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CHAPTER 6

RYEGRASS NUTRITIVE VALUE

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Introduction

Nutritive value of forages is often considered from the dual aspects of digestibility and intake. While these components of nutritive value are usually closely allied, that correlation sometimes becomes uncoupled with highly digestible forages such as ryegrass in its early vegetative stages of growth. Achieving the potential animal performance offered by the nutritive value of ryegrass forages is a major challenge to management of grazing ruminants.

Digestibility

One of the primary reasons for the cultivation of annual ryegrass in Texas is the excellent diet that it provides to ruminants at a time of year when grazing from warm season forages is very low in quality or not available. Ryegrass shares this attribute with the small grain species, but is often preferred for its more uniform growth pattern, its sward stability under grazing in wet weather, and other favorable agronomic characteristics. Ryegrass forage in vegetative stages of growth usually has dry matter digestibility values over 70%, approaching and sometimes exceeding 80% in the first weeks of the grazing season (Beever et al., 1986b; Hodgson et al., 1991; Lippke, 1986). The protein content of these forages ranges from 20 - 30%, and the leaf tips that are grazed are sometimes more than 30% protein.

Figure 1, constructed from data presented by Parks et al. (1964), shows the relationships between digestibility and contents of sugars, protein and cellulose of annual ryegrass as the plant matures. The ryegrass hays in their experiments were finely ground and pelleted, probably reducing apparent digestibility three to five percentage points. In these data one can clearly see that highly digestible forage was available in late winter and that digestibility declined rapidly in response to decreasing levels of the soluble plant components, sugars and protein, and increasing fiber, represented here by the fiber component, cellulose.

Lippke (1986) reported that fresh ryegrass, cut daily during the month of January and fed to yearling heifers and steers, had organic matter digestibilities of 78 and 79% in two experiments. Hand plucked and total sward samples that were collected in an experiment involving steers grazing

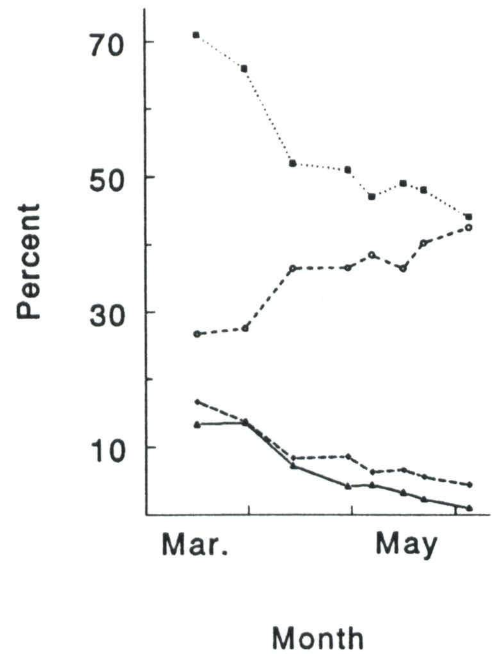

Figure 1 Percent digestible energy --■--, cellulose --○--, crude protein --◆--, and sugars —▲— in eight serially harvested ryegrass hays (data from Parks et al., 1964).

a ryegrass-rye mixture in south Texas (Lippke and Forbes, 1994) showed no consistent change in protein and fiber levels through mid-February (Figure 2). Acid detergent fiber (ADF) content of hand plucked samples was relatively stable and remained at levels indicating very high forage quality for the first three months of the grazing season. With the advent of rapid spring growth, the patterns of protein and fiber contents followed those reported by Parks et al. (1964). The differences shown in Figure 2 between hand plucked and total sward samples, almost always in favor of higher quality in the hand plucked samples, probably represent the minimum differences expected between attributes of the available forage and the diets selected by grazing animals. Given the opportunity, grazing animals usually become more selective as forage plants mature, widening the gap between diet and sward for those measures that relate to diet quality (Lippke and Evers, 1986).

Grigsby et al. (1988) monitored the protein and fiber levels of hand plucked samples from grazed rye-ryegrass pastures in northeast Texas over a 4-month period and reported values suggesting that the increase in forage quality occurs somewhat later in that region than it does along the Texas Gulf coast or in south Texas (Figure 3). This is consistent with the general concepts that forage quality increases

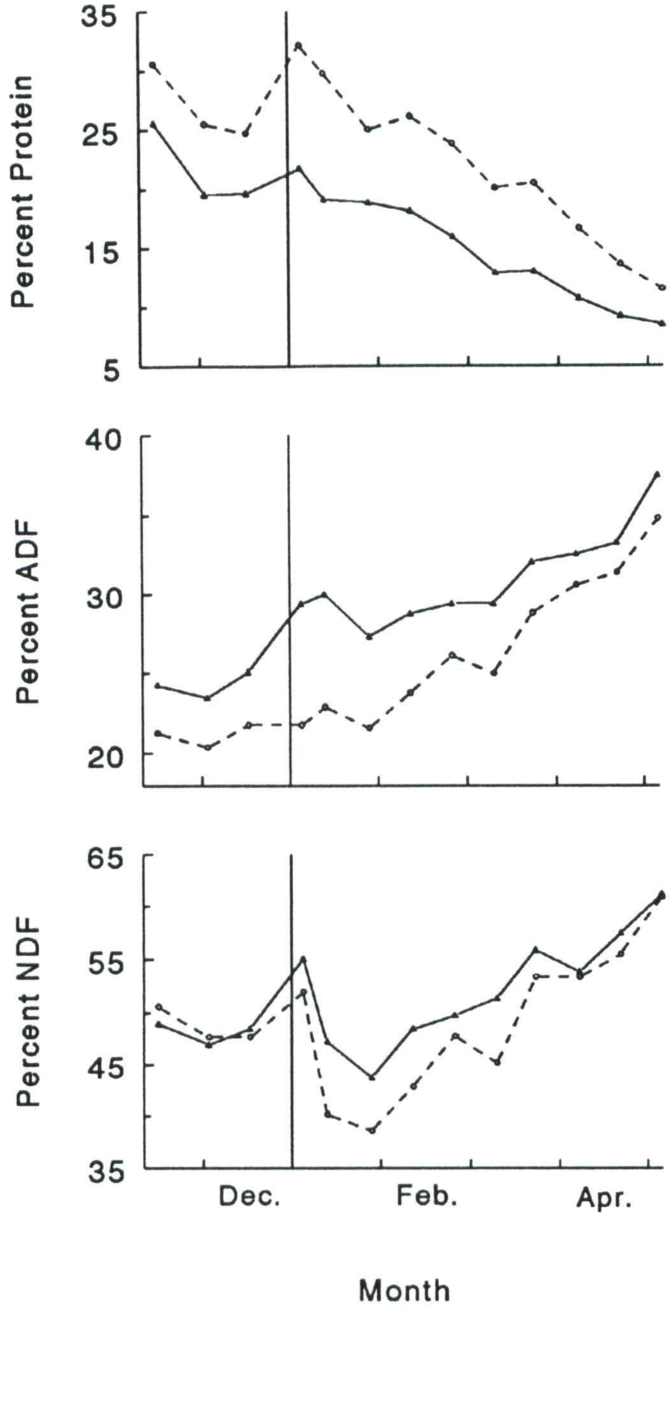

Figure 2 Percent crude protein, acid detergent fiber (ADF), and neutral detergent fiber (NDF) in hand plucked --o-- and total sward —▲— samples collected from ryegrass-rye pastures.

and that plant maturation is increasingly delayed with increasing latitude. Results from analyses of samples collected on January 13 or 14, 1993 from ryegrass swards near Overton, Angleton, and Knippa, Texas (H. Lippke, unpublished data) provide a bit of additional evidence for geographical differences in forage quality (Table 1). However, none of these observations are from tests designed to detect geographic differences and are confounded with soil type, fertilization rates, and plant varieties. The differences in mineral and non-protein nitrogen contents shown in Table 1 reflect the variations in these confounding factors.

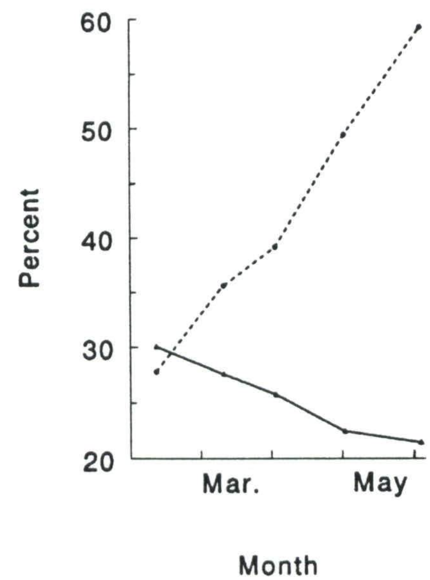

Figure 3 Percent neutral detergent fiber --●-- and crude protein —▲— in hand plucked samples of rye-ryegrass pastures (data from Grigsby et al., 1988).

Intake and Performance

In some instances, young cattle grazing immature ryegrass forages have demonstrated good average daily body weight gains (ADG) of 2.75 lb or more (Lippke and Forbes, 1994). More commonly, however, gains have ranged from 1 to 1.5 lb daily during the first month after turnout (Riewe et al., 1984). Ball and Crews (1992), summarizing the results from many trials in Alabama, indicate gains in this low range for the entire season. Such low growth rates are not consistent with the high digestibility and protein values of the diets being consumed, leaving abnormally low intake as the probable cause of poor animal performance.

Table 1. Comparison of ryegrass samples hand plucked at Angleton, Overton, and Knippa, Texas on or about January 13, 1993.

	Angleton	Overton	Knippa
Neutral Detergent fiber, %	37.51	32.08	39.92
Acid detergent fiber, %	21.75	16.58	21.71
Crude protein, %	22.80	32.14	31.17
Non-protein nitrogen[1]	15.90	34.4	21.4
Potassium, %	2.90	2.35	3.05
Calcium, %	.49	.39	.87
Magnesium, %	.25	.27	.32
Sodium, %	.12	.10	.45
Copper, ppm	7.60	3.80	13.1
Zinc, ppm	27.00	29.20	31.2

[1] Percent of total nitrogen

Stocking rate experiments have consistently demonstrated a positive relationship between herbage mass (HM) and animal performance and between HM and dry matter intake (Hennessy and Robinson, 1979; Le Du et al., 1981), leading to the general conclusion that the effects of HM on animal performance are mediated through the effects of HM on intake. However, low HM does not explain the low intakes found in experiments where the amount of herbage offered was not a factor. Lippke (1986) reported that dry matter intakes were only 70% of expected values when immature ryegrass was cut daily and fed ad libitum to stocker steers. He suggested that the very low levels of indigestible fiber in the immature ryegrass forages were not sufficient to maintain normal rumen function. The data of Beever et al. (1986a) indicate that dry matter intakes of cattle grazing immature perennial ryegrass increased 45% during the first month on pasture, even though estimates of forage digestibility decreased and cellulose content increased slightly. Daily herbage allowances were ample and held constant throughout the experiment.

Lippke and Warrington (1984) hypothesized that low intakes of highly digestible ryegrass or small grains forages were caused by development of acidosis when the animals gorged at turnout or first feeding. They fed a semi-purified diet that simulated the fiber, protein, and sugar levels of ryegrass and found that it produced severe lactic acidosis in mature steers. Other diets with higher levels of fiber moderated or prevented acidosis and led to significantly greater dry matter intakes.

Yield of bacterial cells in the rumen is greatly reduced by lactic acidosis (Allison et al., 1975). This becomes an important consideration in the protein nutrition of young cattle grazing immature ryegrass because less than 25% of the protein in such forages may escape intact to the lower tract (Beever et al., 1986a; Hill and Ellis, 1992). Consequently, cattle with a capacity for rapid growth are very dependent on the protein regenerated in the rumen in the form of bacterial cells. Beever et al. (1974) found only 64% as much microbial biomass reaching the duodenum of calves that were fed fresh ryegrass as when the same forage was fed as hay. If the amino acid supply coming from proteins digested in the lower tract is inadequate relative to the supply of energy, feedback mechanisms in the animals' metabolism will reduce forage intake. Consequently, supplementing high-protein ryegrass diets with protein that escapes breakdown in the rumen will often increase ADG and forage intake (Hill et al., 1991; Worrell et al., 1990).

The nutritive value of ryegrass can provide for excellent animal performance when it is in vegetative stages of growth. However, the same plant characteristics that make ryegrass highly digestible by ruminants can cause digestive upset, perhaps leading to long term protein deficiency at the tissue level of the animal despite extremely high protein content in the forage. Negotiating the rather narrow margin between maximum animal performance and metabolic disruptions is a major challenge to grazing management.

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