of the year, it is important to have a hay barn of some type to store excess hay from year to year. If kept dry, hay will last over 8 to 10 years. Having hay stored under roof will reduce the risk of drought on any pasture system. Rotational grazing can still be practiced by subdividing the hay meadow and/or the ryegrass-clover pastures to improve the urine and manure distribution for nutrient recycling.

Producers may use all or only parts of this system to improve the sustainability of their livestock operation. The percentages of open pasture devoted to hay meadow, ryegrass-clovers pasture, and sacrifice pasture are educated guesses but should be in the ball park.

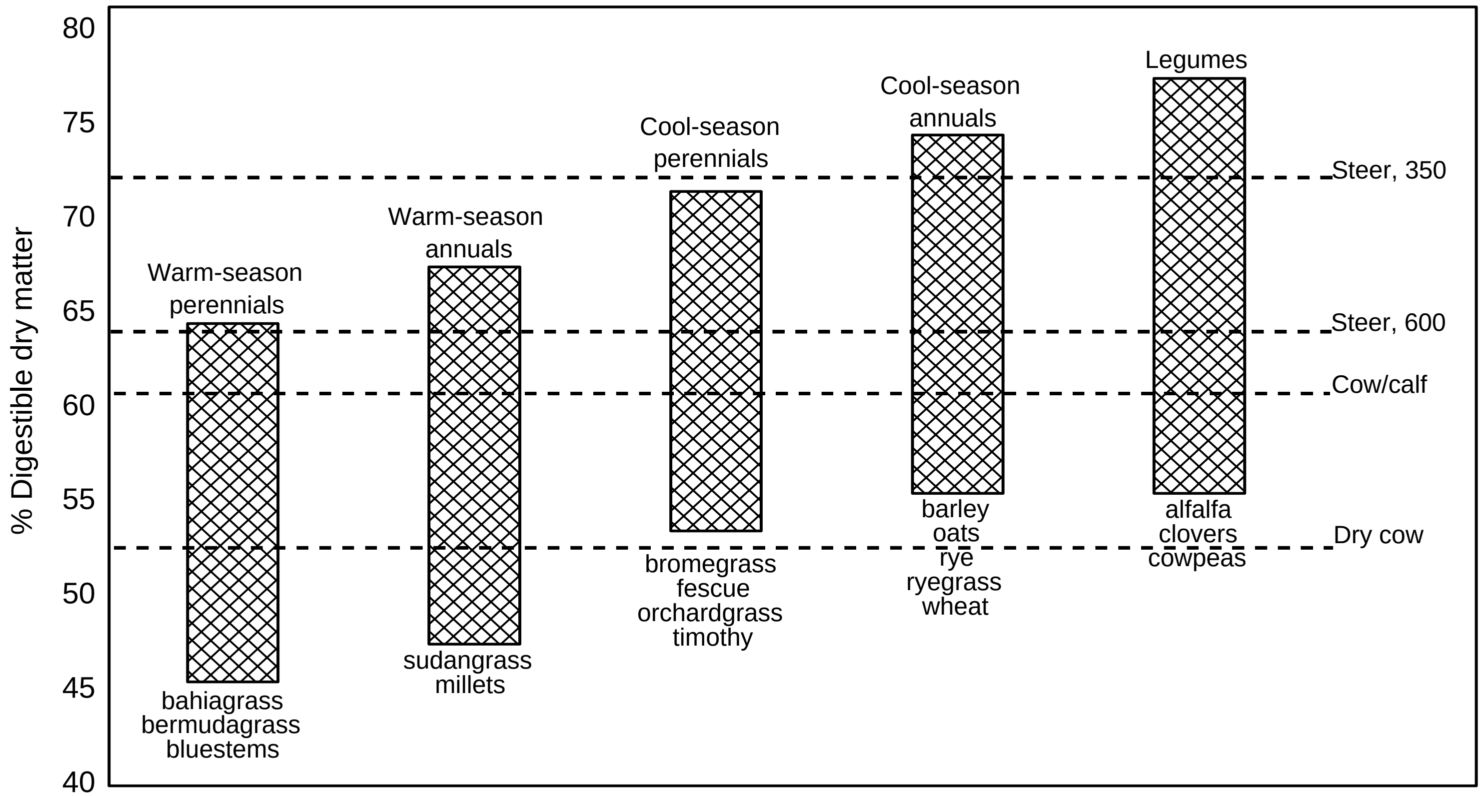

Figure 1. Digestibility percent ranges for several forage groups and requirements of different classes of livestock (H. Lippke, M. E. Riewe).

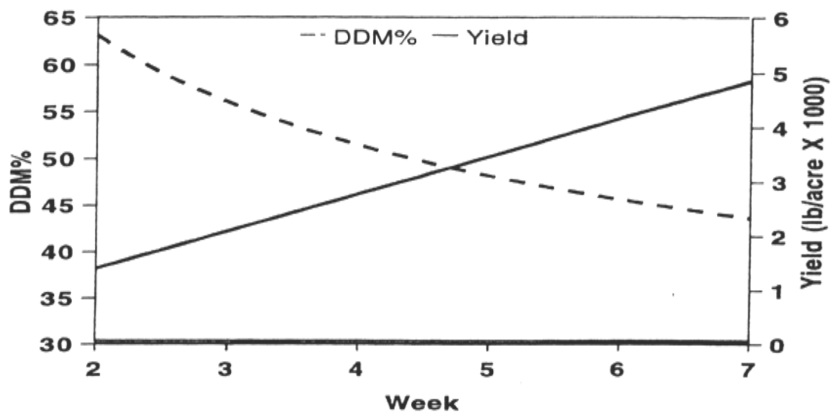

Figure 2A. Effect of maturity on dry matter digestibility and yield of bermudagrass (W. G. Monson, Tifton, GA).

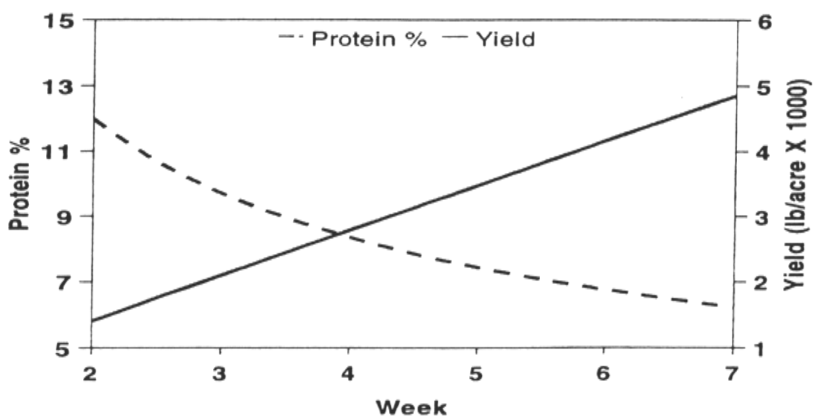

Figure 2B. Effect of maturity on protein percentage and yield of bermudagrass (W. G. Monson, Tifton, GA).

Figure 3. Influence of season on digestibility of continuously grazed sod grass at Overton, Texas, sampled at 2 week intervals (Duble, 1970).

Overseeding Warm-Season Perennial Grasses with Annual Ryegrass (+/- Clover)

Utilization by Winter Calving Cows (2-3 acre/cow)

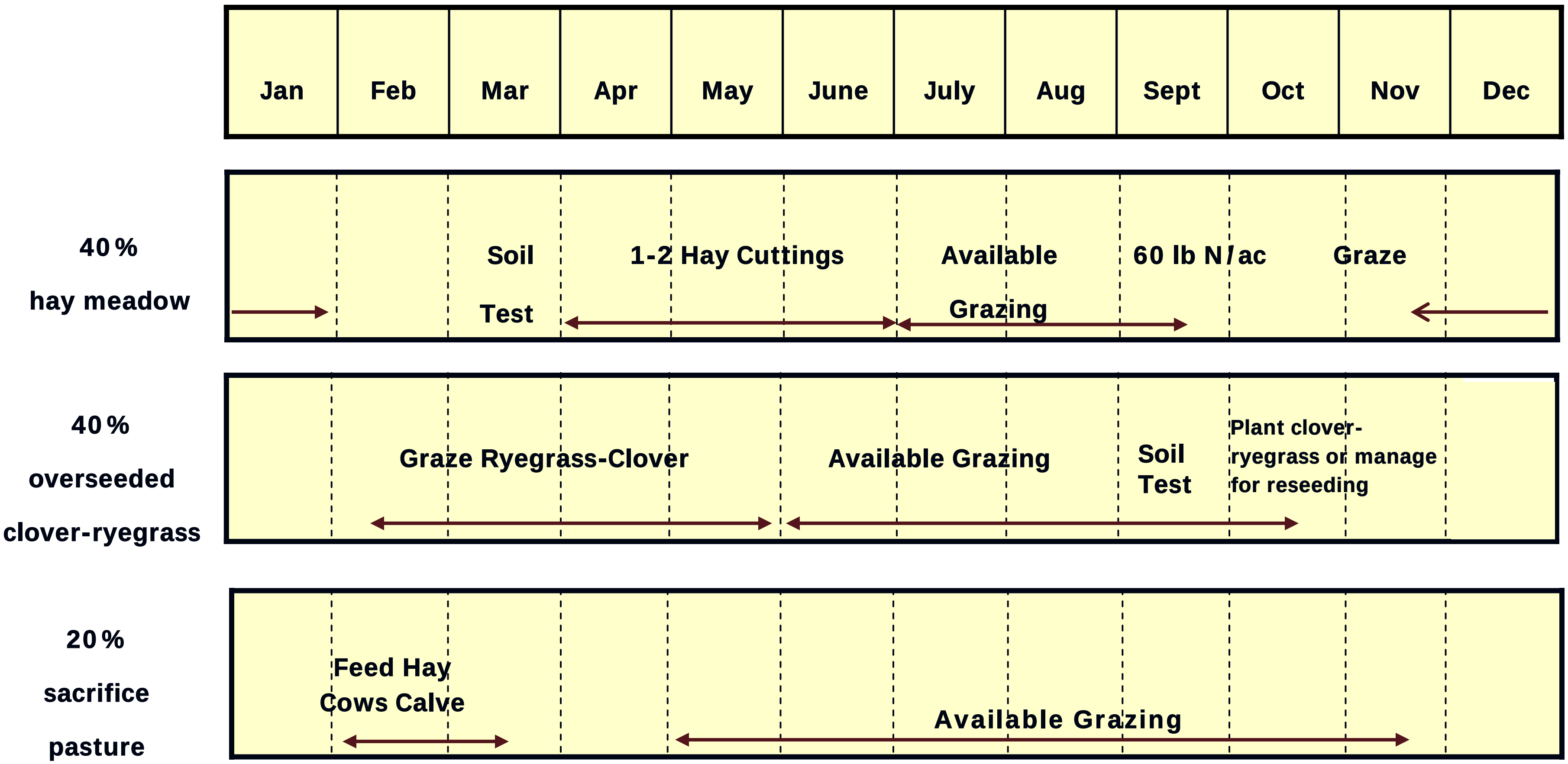

Figure 4. A three pasture forage system with about 40% in a hay meadow, 40% overseeded with ryegrass-clover, and 20% in a sacrifice pasture.