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**DAVID LILE,** County Director and Natural Resources/Livestock Farm Advisor, University of California Cooperative Extension, Lassen County;

**LARRY C. FORERO,** County Director and Livestock/Natural Resources Farm Advisor, University of California Cooperative Extension, Shasta and Trinity Counties;

**MISSY MERRILL-DAVIES,** Livestock and Natural Resources Farm Advisor, University of California Cooperative Extension, Modoc County

# Forage Quality of Mountain Meadows and Irrigated Pastures

## INTRODUCTION

Irrigated pastures and meadows provide an important summer forage base for livestock operations. Management and site factors influence the production and nutritional value of forage and, in turn, livestock performance. Forage quality assessment for livestock production generally focuses on crude protein (CP) and energy. Energy is commonly expressed either as percent total digestible nutrients (TDN) or as a caloric energy value such as net energy for gain or maintenance (expressed as NEg or NEm). Protein and energy are the fundamental components of livestock nutrition and are the major factors affecting production or gain.

Energy is a fundamental requirement for growth and production. The energy value, or digestibility, of forage plants reflects the value of the feed and influences the amount of dry matter intake.

Dry matter intake (DMI) is also an important value for managers. Adequate intake is essential to animal performance: as intake goes up, so does performance. On lush, highly digestible pastures, DMI can be from 2.5 to 3 percent of cattle body weight; with lower-quality forage, which is digested more slowly, DMI will be from 1.5 to 2 percent or less. An accurate estimate of DMI can also help managers calculate the carrying capacity of a pasture: multiplying the daily intake by the number of head and the number of days yields an estimate of the total forage requirement for a given herd. Carrying capacity is defined as the average number of livestock and/or wildlife that may be sustained on a management unit in a manner compatible with management objectives for the unit. In addition to site characteristics, carrying capacity is a function of management goals and management intensity, as well as the potential number of animals or live weight that may be supported on a unit area for a grazing season based on forage potential.

Protein provides the basic building blocks needed for cattle growth, lactation, and replacement of body tissue. Required protein levels for maximum growth or lactation usually range from 10 to 12 percent on a dry matter basis. For maintenance diets, a minimum 6 to 7 percent crude protein is required. If protein levels drop below this threshold, it is difficult for animals to digest forages, and unless some form of protein supplementation is provide animal performance will suffer.

**Table 1.** Intake, energy and protein requirements for two classes of cattle

| | Intake | TDN | Crude protein |
|---|---|---|---|
| | *(DMI, lb)* | *(% DM)* | *(% DM)* |
| **550-lb British-type stocker calf** | | | |
| 1.5 lb per day gain | 17 | 58 | 9 |
| 2.0 lb per day gain | 17 | 61 | 10 |
| 2.5 lb per day gain | 17 | 67 | 12 |
| **1,200-lb British-type cow (average milking)** | | | |
| 2 months post-calving | 28 | 60 | 11 |
| 4 months post-calving | 27 | 56 | 9 |
| 6 months post-calving | 26 | 54 | 8 |

Energy is a fundamental requirement for growth and production. The energy value, or digestibility, of forage plants reflects the value of the feed and influences the amount of dry matter intake. Low-quality forages take longer to break down and digest, reducing the potential amount of intake. Lower intake in turn reduces gain and performance.

In the Intermountain Area, beef cattle are the predominant livestock species grazed on irrigated pastures and meadows, and they are the focus of this publication. Your local UCCE livestock advisor can help extrapolate this information to other species such as horses, sheep, or goats.

Nutrient requirements such as DMI, TDN, and crude protein for typical types of beef cattle raised on irrigated pastures and meadows are displayed in table 1. Note that the required level of TDN and protein increases with higher daily gain for growing cattle. For breeding cattle, peak intake, energy, and protein requirements occur 60 days after calving and begin to decrease as milk production declines. These requirements can be compared with the protein and TDN values obtained from intermountain pastures.

To optimize production, a balance of energy and protein is required. While real-world values vary by pasture and season, the nutritional values reported on most irrigated pastures show that energy is generally more often limiting than protein.

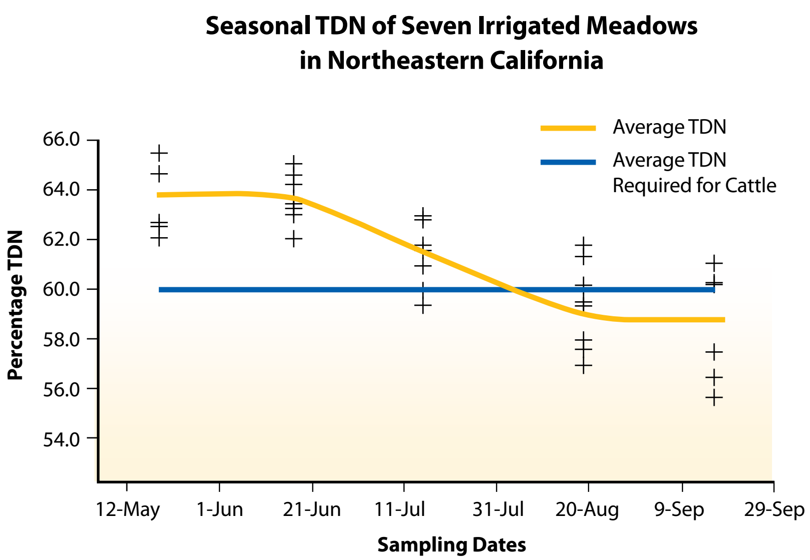


**Figure 1.** Seasonal total digestible nutrients (TDN) from seven irrigated meadows in northeastern California. Values for TDN were calculated using the prediction equation TDN = 88.9 – (0.770 x ADF), where ADF = acid detergent fiber

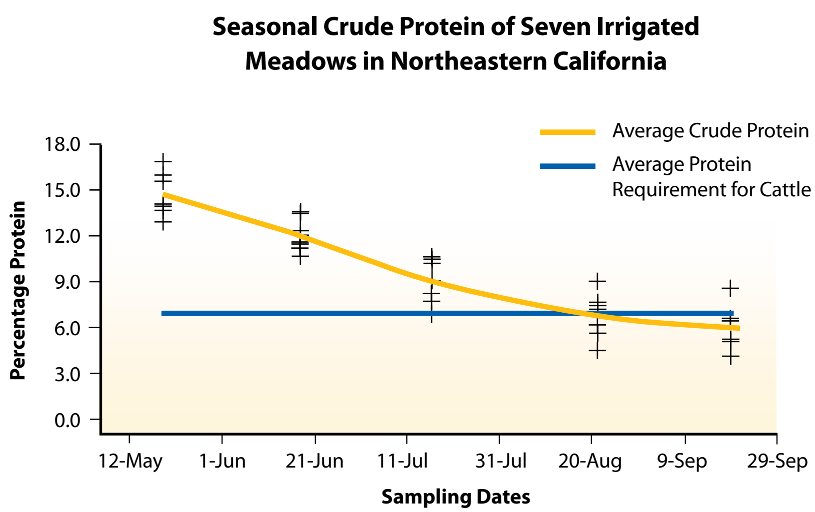


**Figure 2.** Seasonal crude protein from seven irrigated meadows in Northeastern California.

Figure 1 displays the seasonal and site variability in protein values typical among mountain meadows. Energy values vary considerably from pasture to pasture. When expressed as percentage of TDN, observed values vary from nearly 70 percent to below 50 percent. In terms of animal performance, this range in energy value can result in cattle gain ranging from more than 2 pounds per day to almost no gain. As with protein, TDN typically declines from 8 to 10 percent from spring to late summer or fall. This seasonal decline in forage quality is usually steeper on native meadows than on more intensively managed irrigated pastures. However, even native meadows typically produce better-quality late-summer forage than do dryland pastures or rangeland sites. The exception is on very dry years, when even meadow plants become dry and dormant by mid to late summer.

Figure 2 displays the seasonal and site variability in protein values typical among mountain meadows. In late spring and early summer, protein values are relatively high, but by mid to late summer they can be limiting. Note that at any given date, there is a difference of 3 to 4 percent in crude protein across different sites; for example, on July 11, individual sites varied from a high of about 11 percent to a low of 7 percent. Differences between locations are most likely due to differences in the plant species present and how late in the summer adequate soil moisture is present: drier sites tend to lose forage value earlier in the season.

## MANAGING NUTRITIONAL VARIABILITY IN PASTURES

Research has demonstrated a large amount of variability in the nutritive quality among irrigated pastures and meadows. The expected livestock performance varies accordingly. To some extent this variability can be explained by fundamental management factors that include the following.

### *Improved Forage Species*

The predominance of improved forage species (i.e., orchardgrass, fescue, perennial rye, clover, etc.) in proportion to sedges and rushes (sometimes called wiregrass) affect forage quality. Generally, more sedges and rushes indicate poorer forage quality. Species composition on meadows is influenced by soil moisture, soil type, depth to water table, and other factors. Sedges and rushes tend to thrive on sites with very wet, saturated conditions. Opportunities for management vary significantly by location; in some instances, improved irrigation and species mix can drastically improve productivity.

### *Adequate Irrigation Water*

Moisture stress generally reduces forage quality and hastens seasonal decline. A manager's challenge is to provide adequate water to maintain active growth while trying to avoid saturating fields through excessive irrigation. If a field is too dry, plants quit growing, mature early, and lose quality. If it is too wet, water-loving species such as sedges and rushes tend to crowd out more desirable grasses and clovers. Whenever feasible, managers should explore opportunities for developing or improving irrigation management. For more information on this topic, see the Intermountain Irrigated Pasture and Mountain Meadow series (Drake 2003).

### *Fertilizers*

The potential for increased production from the strategic use of fertilizers is well documented (see Orloff et al. 2008). In most cases, the better the soil fertility (particularly nitrogen levels), the better the forage quality. Consider analyzing soil and plant tissue to assess the practicality of improving fertility on the site.

### *Grazing Management*

The number of specified kinds and classes of animals grazing a unit of land for a specific time period, known as the stocking rate, also affects forage quality. Lightly stocked pastures allow animals to pick and choose what they eat; they usually go for the most nutritious forage first, so the quality of the diet is high at first but declines as the preferred forage is consumed. Heavier-stocked, more-intensive grazing allows a relatively efficient harvest of forage, but competition between animals reduces selectivity and may initially reduce the quality of their diet. Well-timed intensive grazing followed by periods of "rest" (temporary removal of livestock) can help keep pasture plants actively growing instead of flowering and producing seed, assuming that soil moisture and temperature are conducive to plant growth.

As soon as the forage on a meadow is of sufficient quantity and normal livestock movements will not compact soil or damage the sod, the meadow should be grazed, leaving an adequate residual plant material to promote regrowth and maintain plant vigor. The objective is to produce an abundance of young leaves that efficiently produce carbohydrates. Subsequent grazing periods should strive to maintain this situation. The final grazing in fall or winter should be timed to assure adequate carbohydrate storage for spring growth and the needed amount of residue, typically 2 to 4 inches.

## ASSESSING FORAGE QUALITY ON YOUR RANCH

The data presented in the tables and figures in this publication provide general guidelines about forage quality based on data collected in the Intermountain Area. Ranchers wanting more precise or site-specific data can collect information from their own fields. Consult your local UCCE Farm Advisor or the references at the end of this publication for information on sampling techniques, laboratory methods, and interpreting lab results.

## MINERAL NUTRITION

Surveys of beef herds in the Intermountain Area have shown that some pastures are deficient in selenium; in some areas, high molybdenum levels reduce copper availability and absorption by cattle. For a thorough review of mineral nutrients for beef cattle in the Intermountain region, see the University of California Cooperative Extension Trace Minerals for California Beef cattle homepage, http://animalsciencey.ucdavis.edu/extension/mineralproject/.

## USING DRY MATTER INTAKE (DMI) TO HELP ESTIMATE CARRYING CAPACITY

Assume a 100-ac pasture produces 8,000 lb of forage on a dry matter basis annually. This pasture will be stocked with 550-lb steers at the onset of the grazing season that are expected to gain 2.0 lb/day for 125 days and will be shipped to a feedlot weighing 800 lb. Harvest efficiency of 45% is estimated, meaning that of the total dry matter in the field, 45% will be harvested by the grazing animal. It is important to note that all the forage in the pasture is not actually consumed by the animal. Plants are also damaged by trampling, loafing, fouling, and other nonlivestock factors such as drying of shaded lower leaves and plant material consumed by insects or wildlife. Considering these factors, how many steers could this pasture carry for the season?

**Average steer weight = 675 lb**

**Estimated dry matter intake = 20.25 lb/day (3% of average body weight)**

**Harvest efficiency = 45%**

Calculate daily forage requirement:

**20.25/lb/day/.45 harvest efficiency = 45 lb/day/steer.**

Determine the forage requirement for each steer the season:

**45 lb/day/steer × 125 days = 5,625 lb/steer for the season.**

Determine the number of acres required for each steer for the season:

**8,000 lb forage dry matter/acre/season/5,625 lb/steer/season = 1.42 steers/acre.**

Multiply the number of acres by the number of steers per acre to estimate the initial stocking rate:

**1.42 steers/acre × 100 acres = 142 steers.**

## REFERENCES

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Richmond, CA 94804-4600

Telephone 1-800-994-8849
510-665-2195
FAX 510-665-3427
E-mail: anrcatalog@ucanr.edu



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