Supplementing Range Livestock

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A major operational expense confronting the range livestock industry in many parts of the United States is that for supplemental feed. Rising costs for supplemental feed coupled with declining prices for range livestock products during the last ten years have increased interest in ways to minimize supplementation costs without sacrificing livestock production.

Differences in forage quality and livestock management cause supplementation to vary considerably in the United States. In the western United States, major nutritional deficiencies occur only during drought and winter time forage dormancy. In contrast, soils in the southeastern United States are heavily leached due to the high rainfall, making yearlong supplementation necessary for sustained livestock productivity.

Energy, protein, phosphorus and vitamin A are the nutrients most limiting to range livestock production. Except for emergency conditions such as after heavy snow or severe drought, energy supplements are seldom used. The energy supplements will substantially improve performance of range animals but they have proven uneconomical in most situations because of high cost and labor requirements. Protein and mineral supplements are most cost affective because they generally improve range forage intake and digestibility.

Range Livestock Nutritional Guidelines

Range livestock nutritional requirements are poorly understood compared to those for confined livestock. Palatable forbs and shrubs often have chemical and physical properties much different from pasture and harvested forages. Low to moderate (10-50% of the diet) amounts of these plants, such as globemallow and verbena in New Mexico, in the diet can be nutritionally advantageous while amounts exceeding 50% of the diet are sometimes toxic. For the above reasons, recommendations by the National Research Council on livestock nutritional requirements are not always applicable to range livestock. Based on range livestock nutritional studies in New Mexico, I have developed some guidelines presented in the table.

Some range livestock operations are geared towards calf and/or lamb production because mature female animals can subsist on low quality forages better than growing animals that have higher nutritional requirements. The alternative is to graze with yearling animals during the period of active forage growth. In the southeastern United States where range forage quantity is high but quality is low throughout the year, cow-calf operations are used almost exclusively.

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Short periods of nutrient deficiency in livestock diets do not have adverse effects if followed by high diet quality. Research shows mature pregnant cows in good condition can lose 10% of body weight during the winter and still produce calf crops approaching 90% if they can gain weight after parturition. This also applies to ewes. Supplementation of these animals at levels that does not permit some weight loss is a poor economic practice. Young animals that are subjected to severe undernutrition during the first six months of life tend to have a reduced skeleton size and are often permanently stunted. However, after six months of age, they can show good recovery from a low nutritional plane. It is well documented that livestock show greater feed efficiency and have higher gain after periods of moderate undernutrition. This extra gain of thin compared to fat animals is commonly referred to as compensatory gain. When losses exceed 15% of the animal's weight in good condition, poor recovery often occurs when the animal is placed on a high nutritional plane. Animals that lose 30% or more of normal body weight will nearly always die.

From mid-gestation until parturition, cows and ewes experience their lowest protein and energy requirements. Demand for these nutrients escalate after parturition because of lactation. If forage quality is low, post-partum supplementation will generally be more effective than that in the pre-partum period.

Minimizing Supplement Needs by Range Management

Judicious grazing is one of the most effective tools to minimize needs for supplemental feed. Animals on lightly to moderately (25 to 50% use) grazed ranges require less supplement because they can selectively graze and expend less energy in travel to obtain a full rumen. Grazing levels that permit high selectivity are important during forage dormancy when there is nutritive variation between forages. During active growth, all forages are generally high in nutritive quality.

Seasonal sustability grazing systems have considerable potential to minimize needs for supplemental feed. These systems are discussed in a recent *Rangelands* article (1982, 4:252). On dormant ranges, mixtures of grass and palatable browse can reduce weight losses compared to pure stands of grass. Crested wheatgrass pastures provide very high quality early spring forage for livestock in the Great Basin and Northern Great Plains regions. Buffelgrass is an excellent spring forage in south Texas. Seedings of smooth bromegrass, orchardgrass, intermediate wheatgrass and Russian wildrye provide livestock with good spring feed in the tall grass region of the Dakotas and Nebraska. Seeded pastures

for spring use concentrate livestock for better management during the critical parturition and breeding periods. In the Southwest, characterized by dry springs, upland sandy ranges have good crops of cool-season forbs in most springs from winter precipitation. These forbs can comprise up to 75% of cattle diets and play a key role in supplying livestock with their nutritional needs when the grasses are dormant.

Periodic burning can substantially lengthen the period when forage is green and nutritious, particularly on wet, humid ranges. Burning is routinely used to lengthen the period of high quality forage in the tall grass prairie of Kansas and Oklahomas, the coastal prairie of Texas and the southern pine region. Fertilization can be a cost effective tool to improve both forage quality and quantity in some range types. Nitrogen fertilization has substantially increased the period of high quality forage, cattle weight gains and forage quantity on blue grama ranges in the Great Plains. The decision to implement this practice depends on the cost of fertilizer versus the price of meat. Chemical and mechanical treatments of rangeland have been effectively used to improve range livestock nutritional status. Two recent books, *Brush Management* and *Range Development and Improvements,* provide excellent coverage of this subject, which is beyond the scope of this article.

Identification of Periods When Supplement Is Required

Identification of what nutrients are deficient, when they are deficient, and the severity of the deficiency are major concerns of range livestock producers. Clipped samples of the available forage provide inaccurate measures of diet quality because grazing animals show high selectivity for particular plant parts and species. Esophageal fistulated animals have been useful for studying nutrient levels and trends in livestock diets. Studies have shown that the nutritional quality of livestock diets varies substantially between years on most range types. The periods when supplementation can be advantageous vary substantially within and between years. Although fistulated animals are a good research tool, they are not practical for ranchers to monitor nutritional status because of the high cost and labor requirements for sample collection and analysis. Further, the lag time between collection of the sample and actual analysis may be too long (5-14 days) for any practical decision making.

In recent years, fecal analysis has shown potential as a quick, practical means for ranchers to detect periods when energy, protein and phosphorus supplementation will be economically most advantageous. Concentrations of nitrogen and phosphorus in the feces are well related to the nutritional status of the animal. Equipment using a microcomputer and near infrared reflectance spectroscopy is being developed that will permit instantaneous analysis of livestock fecal samples for chemical characteristics (nitrogen and phosphorus concentrations). This equipment, when fully developed, should be affordable to most ranchers. Presently ranchers can have fecal samples analyzed for chemical characteristics (nitrogen, phosphorus) by contacting local county extension specialists or custom laboratories.

Fecal samples used for nutritional evaluation of a grazing herd should not be over one half hour old. A composite of equal amounts of 10 fresh samples randomly collected from the herd should work well for most management decisions. Fecal samples should be frozen after collection and kept in this state until preparation for laboratory analysis.

Dr. John Shenk at Penn State University has developed technology using near infrared reflectance spectroscopy in conjunction with computers that permits accurate prediction of nitrogen, fiber, and digestibility levels in forages without laboratory processing. This equipment is transported by a van and is being used for grading hays in the East. My studies with Dr. Shenk indicate this same technology can be applied to fecal samples. This technology may soon provide ranchers with a quick, inexpensive means for routine decisions regarding supplementation.

Although fecal sampling needs more study, it presently appears to be the most promising and practical tool available to ranchers for detecting when supplementation will be most advantageous. Ranchers who have started applying this tool in the southwestern United States are having good results.

The concentration of nitrogen in the fecal organic matter of ruminants shows a strong linear association with livestock weight changes, forage intake, diet digestibility and diet crude protein content. A number of recent studies have shown that when total nitrogen concentration of the fecal organic matter drops below 1.60%, ruminant animals undergo weight losses Severe weight losses (over .50 pound per day) can be expected if fecal nitrogen concentrations drop below 1.30%. A fecal nitrogen concentration below 1.60% indicates diet crude protein levels are generally lower than 6%. Once this level is reached, the forage intake declines precipitously because rumen microbial needs for nitrogen are not satisfied. Increases in range forage intake (20-60%) and digestibility (5-15%) can be expected from supplemental protein when diet crude protein levels are below 6%. When diet crude protein is above 6%, supplemental protein has had small to no effect on range forage digestibility and intake.

Studies with penned deer, elk, and goats show that animals consuming browse diets high in essential (volatile) oils (sagebrushes, rabbitbrushes, junipers) or tannins (oaks) can have elevated fecal nitrogen levels relative to diet nitrogen values. However, cattle and sheep on most ranges generally will starve before consuming forages high in essential oils and/or tannis. Our research shows that browse species palatable to cattle and sheep such as fourwing saltbush, mountain mahogany, common snowberry and ninebark do not cause elevated fecal nitrogen values.

Diet and fecal phosphorus concentrations show a strong linear association for ruminant animals. When fecal phosphorus concentrations drop below 0.60% in the organic matter, diet phosphorus levels below maintenance are likely. Fecal phosphorus levels above .85% indicate dietary phosphorus levels adequate for growing and lactating animals.

Protein Supplementation

The two basic types of protein supplements provided to range livestock are non-protein nitrogen (urea and biuret) and high protein natural feeds (alfalfa hay, cottonseed meal, soybean meal). Non-protein nitrogen sources can substitute for costlier feed proteins because rumen microorganisms can convert nitrogenous compounds into proteins. Under

the right conditions about one third of the total protein requirement can be met by non-protein nitrogen. In order for non-protein nitrogen supplements to be effectively utilized, a good energy source must be available. This approach is used with feedlot animals consuming grains but seldom with animals consuming dormant range forages. Beef cows consuming range forages have often shown a negative response to high urea protein supplements in terms of increased weight losses, lower weaning weights, reduced reproductive performance and even death losses. This is presumably due to build-up of nitrogen in the toxic nitrite form in the rumen. Urea and other non-protein nitrogen sources are well utilized, if accompanied by a high energy supplement. Lickwheels involving urea-molasses mixtures have been one of the most common means of providing this combination. The added energy associated with this type of supplement may depress range forage intake.

Cottonseed meal is probably the most heavily used high protein plant supplement. It typically has about 40-45% crude protein so fairly small amounts satisfy daily requirement. Levels of cottonseed meal from 1 to 2 pounds per day for cows and from one fourth to one third pound per day for ewes have given the best economic returns. These levels allow animals to meet their protein requirement and often improve intake of range forage. Higher levels may reduce intake of range forage because the excess protein will be converted into energy.

Research on blue grama range in New Mexico shows yearling heifers supplemented with high quality alfalfa hay (18% crude protein) had weight gains comparable to those supplemented with cottonseed meal. Neither supplement affected the intake of range forage. Three to five pounds of high quality alfalfa hay per day for cows and one half to one pound per day for ewes should be profitable under most conditions. Which type of protein supplement to use is primarily an economic decision that depends on the comparative unit protein cost per feed. Labor and equipment requirements are other considerations.

Because of the labor cost, frequency of protein supplementation is of considerable concern to ranchers. The several studies addressing this problem have consistently shown no real differences in livestock performance between daily, alternate day, every third day and even weekly feeding of cottonseed meal or alfalfa hay. A major advantage of alternate day or weekly feeding compared to daily feeding is greater opportunity for animals in poor condition to get part of the supplement.

Salt has been used to control intake of cottonseed meal. High salt consumption can have adverse impacts on ruminant protein digestion. The increased water intake associated with high salt consumption causes increased nitrogen losses in the urine. Tallow is being used to control cottonseed meal consumption by calves and yearlings; meat and fish meal show potential to limit cottonseed meal consumption by mature cows.

Mineral Supplementation

Phosphorus is the most limiting mineral to range livestock production in nearly all parts of the world. On western U.S. ranges phosphorus levels in livestock diets are usually adequate when forage is actively growing. During dormancy, forb and shubs have much higher phosphorus levels than grasses, and if included in the diet, can greatly reduce the need for supplemental phosphorus. Bone phosphorus can be mobilized during short periods (one to three months) when diet phosphorus concentrations are below maintenance without adverse affect on the animal. Continuous supplementation of phosphorus throughout the year appears warranted only in the southeastern pine region. In most parts of the West, phosphorus supplement is needed only in the fall and winter. However, because the costs of supplying supplemental phosphorus are low ($1.50 per cow per year), many ranchers routinely include phosphorus as part of their salt mixtures.

Table 1. Range livestock nutritional requirements for maintenance and production based on range research studies.

	Crude Protein %	Phosphorus %	Digestibility %
Cows			
Maintenance	6–8	.10–.15	40–45
Lactation	9–12	.20–.25	50–55
Yearling Cattle (1 lb gain/day)	8–9	.20–.25	45–50
Ewes			
Maintenance	7–9	.15–.20	45–50
Lactation	10–12	.25–.30	55–60

Salt (sodium and chlorine) is routinely provided to livestock on rangelands throughout the United States. On some western ranges it serves more as a tool to improve livestock distribution rather than as a needed nutritional supplement. California researchers found that range cattle not provided with salt performed as well as those receiving salt in terms of calf production. From a nutritional stand point, they questioned the practice of routinely providing range livestock with salt. In contrast, Oregon research showed providing salt to steers on new growth crested wheatgrass improved their performance. Unlike other nutrients, sodium concentrations are lowest in new growth and highest in mature forage. Because of the low cost of salt, it seems advisable that it be provided at least during the period of active forage growth. Young growing cattle should receive about one pound of salt per month; two pounds per month is recommended for lactating cows on actively growing forage. One half pound per month is usually alloted to ewes. Its costs about $1.20 to $1.40 per cow to supply salt throughout the year.

Iodine deficiencies occur at several localities, particularly in the Northwest. Iodized salt is cheap insurance that iodine requirements will be met. Iron, copper, cobalt and potassium are recommended in mineral mixtures in the southern pine region, particularly in Florida. Magnesium should be included to prevent grass tetany when animals graze lush, early growth such as on wheatfields or crested wheatgrass pastures. Potassium is generally deficient in dormant warm season grasses in Texas and should be supplemented when forage is dormant.

Forage analyses generally show minerals such as iron, copper, cobalt, zinc and manganese are not deficient in

forages from ranges in the western United States. However, recent studies at New Mexico State University have shown improvements in range livestock performance when these minerals were supplemented. Many range forages, particularly grasses, have high silica levels. Silica in forages forms complexes with other minerals making them unavailable to the animal. Therefore, routine provision of mineral supplements throughout the year appears to be cheap insurance against deficiency.

Several feed companies provide salt mineral mixes designed for particular parts of the United States. These mixes are uually provided free choice throughout the year, and range in cost from $3 to $4 per cow per year.

Energy Supplementation

Energy supplements have been considered most practical under conditions of drought or heavy snow. There is evidence the extremely high protein to energy ratios of the lush, early growth of some pasture forages has an adverse affect on livestock performance. This may be due to high levels of non-protein nitrogen that causes a build-up of the poisonous nitrite form in the rumen. Passage rates are very high with these forages causing a high wash out of rumen microflora.

Available energy sources vary widely by area. Barley and cracked corn are two of the more common energy supplements used under range conditions. These feeds usually depress the intake and digestibility of range forage, and serve primarily as substitutes for range forage. Alfalfa hay can be a good source of energy as well as protein. At moderate levels (4 to 5 pounds per cow per day) it will either improve or not affect range forage intake and digestibility. If protein as well as energy is deficient in the range animal diet, it is particularly advantageous. When lush forage is consumed with high protein levels (over 15%), one of the grain supplements would be advisable.

In contrast to protein, energy supplements must be fed daily to obtain satisfactory animal performance. Research at the USDA Livestock and Range Research Station near Miles City, Montana showed cattle fed cracked corn daily gained twice a much as cattle fed double the daily amount every other day. Alternate day feeding appeared to result in rumen conditions less suitable for fiber digestion compared to feeding every day.

In another study at Miles City, the time of day energy supplements were provided to cattle influenced livestock performance. Two groups of steers were fed the same diet of cracked corn daily. One group was fed in the early morning while the other group was fed in the middle of the afternoon. Steers fed in the afternoon outgained steers fed in the morning by about one half pound. This difference is explained by reduced grazing of the early morning compared to late afternoon fed group. The early fed group tended to remain near the feed grounds waiting for the feed truck instead of grazing in the morning. The other group grazed in the morning and waited for feed in the afternoon. Cattle typically graze in the morning and evening and water and loaf in the afternoon. Therefore, normal grazing activities of the afternoon group were unaffected. Steers fed in the late afternoon had higher total intake of feed which probably accounts for their extra gain. (Editor Note: See "Getting the Most Out of Grain Supplements" by D.C. Adams, *Rangelands*).

Vitamin Supplementation

Vitamin A is the only vitamin deficient in most range livestock diets. Carotene, the precursor of vitamin A, is deficient in dormant plant material although levels far above minimum requirements occur in green plant parts. Vitamin A deficiency is not generally a problem on ranges with a high component of palatable evergreen shrubs, or on ranges where green forage is available for over eight months during the year. Vitamin A can be stored by the body, and even low levels of material from evergreen shrubs will more than meet livestock needs. Vitamin A can be supplied by injections or commercial range supplements.

Summary

Energy, protein, phosphorus and vitamin A are the major nutrients limiting the performance of range livestock. With the exception of protein, these nutrients can be stored by the body during periods of high diet quality for later use when levels in the diet are inadequate. Because of low cost, routine phosphorus supplementation during periods for forage dormancy seems justified. Because silica can reduce the availability of essential microminerals, routine inclusion of these minerals in salt blocks is a good practice. Vitamin A supplementation is recommended when livestock must go for over four months without access to green grass or browse. Energy supplementation may be advantageous when forage quantity is in short supply (drought, heavy snowfall). Energy supplementation can reduce nitrite toxicity problems and improve protein/energy ratios of livestock using lush, high protein pastures. Unlike protein supplements, energy supplements (particularly grains) usually reduce the intake of range forage. Livestock perform best when energy supplements are provided on a daily basis in mid-afternoon.

Protein is the major supplement cost of most ranches. Protein supplementation to livestock is economically most advantageous when diet concentrations drop below 6-7%. The detection of when range livestock diets are deficient in protein has been a major problem confronting ranchers. Recently studies have shown that fecal nitrogen concentration has utility for detecting deficiencies in diet crude protein. Equipment affordable to ranchers is being developed that will permit them to quickly determine the protein status of their livestock based on fecal nitrogen concentration. Protein supplements can be provided to livestock on every other or every third day without influencing their performance. New protein carriers other than salt such as tallow and fish meal are being used to limit consumption of protein supplements such as cottonseed meal. This is because salt has an adverse effect on protein digestion.

Supporting Literature

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The Ballad of One Four Oh

An old range steer has little to fear
Where Wyoming's breezes blow,
But the stress and strife of a test steer's life
Blew the mind of One Four Oh.

His early days were a pleasant haze
Of juvenile bovinity
Till man's harsh hand applied a brand
And removed his masculinity.

Then he was weaned and cowboys lean
Rounded up the herd en masse
And hauled their freight down the Interstate
To a place called Happy Grass.

'Twas not too bad till a little lad,
Less mischievous than dense,
Did put the fear in all the steers
And chased 'em through the fence.

A further strain on his bovine brain
Were flies of nightmare size;
He'd never heard of whirlybirds
In an Air Force exercise.

Some orn'ry folk then tried to poke
One more tag in his ear;
He cut up rough, one tag's enough
For any research steer.

But a whisk'ry dude of manner rude
Smacked him upside of his head
With profanity rich; "You sonofabitch!"
Was the mildest thing he said.

One Forty's psyche then took a hike,
His mind came plumb unravelled.
Up went his tail, right through the scales
And over the fence he travelled.

A cowboy shrink diagnosed "I think,
Though the etiology's hazy,
He's a manic-depressive schizoid-repressive;
In short, the critter's crazy!"

Now he roams the range with manner strange,
Making no contribution to science.
He will until MacDonald's grill
Puts an end to his defiance.

And if sometime you chance to dine
'Neath the arches' golden glow
Then home you'll take a belly ache,
The revenge of One Four Oh.

— Dick H. Hart

Editor's Note: 'Happy Grass' is the "High Plains Grassland Research Station" = (HPGRS). The "whisk'ry dude" is Dick Hart