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Approaches to Minimize Protein Supplementation

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The Story in Brief

When feed and fuel prices are up one method to increase margin is to decrease costs. Due to the environment in New Mexico range cattle graze dormant forage for at least 40 weeks every year. Supplementation a certain times is a profitable management tool and is a means to maintain a yearly calving interval. If a rancher wanted to decrease supplements cost the following questions might be asked:

- What is the minimum amount of supplement required?
- When should supplement be fed to be the most effective?
- What should the supplement be composed of?

We have been working on discovering the answers to these questions. We have organized our supplementation plan into a program for strategic and cost effective supplementation.

The Problem and Goal

Supplementation used effectively can be profit generating. Supplements can enhance health, alter milk production, improve reproduction and maintain body condition. Supplementation however is a cost. The cost is not only composed of the feed itself but also the associated costs of delivery to the pasture, storage, transport from a production site and other logistic factors. The environment in every year is different so that calls for a modification to supplementation management when supplied strategically. Our goal is to maintain a 95% pregnancy rate, with 80% of the cows calving in the first 30 days of the breeding season while spending no more than $50 per cow per year in 3 out of 5 years. (In 2005 our goal was to spend no more than $30 per cow.)

Approach

In New Mexico, cows graze dormant brown-colored vegetation for nearly 9 months of each year. The lack of green color is a sign that this feed is low in nutritional quality. We know that it contains a high concentration of slowly digestible fiber; it is low in highly digestible nutrients such as starch and fat and is less than 7% crude protein (more like 5% crude protein or less). This class of forage is usually less than 50% digestible.

When cattle consume a low protein diet as described above, digestibility, intake and productivity are negatively impacted. Usually this negative effect occurs when forage crude protein content is less than 7%. Protein supplements that supply approximately 0.3 lb of ruminally degradable crude protein per day (1.0 lb of a 40% crude protein supplement) will usually improve digestibility and intake. Intake may improve from 5% up to 40% (on rare

occasions) and digestibility will increase 2 to 5 percentage units. If a cow is consuming 20 lb of forage per day (50% digestible or 50% TDN) and she consumes 1.0 lb of a 40% crude protein supplement (70% TDN), we might expect a 5% (1.0 lb) increase in grazed forage intake. The impact of this is shown below.

1.0 lb improved forage intake * 50% TDN = 0.5 lb additional TDN from forage
1.0 lb supplement * 70% TDN = 0.7 lb TDN due to supplement
0.45 + .3 = **1.7 additional lb TDN due to protein supplementation**

Both protein nutrition and energy nutrition are improved with protein supplements fed to cattle grazing dormant range forage.

There are many sources of protein available; these include non-protein nitrogen (NPN) such as urea, and natural protein sources such as oil seed meals (soybean, cottonseed, sunflower meals) and byproduct feeds (brewers dried grains, distillers dried grains, corn gluten meal, blood meal, feather meal, fish meal, etc.). Non-protein nitrogen has been shown to improve forage intake in many situations when forage protein was low. Microorganisms living in the rumen that digest fiber use non-protein nitrogen. However, natural protein sources usually improve intake and cow weight change compared to supplements that contain urea as the sole source of protein. The reason for this is due to the rate of protein release from the supplement and the natural protein provides other nutrients needed by the microbial population. Higher-protein containing manufactured cubed supplements (30% or more crude protein - CP) can contain as much as 15% of the protein from NPN with little change in animal response compared to supplements without urea.

A traditional natural protein supplement is made of 80% or more of an oil seed meal (such as soybean or cottonseed meal). This supplement is very effective when fed at 1.0 lb per day during pregnancy or for a lactating cow in good body condition with access to abundant range forage. This type of supplement is expected to reduce weight loss.
Another effective formulation may include a mixture of protein sources. This mixture would include urea (less than 6% of total CP) which is very rapidly released in the rumen, plus an oil seed meal, which is used in the rumen at a moderate rate, plus a byproduct protein source, which is broken down very slowly with a large portion bypassing to the small intestine. The ideal formulation would provide 50% of the protein as available in the rumen and 50% bypassing the rumen to supply approximately 0.6 lbs crude protein per day. These combination types of protein supplements are most effective when nutrient requirements are high and cows are losing weight. The most effective period for feeding this supplement would be during the last month of pregnancy and after calving and before breeding. This supplement stimulates intake and supplies protein directly to the cow that is needed for nutrient balance, fetal development, milk production, reproduction and reduces protein tissue loss (Figure 1).

Strategies that may be follow variations of the supplements described above could be characterized into 5 levels of high protein supplementation (32% crude protein and greater)

Level 1 – 0.25 lb supplement self fed per day	(minute)
Level 2 – 0.5 lb supplement per day fed 1 day per wk	(mini)
Level 3 - 1.0 lb supplement per day (fed every other day)	(moderate)
Level 4 – 2.0 lb supplement per day (fed 2 times per wk)	(max)
Level 5 - 2.0 lb supplement per day (fed 2 times per wk)	(super max)

Level one is a self fed supplement composed of 50% mineral mix and 50% bypass protein. It is self fed and consumed at a rate of 0.25 to 0.5 lb per day. It is effective when cows need a little supplement to optimize the environment in the rumen. The protein is used very efficiently.

The 0.5 lb per day level would be used after weaning and during middle gestation to optimize digestibility and intake, diminish weight loss, and minimize costs and labor. This program is most successfully implemented by feeding 1 day per week supplying 3.5 lb per head at one feeding. Cows would be in fair to good condition and forage conditions good so cows could be selective in their diet. The feed cost are equal to 40% of level 3.

Level two is fed one day per week at 3.5 lbs per head per feeding. This supplement is also used with high efficiency. It is most appropriate for wintering cows early in the winter needing just a little help. This approach is half the cost of level 3.

The third level, which is more potent, is appropriate for winter and gestation supplementation to supply 1.0 lb per day of a natural protein (with a little urea) supplement (30 to 40% CP). It is especially effective when climatic conditions are more severe. This could be fed 2 to 4 times per week or every other day. The daily feed cost per cow may equal $0.15 per day.

Next a nutritionally robust supplement made of a mixture of proteins (NPN + natural proteins + bypass/byproduct protein) would be fed at a rate of 2.0 lb per head per day. It would contain 36% crude protein that is 50:50 ruminally degradable:ruminal bypass protein. This could be effectively fed to thin pregnant cows and lactating cows that are losing weight. This could also be fed 2 to 4 times per week. Studies at New Mexico State University and in Australia (Leng 2003) have shown improvements in body condition and reproduction when supplements like these are fed to range cows after calving and up to 14 days into breeding.

Young cows in the most severe nutritional stress such as 2 and 3 years olds nursing a calf and grazing dormant vegetation are the best candidates the utilize level 5. This supplement improves level 4 by adding 50grams per day of calcium propionate. The cost of this supplement is the greatest but has the potential to be the most profitable as shown in a 7 year study conducted at NMSU (Table 1). The level 1 and 2 of protein supplementation is the most efficient since the biggest benefit occurs with the lowest amount used, following the relationships of a diminishing returns curve. On the other hand level 3 will give the maximum benefit but at a lower efficiency (Figure 2).

Studies at New Mexico State University have been conducted to investigate the relationships between the type of supplement fed to range raised replacement heifers and pregnancy rate. In a 4 year, study heifers grazed the NMSU Corona Range and Livestock Research Center and were supplemented with one of two supplements that were both 36% crude protein but differed in proportion of ruminally degradable to bypass protein. The two supplements contained either 65:35 or 50:50 ruminally degradable: bypass protein. At breeding time in the spring, the average heifer weighed less than 275 kg. Even though there were no strong differences in winter weight gain there was a 15% higher pregnancy rate in the heifers fed the 50:50 protein supplement. This demonstrates an influence of bypass protein on reproduction independent of body weight gain.

The strategic supplementation concept had been applied to the management of the Corona Range and Livestock Research Center cow herd. Our purchased feed costs vary from year to year (ranging from less than $30 to nearly $50 per cow per year). The cows have maintained a 90%+ pregnancy rate in the fall with 80% of the cows calving in the first 45 days of the calving season.

There are 2 important underpinnings to an effective strategic supplementation program. The first is that a cow must have the ability the consume all of the range forage she wants every day. The second is to supply protein supplements with a composition and timing that is most appropriate to meet the cows needs cost effectively.

References

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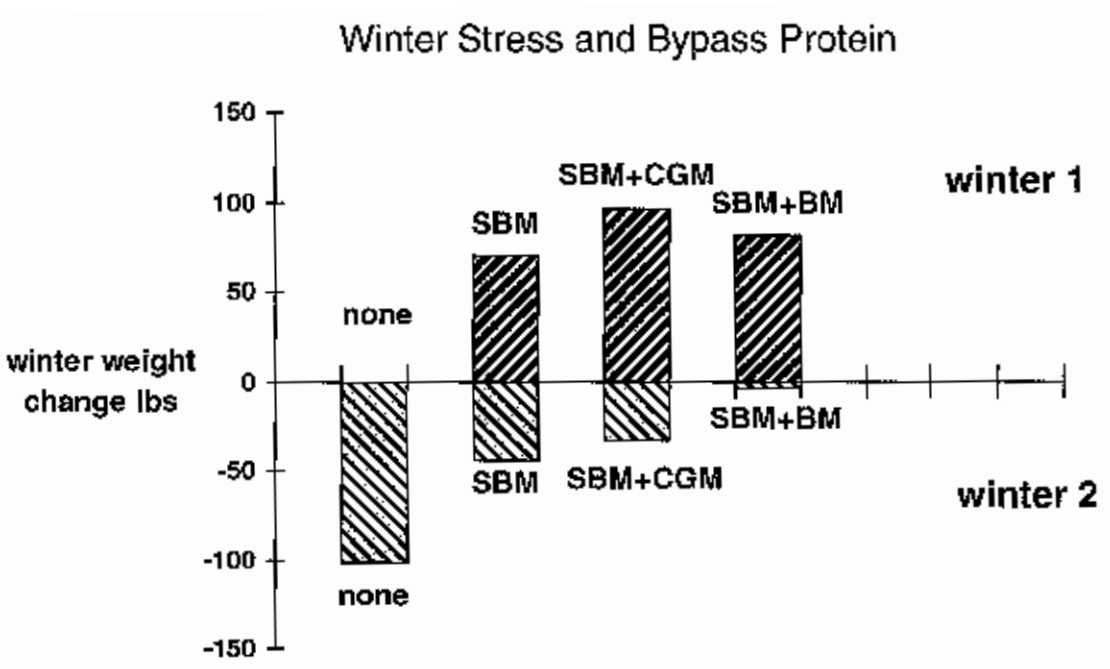

Figure 1. When pregnant range cows cattle lost weight in winter 2 the bypass protein reduced weight loss (Miner et al. 1989)

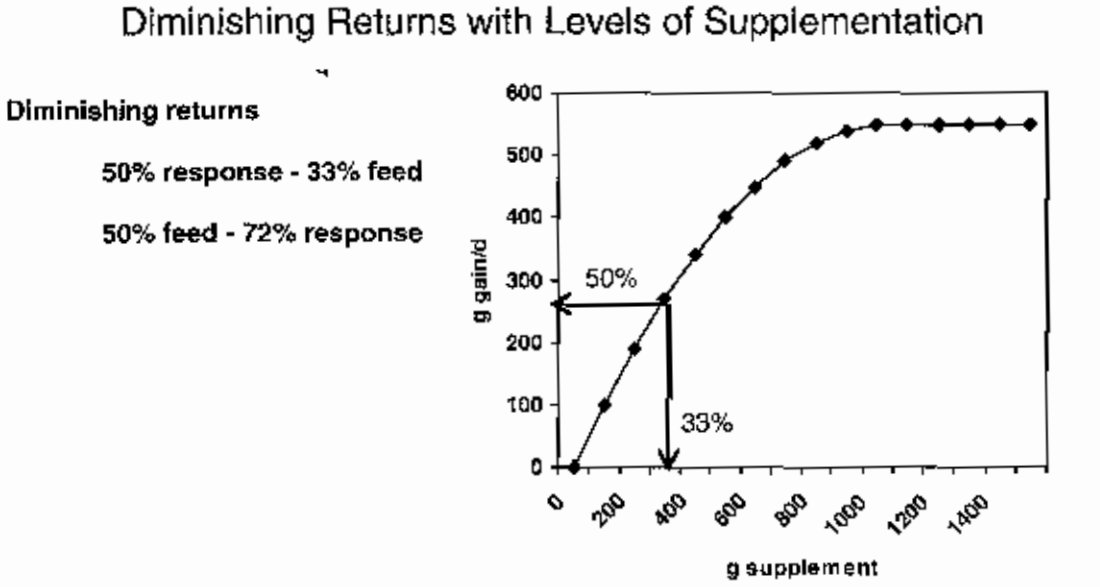

Figure 2. Diminishing returns curve relationships show that the lower amounts of supplement are used most efficiently.

Table 1. Pregnancy rate, return to estrus, milk production, and calf weaning weight of for young cows fed three different postpartum supplements (2000 to 2007)

Item	Supplement Level 3	Level 4	Level 5
Pregnancy rate, %	84	88	95
Return to estrus, days	90	89	84
Milk production, lbs/d	13.4	15.1	13.8

Table 2. Economic comparison of three postpartum supplements fed to 100, 2 & 3 yr old cows.

Item	Year 1 Level 3	Level 4	Level 5
No. of cows	100	100	100
Supplement cost/ton $	318	385	474
Feed cost/cow $	22.26	26.95	33.18
Calf weaning wt, lb	460	480	473
Value calves $	570	595	586
Value minus feed $	546	569	553
difference $		21	6
Pregnancy, %	84	88	95
	Year 2		
Calf loss/exposed cow,%	2.8	2.8	2.8
Calf crop/exposed cow, %	82.6	85.2	92.3
No. of cows	82	85	92
Adjusted calf weaning wt, lb	459	482	485
Value calves $	570	597	601
Total revenue,$	44845	48512	52276
difference $	---	3666	7430