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LAND & LIVESTOCK

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Low Cost Cow/Calf Program: The School – Part XIII

In this issue I'll present what ingredients would be needed in a supplement for a cow herd – average Shrunk Body Weight (SBW) 1200 pounds when in Body Condition Score (BCS) 5.0; calving season 60 days beginning first of February; average calf birth weight 100 pounds; peak milk production at 8.5 weeks 17.5 lb/day; and calves weaned in October – that is provided late bloom smooth bromegrass hay in lieu of range forage Jan – Apr.

A goal for the beef cow rancher should be to have their cows in a BCS of 5 to 6 at the start of the breeding season, so that at least 95% of them will be breed within six to eight weeks. As with the cow herd in Part XII (Jan 2013) that grazed rangeland year round these cows will also begin the breeding season in a BCS 5.5 the first of May for the Feb calving cows and the first of Jun for the Mar calving ones and be in at least this BCS at the beginning of the next breeding season. We'll not go through how the amounts of each ingredient of the supplement was determined, as that was shown in Part XII but will present monthly nutrient deficiencies and how much of each ingredient will be needed to satisfy the shortfalls for both the Feb and Mar calving cows. The total annual amount of each nutrient ingredient needed to satisfy the deficiencies for both management scenarios (year round grazing vs. winter hay feeding) will be compared. In addition, how much of the bromegrass hay needed Jan – Apr will be compared to how much additional rangeland would have be required.

Net Energy Maintenance (NEm)

The range forage did not provide the cows an adequate amount of NEm in Nov and Dec nor did the bromegrass hay in Jan, Mar, and Apr for the Feb calving cows (Table 1) and in Jan, Feb, and Apr for the Mar calving cows (Table 2). However, with the Feb cows entering Nov in a BCS of 6.5 and the Mar cows in a BCS of

5.9 this is not of concern. The reason the bromegrass hay did not provide the Feb cows an adequate amount of NEm in Jan but did so in Feb was due to the cows not being able to consume enough of it in their 9th month of pregnancy compared to after calving and that their NEm (G) needs in the 9th month was greater than their NEm (L) needs in the first month of lactation. However, with an increase in the amount of milk produced in the 2nd and 3rd months of nursing the hay did not fully meet their NEm needs and as a result the cows lost some weight and condition but not too much as they entered breeding in a BCS of 5.5. These were the same reasons as to why the brome hay did or did not satisfy the Mar calving cows NEm requirements but they too did not lose too much weight as they entered the breeding season (Jun) in a BCS of 5.6.

Protein and Degradable Intake Protein

The Feb and Mar calving cows were able to obtain an adequate amount of protein to meet their needs from all forage sources throughout the production year (Table 1 for Feb cows; data not shown for Mar cows). However, the range forage did not provide an adequate amount of DIP in Nov and Dec for both groups to meet the needs of the rumen microbes (Tables 1 and 2). It might be advised to furnish a protein supplement those months but in this exercise they weren't but not knowing what weather conditions will actually be like during these months the provision of a protein supplement would allow the cows to not only consume more of the low quality range forage but be able to utilize more of its energy for warmth which would be needed if it were to turn bitter cold as it did this past December.

Protein Supplement and Bromegrass Hay

As noted above weather conditions can have an influence on whether ranchers decide to feed their livestock supplemental protein and/or energy. However, in Part XII it was shown that if this cow herd was grazing native rangeland year round it would need to be provided a protein supplement Nov – Apr to satisfy the rumen bugs' DIP needs. The protein source used was cottonseed meal that besides being a good source of DIP was also fairly high in NEm. Thus, not only protein was furnished the cows but also additional energy. The amount of the cottonseed meal needed averaged 2.1 lb/day for each cow for a total of 377 lb/cow.

Because late bloom bromegrass hay contains an adequate amount of DIP and NEm to satisfy the rumen bugs' needs the cows' being furnished this hay instead of grazing native rangeland Jan – Apr would not need a protein supplement during this period. However, the cows could use a protein supplement in Nov and/or Dec when they were grazing range and not fed hay, especially if it were extremely cold. If cottonseed meal was the protein source an average of 1.1 and 1.8 lb/day of it would be needed to satisfy the rumen bugs' DIP needs in Nov and Dec, respectively. This would then amount to a total of 88 pounds of the meal per cow for the two months and would result in them being in a BCS of 5.8 to 5.9 at the beginning of breeding.

The total amount of the bromegrass hay needed per cow would average 3325 pounds on a dry matter basis. If grass hay contains on average 12% moisture the total amount on an as is basis would be 3780 pounds or nearly two tons. Wastage has to be factored in and if the hay is feed on the ground by rolling out the bales up to 25% of it could go to waste. If so, the total amount of the bromegrass hay needed per cow Jan – Apr would be 2 ½ tons.

How many acres of native rangeland would be needed per cow during the Jan – Apr period is variable due to the year (wet vs. dry) and the ecological sites (range sites) of the pastures. The total amount of rangeland forage on a dry matter basis that each cow consumed for this period averaged 3242 pounds (Part XII); no

real difference from the amount of hay they each would ingest if they were fed that instead of grazing native range. For the 10 to 14 inch precipitation zone of the Northern Great Plains under a 'Normal' year it is possible that an average of 300 lb/ac of dry forage could be harvested by livestock during the winter months. If that would be the case 10 to 11 acres per cow would be required in order for her to obtain an adequate amount of forage without degrading the range.

Macro-minerals

The range forage did not provide an adequate amount of phosphorus (P) to meet the cows needs Jul – Dec (Tables 1 and 2). The P deficiency in the range forage was least in Jul and increased as the grasses became dormant and weathered. The deficient levels of P were similar between the Feb and Mar calving cows so the average daily amount of dicalcium phosphate (DCP) needed would increase from 0.044 lb/day in Jul to 0.235 lb/day in Dec (Table 3) for a total of at least 24 pounds per cow. The cows grazing rangeland year round required a total of 38 pounds of DCP per cow (Part XII; Table 4). The reason for the lower amount for the hay fed cows was due to the bromegrass hay providing enough P that there was no need to supplement with DCP.

The total amount of calcium (Ca) in the Feb calving cows' diet from forage and DCP was greater than 1.5 times the amount of P in their diet but was not more than seven times the amount (Table 1: Row 41 – Ca: P ratios). The same was true for the Mar calving cows (data not shown).

The range forage did not provide an adequate amount of potassium (K) to meet the cows' needs Sep – Dec (Tables 1 and 2). The amount of potassium chloride (KCl) needed to satisfy the deficiencies in Sep and Oct was 0.07 lb/day and in Nov and Dec it was 0.15 lb/day (Table 3) for a total annual amount per cow of 13 pounds. If cows grazed native range Jan – Apr instead of being fed bromegrass hay the total annual amount of KCl needed would have been 54 pounds per cow even though the cottonseed meal would have provided the cows some K (Part XII; Table 4).

The rangeland forage nor the bromegrass hay provided the cows an adequate amount of magnesium (Mg) through the year (Tables 1 and 2). The daily amounts of magnesium oxide (MgO) needed to satisfy the Mg deficiencies were similar for both groups of cows averaging 0.041 lb/day for when the cows were grazing range (May – Dec) and 0.018 lb/day when they were fed hay (Jan – Apr) (Table 3). The total annual amount of MgO needed per cow would be at least 12 pounds.

The total annual amount of MgO needed per cow when grazing rangeland year round was 13 pounds (Part XII; Table 4). The reason this amount was not greater with the dormant range forage not providing as much Mg to the cows as the bromegrass hay would have was because the cottonseed meal contained Mg.

Although dicalcium-phosphate contains 0.07% K and 0.59% Mg these levels in conjunction with the amounts of DCP provided the cows contributed little to their K and Mg needs.

If the K: Ca + Mg ratio in the cow's diet is less than 2.2: 1 there should not be a grass tetany problem. The provision of MgO when Mg was deficient in the diet (all 12 months) kept the K: Ca + Mg ratios below 2.2: 1 (Table 1; Mar calving cow ratios not shown). Sep and Oct were the only months where the ratios would have been below this threshold without the provision of MgO.

Nov and Dec range forage did not provide the cows an adequate amount of sulfur (S). To satisfy this S shortfall sodium sulfate ($NaSO_4$) could be furnished. However, the range forage

provided 94% and 80% of the cows' S requirements in Nov and Dec, respectively, so the provision of $NaSO_4$ is probably not warranted. In addition, DCP which was provided the cows these two months would furnish them some S, albeit a very slight amount but it would still help.

Although $NaSO_4$ was included in the Nov-Apr supplement furnished the cows grazing native range year round it might not have been necessary as the average daily shortfall would have been 13% of their needs. However, it was provided and the total annual amount per cow was 13 pounds (Part XII; Table 4).

The cows did not obtain an adequate amount of sodium (Na) from the forages and the amounts furnished by DCP and KCl when provided were slight so salt (NaCl) would need to be provided to meet their Na requirement. A daily average of 0.08 pounds of salt would need to be provided the cows for an annual total of 28 pounds. Obviously, salt can be furnished free-choice and let the cows decide how much they want which usually is more than they need.

The total annual amount of salt needed by the cows grazing native range year round was 23 pounds per cow (Part XII; Table 4). This lower amount was due to the range forage providing a pound more Na compared to the bromegrass hay and the $NaSO_4$ furnished these cows providing another two pounds of Na.

Micro-minerals

Both the native range forage and the bromegrass hay provided the cows an adequate amount of cobalt (Co) (Tables 1 and 2).

The range forage did not provide the cows with a sufficient amount of copper (Cu) to meet their needs May – Sep (Tables 1 and 2). Why the range forage provided an adequate amount of Cu to the cows Oct – Dec was not because the Cu content increased but due to the decline in the NEm content of the forage. To satisfy the Cu deficiency in the cows' May – Sep diet copper sulfate ($CuSO_4$) would be provided. The daily amount in mg of $CuSO_4$ needed by the cows would be 100 in May but would decline to 25 in Jun and Jul, 13 in Aug, and 4.5 in Sep (Table 3). The total annual amount of $CuSO_4$ needed per cow would be around 5200 mg or 5.2 grams (g). The cows grazing rangeland year round required 6.2 g of $CuSO_4$ (Part XII; Table 4).

Neither the range forage nor the bromegrass hay contained iodine (I) so to supply the cows with this nutrient they will be furnished EDTA. The daily amount of EDTA provided each cow would average about 10 mg for a total annual amount of 3.5 g (Table 3). The cows grazing range year round also required a similar amount (Part XII; Table 4).

The native range forage and the bromegrass hay contained an adequate amount of iron (Fe) to meet the cows' needs (Tables 1 and 2). In addition, DCP and KCl when they were furnished also provided some Fe.

The range forage May – Sep did not contain a sufficient amount of manganese (Mn) to meet the cows' requirement and the Mn content of the bromegrass hay was inadequate (Tables 1 and 2). DCP provided from 5 to 35 mg of Mn to the cows when it was furnished and MgO provided a small amount of Mn. Manganese carbonate ($MnCO_3$) would be used to make-up for the Mn deficiencies in the forages. The total annual amount of $MnCO_3$ needed per cow would be at least 121 g (Table 3).

For the cows on native range year round the total annual amount per cow was 104 g (Part XII; Table 4). The reason for this lesser amount compared to that for the hay fed cows was due to the bromegrass hay not containing as much Mn as the range forage (Appendix Table 1).

As with I, neither the range forage nor the bromegrass hay contained selenium (Se) so to meet the cows' requirement for this trace mineral sodium selenite (Na_2SeO_3) will be furnished. The total annual amount needed per cow would be 2.5 g. The cows grazing range year round required a total of 2.2 g per cow (Part XII; Table 4). Why the slightly lower amount for the cows grazing range year round was due to the cottonseed meal containing a small amount of Se.

Neither the range forage nor the bromegrass hay contained an adequate amount of zinc (Zn) to meet the cows' need for this nutrient (Tables 1 and 2). To satisfy this shortfall in the cows' diet for Zn zinc sulfate ($ZnSO_4$) would be used. The total annual amount of $ZnSO_4$ needed per cow would be at least 1 pound (Table 3). The total amount needed per cow when grazing range year round was 530 g or nearly 1.2 pounds (Part XII; Table 4).

Supplement Formulations

For the cows grazing native rangeland year round it was decided that two supplement formulas would be sufficient for both the Feb and Mar calving cows: 1) for May-Oct; and 2) for Nov-Apr (Part XII). However, for the cows fed late bloom bromegrass hay Jan – Apr it appears that three supplement formulas would be needed: 1) May – Aug; 2) Sep – Dec; and 3) Jan – Apr (Table 4).

The May – Aug supplement has DCP as one of the ingredients even though the cows may not need any supplemental P in May and Jun (Table 3). It could be excluded in the supplement for these two months but it might be less costly to include it instead of having a specific supplement formulation for these two months. In addition, it is possible the range forage could be deficient in P in May and Jun so including it ensures against a deficit and even if not, the likelihood that there would be a Ca: P imbalance would be remote.

Although the Cu content of the rangeland grasses was consistent May – Dec their NEm content was not with it being high in May and declining as the grasses matured and went dormant (Appendix Table 1). As a result of this the cows would not ingest enough Cu to satisfy their rumen bugs' needs, especially in May (Tables 1 and 2). However, so as not to have too many supplement formulations the amount of $CuSO_4$ to include in the May – Aug formula will be the average amounts needed for this period (Table 3). This could result in the cows being short of dietary Cu in May by 15 mg per day but this is less than 9% of their requirement so would probably not result in a health issue.

In order to come reasonably close to meeting the cows' Mn and Zn needs without additional supplement formulas the amount of $MnCO_3$ and $ZnSO_4$ to include in the May – Aug formula would be based on the average amounts of these two ingredients needed in May, Jun, and Jul (Table 3). For the Sep – Dec formula with regard to the amount of $MnCO_3$ needed it would be the average amounts required for Aug through Dec and for $ZnSO_4$ Aug through Oct. Thus the amounts of these two ingredients in the Jan – Apr formula would be the average amounts needed for Jan through Apr with respect to $MnCO_3$ and Nov through Apr for $ZnSO_4$.

Cost Comparison: Winter hay feeding vs. Year round grazing

To estimate what the price per additional needed acre would be for the cows grazing rangeland year round we'll use the rental price of $19.40 per cow per month (Wyoming 2013 Agricultural Statistics).

$19.40 x 4 months = $77.60 per cow

$77.60/cow ÷ 11 acres/cow = $7.05 per acre

Scorecard for forage, energy and protein:

	Per cow	
Feed	Hay Fed	Range All Year
Acres	0	11
Hay (Tons)	2.5	0
CSM (lb)	0	377

	Total dollars per cow	
Acres ($7.05/ac)	$ 0.00	$ 77.60
Hay ($100/T*)	250.00	0.00
CSM ($0.21/lb)	0.00	79.17
Total	$250.00	$156.77

Note: Although the hay fed cows most likely will not be in a dry lot but on either native range or hay fields it is presumed that by Jan there would be little standing forage available for grazing. *Price for hay could be much higher as it was in 2013 or closer to the long-term average of $80/T.

Based on the above costs for land, hay and cottonseed meal it appears grazing cows on native range year round instead of feeding hay Jan – Apr could save around $93 per cow. However, costs for the mineral supplements still needs to be taken into account.

Scorecard for macro-minerals:

	Total pounds per cow	
Ingredient	Hay Fed	Range All Year
DCP	27.5	38.4
KCl	12.1	53.8
MgO	13.4	13.1
$NaSO_4$	0.0	12.8
Salt (NaCl)	27.8	22.7

	Total dollars per cow	
DCP ($0.18/lb)	$ 4.95	$ 6.90
KCl ($0.15/lb)	1.82	8.07
MgO ($0.14/lb)	1.88	1.83
$NaSO_4$ ($0.08/lb)	0.00	1.02
Salt ($0.10/lb)	2.78	2.30
Total	$11.43	$20.12

Macro-mineral costs for the cows grazing rangeland year round was almost $9 more per cow compared to the cows fed bromegrass hay Jan – Apr. Thus, total savings in costs per cow for grazing the cows year round on range compared to feeding them late bloom bromegrass hay Jan – Apr is reduced to $84.

Scorecard for micro-minerals:

	Total grams per cow	
Ingredient	Hay Fed	Range All Year
$CuSO_4$	5.1	6.2
EDTA	3.5	3.7
$MnCO_3$	138.3	104.0
Na_2SeO_3	2.5	2.2
$ZnSO_4$	543.9	528.3

	Total dollars per cow	
$CuSO_4$ ($2.20/lb)	$0.025	$0.030
EDTA ($59/lb)	0.455	0.481
$MnCO_3$ ($0.30/lb)	0.091	0.069
Na_2SeO_3 ($40/lb)	0.220	0.194
$ZnSO_4$ ($0.32/lb)	0.383	0.372
Total	$1.17	$1.15

Total costs for micro-minerals between the two management scenarios was basically the same. Thus, total feed and supplement costs for the cows grazing range year round was $85 less per cow compared to the cows fed bromegrass hay Jan – Apr (Total costs: $263/cow hay fed vs. $178/cow on rangeland year round).

Next issue:
There are numerous commercial protein supplements on the market with many that include minerals. Furnishing one of these commercial products instead of developing a custom mix may be easier and possibly even cost less. However, how well would they meet livestock nutrient needs has to be considered as nutrient deficiencies can lead to production losses that would be more costly. We'll look at some commercial products (they will not be named) to see how well they meet this cow herd's nutrient needs.

Table 1. Monthly physiological conditions of February calving beef cows (1333 lb EMBW; 1200 lb SBW @ BCS 5.0), their daily intake of nutrients from the range forage or bromegrass hay (Jan – Apr), their daily nutrient requirements, and the nutrient balances before and after supplementation. ***Note: May of following year cow EBW 1081 lb; SBW 1271 lb; BCS 5.55.***

R/C	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		**Units**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**
2		Days	31	30	31	31	30	31	30	31	31	28	31	30
3	**Cow Physiological Conditions**													
4	Gestation	Month in					5	6	7	8	9			
5	Lactation	Month in	4	5	6	7	8					1	2	3
6	EBW	Pounds	1076	1103	1123	1149	1165	1180	1185	1150	1098	1079	1085	1083
7	SBW	Pounds	1265	1296	1320	1350	1369	1387	1393	1351	1290	1268	1275	1273
8	Wt. Change	lb/day	0.86	0.70	0.82	0.53	0.51	0.15	-1.19	-1.69	-0.60	0.22	-0.06	-0.07
9	BCS	1.0 – 9.0	5.5	5.7	5.9	6.2	6.3	6.5	6.5	6.2	5.7	5.5	5.6	5.6
10	**Forage consumed (dry matter basis) based on percent of cow Shrunk Body Weight (SBW)**													
11	%SBW		2.7	2.7	2.7	2.3	2.3	2.0	1.5	1.5	2.0	2.3	2.3	2.3
12	Consumed	lb/day	34.1	35.0	35.6	31.0	31.5	27.7	20.9	20.3	25.8	29.2	29.3	29.3
13	**Net Energy maintenance (NEm) – Mcal/day; Protein – lb/day; and Degradable Intake Protein (DIP) – lb/day**													
14	**NEm from forage**		24.9	22.7	23.2	19.9	19.8	16.1	11.3	10.5	13.4	15.2	15.3	15.2
15	Required (Maintenance)		8.0	8.1	8.3	8.4	8.5	8.6	8.6	8.4	8.1	8.0	8.1	8.0
16	Required (Gestation)						0.5	1.0	1.8	3.1	5.1			
17	Required (Lactation)		4.9	3.8	2.8	2.0	1.4					3.2	5.8	5.8
18	Required (cold weather)							0.7	0.8	0.5	0.5	0.3		
19	Required (activity)		4.0	4.1	4.1	4.2	4.2	4.3	4.3	4.2	1.6	1.6	1.6	1.6
20	Required Total		16.9	16.0	15.2	14.6	14.6	14.6	15.5	16.2	15.3	13.1	15.5	15.4
21	Net Balance		8.0	6.2	8.0	5.3	5.2	1.5	-4.2	-5.7	-1.9	2.1	-0.2	-0.2
22	**Protein from forage**		5.63	4.02	3.92	3.26	3.15	2.91	1.46	1.22	2.58	2.92	2.93	2.93
23	Required (Maintenance)		0.63	0.64	0.65	0.66	0.67	0.68	0.68	0.66	0.64	0.63	0.64	0.63
24	Required (Gestation)						0.05	0.09	0.17	0.30	0.49			
25	Required (Lactation)		1.15	0.89	0.65	0.46	0.32					0.76	1.37	1.37
26	Required Total		1.78	1.53	1.30	1.12	1.04	0.77	0.85	0.97	1.13	1.39	2.00	2.00
27	Net Balance		3.85	2.49	2.62	2.13	2.11	2.14	0.61	0.25	1.45	1.52	0.93	0.93
28	**DIP from forage**		4.06	2.90	2.82	2.35	2.20	1.98	0.95	0.77	1.52	1.72	1.73	1.73
29	Required		2.49	2.27	2.32	1.99	1.98	1.61	1.13	1.05	1.34	1.52	1.53	1.52
30	Net Balance		1.57	0.63	0.50	0.36	0.22	0.37	-0.18	-0.28	0.18	0.20	0.20	0.21

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		Units	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**
31	**Intake amounts of minerals from forage and supplement ingredients, the amounts Required and resultant Net balances, and amount of each ingredient in the supplement to satisfy negative balances**													
32	Macro-Minerals (lb/day):													
33	Phosphorus	Forage	0.075	0.056	0.036	0.028	0.022	0.017	0.003	0.002	0.064	0.073	0.073	0.073
34		Required	0.047	0.045	0.043	0.041	0.042	0.041	0.045	0.051	0.059	0.043	0.050	0.050
35		Net	0.028	0.011	-0.007	-0.013	-0.020	-0.025	-0.042	-0.049	0.006	0.030	0.023	0.023
36	Dicalcium phosphate*				0.036	0.068	0.105	0.127	0.218	0.253				
37	Calcium	Forage	0.171	0.175	0.178	0.202	0.205	0.180	0.136	0.122	0.077	0.088	0.088	0.088
38		DCP*			0.008	0.015	0.023	0.028	0.048	0.056				
39		Total	0.171	0.175	0.186	0.217	0.228	0.208	0.184	0.178	0.077	0.088	0.088	0.088
40		Required	0.113	0.084	0.064	0.062	0.063	0.062	0.068	0.076	0.097	0.109	0.110	0.110
41	Ca: P Ratios	1.5-7: 1	2.3	3.1	4.4	5.3	5.4	5.1	4.1	3.5	1.2	1.2	1.2	1.2
42	Potassium	Forage	0.683	0.612	0.535	0.404	0.283	0.222	0.104	0.091	0.516	0.583	0.587	0.586
43		Required	0.399	0.364	0.371	0.318	0.317	0.257	0.181	0.169	0.215	0.243	0.244	0.244
44		Net	0.284	0.248	0.164	0.086	-0.034	-0.035	-0.076	-0.078	0.301	0.340	0.343	0.342
45	Potassium chloride (KCl)						0.068	0.071	0.152	0.155				
46	Magnesium	Forage	0.048	0.045	0.039	0.034	0.035	0.028	0.017	0.014	0.031	0.035	0.035	0.035
47		Required	0.075	0.068	0.070	0.060	0.060	0.048	0.034	0.032	0.040	0.046	0.046	0.046
48		Net	-0.027	-0.023	-0.030	-0.025	-0.025	-0.021	-0.017	-0.017	-0.009	-0.011	-0.011	-0.011
49	Magnesium oxide (MgO)		0.048	0.040	0.054	0.045	0.044	0.037	0.030	0.031	0.017	0.019	0.019	0.019
50	K: Ca+Mg	< 2.2: 1	1.2	1.1	0.9	0.7	0.5	0.5	0.4	0.4	1.8	1.8	1.8	1.8
51	Sulfur	Forage	0.075	0.063	0.061	0.050	0.047	0.042	0.029	0.024	0.046	0.053	0.053	0.053
52		Required	0.051	0.052	0.053	0.047	0.047	0.042	0.031	0.030	0.039	0.044	0.044	0.044
53		Net	0.024	0.010	0.007	0.003	0.000	0.000	-0.002	-0.006	0.008	0.009	0.009	0.009
54	Sodium sulfate ($NaSO_4$)								0.021	0.061				
55	Sodium	Forage	0.014	0.014	0.014	0.012	0.013	0.011	0.008	0.008	0.003	0.003	0.003	0.003
56		Required	0.057	0.052	0.053	0.045	0.045	0.037	0.026	0.024	0.030	0.034	0.035	0.035
57		Net	-0.043	-0.038	-0.038	-0.033	-0.032	-0.025	-0.017	-0.016	-0.028	-0.032	-0.032	-0.032
58	Salt		0.109	0.096	0.097	0.083	0.082	0.065	0.044	0.040	0.071	0.080	0.081	0.080

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		Units	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
59	Micro-Minerals (mg/day):													
60	Cobalt	Forage	3.7	3.8	3.9	3.4	3.4	3.0	2.3	2.2	6.8	7.7	7.7	7.7
61		Required	2.3	2.1	2.1	1.8	1.8	1.5	1.0	1.0	1.2	1.4	1.4	1.4
62		Net	1.5	1.8	1.8	1.6	1.6	1.6	1.3	1.3	5.6	6.3	6.4	6.3
63	Copper	Forage	155	159	162	141	143	126	95	92	106	119	120	120
64		Required	181	165	169	145	144	117	82	77	98	110	111	111
65		Net	-26	-6.4	-6.5	-3.4	-1.1	9.1	13	15	8.0	9.0	9.1	9.1
66	Copper Sulfate		102	25	25	13	4.5							
67	Iodine	Required	11	10	11	9.0	9.0	7.3	5.1	4.8	6.1	6.9	6.9	6.9
68	EDTA		14	13	13	11	11	9.1	6.4	6.0	7.6	8.6	8.6	8.6
69	Iron	Forage	3181	3180	4051	4163	5009	5296	4652	4145	821	928	933	932
70		DCP			239	446	686	834	1428	1657				
71		Total	3181	3180	4289	4609	5695	6129	6080	5801	821	928	933	932
72		Required	1133	1034	1053	903	902	731	513	479	610	689	693	692
73		Net	2049	2147	3236	3706	4793	5398	5567	5322	211	239	240	240
74	Manganese	Forage	729	572	681	691	730	668	522	470	352	398	400	399
75		DCP			5.0	9.3	14	17	30	35				
76		Total	729	572	685	701	744	686	552	504	352	398	400	399
77		Required	1020	930	948	813	811	658	461	431	549	620	624	623
78		Net	-290	-358	-262	-112	-67	27	91	73	-197	-223	-224	-224
79	Manganese Carbonate		607	748	549	234	141				412	466	469	468
80	Selenium	Required	4.5	4.1	4.2	3.6	3.6	2.9	2.1	1.9	2.4	2.8	2.8	2.8
81	Sodium Selenite		9.9	9.1	9.2	7.9	7.9	6.4	4.5	4.2	5.4	6.1	6.1	6.1
82	Zinc	Forage	279	239	243	198	172	151	104	101	235	265	267	266
83		Required	1020	930	948	813	811	658	461	431	549	620	624	623
84		Net	-740	-692	-705	-615	-640	-507	-357	-330	-314	-355	-357	-357
85	Zinc Sulfate		2036	1902	1938	1692	1759	1394	982	907	864	977	983	981

Table 2. Monthly body condition scores (BCS) and daily nutrient deficiencies of the March calving cows and the amounts of each ingredient to rectify the deficiencies. ***Note: Jun of the following year cow EBW 1087 lb; SBW 1278 lb; and BCS 5.60.***

Nutrient	Ingredient	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
BCS (1 – 9)		5.5	5.7	5.9	6.0	6.1	6.2	5.9	5.5	5.5	5.4	5.4	5.4
NEm (Mcal)							-3.42	-4.43	-0.11	-1.81		-0.33	
	None												
DIP (lb)							-0.17	-0.28					
	None												
Phosphorus (lb)			-0.010	-0.015	-0.019	-0.022	-0.037	-0.042					
	DCP		0.052	0.080	0.100	0.114	0.194	0.216					
Potassium (lb)					-0.033	-0.034	-0.074	-0.075					
	KCl				0.066	0.069	0.147	0.151					
Magnesium (lb)		-0.022	-0.029	-0.025	-0.024	-0.020	-0.017	-0.017	-0.009	-0.009	-0.010	-0.010	-0.027
	MgO	0.040	0.053	0.044	0.043	0.035	0.023	0.030	0.016	0.016	0.018	0.019	0.048
Sulfur (lb)							-0.002	-0.006					
	$NaSO_4$						0.020	0.059					
Sodium (lb)		-0.037	-0.037	-0.032	-0.031	-0.024	-0.014	-0.009	-0.027	-0.027	-0.031	-0.031	-0.042
	Salt	0.093	0.095	0.081	0.079	0.062	0.036	0.022	0.033	0.033	0.038	0.038	0.108
Copper (mg)		-6.2	-6.3	-3.3	-1.1								-26
	$CuSO_4$	24	25	13	4.4								101
Iodine (mg)		-10	-10	-8.8	-8.7	-7.1	-5.0	-4.7	-6.0	-6.0	-6.8	-6.8	-11
	EDTA	13	13	11	11	8.8	6.2	5.8	7.4	7.4	8.4	8.5	14
Manganese (mg)		-349	-253	-107	-65				-193	-193	-219	-220	-287
	$MnCO_3$	730	529	224	137				404	404	458	461	600
Selenium (mg)		-4.0	-4.1	-3.5	-3.5	-2.8	-2.0	-1.9	-2.4	-2.4	-2.7	-2.7	-4.5
	Na_2SeO_3	8.9	9.0	7.7	7.7	6.2	4.4	4.1	5.3	5.2	5.9	6.0	9.8
Zinc (mg)		-675	-686	-597	-619	-491	-346	-321	-308	-308	-349	-351	-732
	$ZnSO_4$	1857	1886	1642	1703	1349	951	882	848	847	960	966	2013

Table 3. Average daily amounts of each supplement ingredient to satisfy the mineral needs of the February and March calving beef cows. ***Note: Feb and Mar calving cows EBW, SBW, and BCS at the beginning of next year's breeding season (May and Jun) were the same as in Tables 1 and 2.***

Nutrient	Ingredient	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Phosphorus	DCP (lb)			0.044	0.074	0.102	0.121	0.206	0.235				
Magnesium	MgO (lb)	0.048	0.040	0.053	0.045	0.044	0.036	0.030	0.031	0.016	0.017	0.019	0.019
Potassium	KCl (lb)					0.070	0.070	0.150	0.153				
Sodium	Salt (lb)	0.109	0.095	0.096	0.082	0.081	0.064	0.043	0.040	0.070	0.075	0.080	0.080
Copper	$CuSO_4$ (mg)	102	25	25	13	4.4							
Iodine	EDTA (mg)	14	13	13	11	11	9.0	6.3	5.9	7.5	8.0	8.5	8.6
Manganese	$MnCO_3$ (mg)	599	736	534	225	135					433	461	463
Selenium	Na_2SeO_3 (mg)	9.9	9.0	9.1	7.8	7.8	6.3	4.4	4.1	5.3	5.6	6.0	6.0
Zinc	$ZnSO_4$ (mg)	2025	1879	1912	1667	1731	1372	966	894	856	912	971	974

Table 4. Daily amounts in grams of each supplement ingredient to satisfy the mineral needs of the February and March calving cows and the supplement mixes to be provided all cows for the May-August, September-December, and January-April periods.

		May-Aug Supplement			Sep-Dec Supplement			Jan-Apr Supplement		
Nutrient	Ingredient	Amount[1]	% of[2]	Lb/T[3]	Amount[1]	% of[2]	Lb/T[3]	Amount[1]	% of[2]	Lb/T[3]
Phosphorus	DCP	26.8	28.6	571.7	75.4	44.7	893.6			
Magnesium	MgO	21.1	22.5	449.4	15.9	9.4	188.7	8.07	18.3	366.4
Potassium	KCl				49.9	29.6	591.5			
Sodium	Salt	43.3	46.1	922.9	25.9	15.3	306.4	34.6	78.5	1570.8
Copper[1]	$CuSO_4$	0.041	0.044	0.88						
Iodine[1]	EDTA	0.013	0.014	0.27	0.008	0.005	0.10	0.008	0.019	0.37
Manganese[1]	$MnCO_3$	0.623	0.664	13.28	0.072	0.043	0.85	0.441	1.00	20.03
Selenium[1]	Na_2SeO_3	0.009	0.010	0.19	0.006	0.003	0.07	0.006	0.013	0.26
Zinc[1]	$ZnSO_4$	1.94	2.07	41.33	1.59	0.942	18.84	0.929	2.11	42.19
Totals		*93.8*	*100*	*2000*	*168.7*	*100*	*2000*	*44.0*	*100*	*2000*

[1]To convert grams (g) to pounds divide g by 454.5. Example: DCP May-Aug = 26.8 g; 26.8 ÷ 454.5 = 0.059 lb

[2]% of = Grams (g) of an ingredient ÷ total grams of supplement. Example: DCP May-Aug = 26.8 g ÷ 93.8 g = 28.6%

[3]Lb/T = % of ingredient in supplement x 2000. Example: DCP May-Aug = (28.6% ÷ 100) x 2000 = 0.286 x 2000 = 572 lb

Appendix Table 1. Forage quality amounts stated in the Feed Library for late bloom bromegrass hay (fed Jan – Apr) and analysis results for NE Wyoming rangeland grasses (May – Dec; average of 2001, 2002, and 2003).

R/C	A	B	C	D	E	F	G	H	I	J	K
1	**Nutrient**	**Units**	**Hay**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2	NEm	Mcal/lb	0.52	0.73	0.65	0.65	0.64	0.63	0.58	0.54	0.52
3	Protein	%	10.0	16.5	11.5	11.0	10.5	10.0	10.5	7.0	6.5
4	Degradable	%	59	72	72	72	72	70	68	65	63
5	Phosphorus	%	0.25	0.22	0.16	0.10	0.09	0.07	0.06	0.015	0.01
6	Calcium	%	0.30	0.50	0.50	0.50	0.65	0.65	0.65	0.65	0.60
7	Magnesium	%	0.12	0.14	0.13	0.11	0.11	0.11	0.10	0.08	0.07
8	Potassium	%	2.00	2.00	1.75	1.50	1.30	0.90	0.80	0.50	0.45
9	Sulfur	%	0.18	0.22	0.18	0.17	0.16	0.15	0.15	0.14	0.12
10	Sodium	%	0.01	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
11	Copper	mg/kg	9	10	10	10	10	10	10	10	10
12	Iron	mg/kg	70	205	200	250	295	350	420	490	450
13	Manganese	mg/kg	30	47	36	42	49	51	53	55	51
14	Molybdenum	mg/kg	0.25	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
15	Zinc	mg/kg	20	18	15	15	14	12	12	11	11
16	Converted to lb/Mcal NEm or mg/lb of dry matter forage (See Table 1 from Part XI for equations)										
17	Protein	lb/Mcal	0.192	0.226	0.177	0.169	0.164	0.159	0.181	0.130	0.125
18	Degradable	lb/Mcal	0.114	0.163	0.127	0.122	0.118	0.111	0.123	0.084	0.079
19	Phosphorus	lb/Mcal	0.005	0.003	0.003	0.002	0.001	0.001	0.001	0.000	0.000
20	Calcium	lb/Mcal	0.006	0.007	0.008	0.008	0.010	0.010	0.011	0.012	0.012
21	Magnesium	lb/Mcal	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001
22	Potassium	lb/Mcal	0.057	0.027	0.027	0.023	0.020	0.014	0.014	0.009	0.009
23	Sulfur	lb/Mcal	0.004	0.003	0.003	0.003	0.003	0.002	0.003	0.003	0.002
24	Sodium	lb/Mcal	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
25	Copper	mg/lb	4.1	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
26	Iron	mg/lb	32	93	91	114	134	159	191	223	205
27	Manganese	mg/lb	14	21	16	19	22	23	24	25	23
28	Molybdenum	mg/lb	0.11	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
29	Zinc	mg/lb	9.1	8.2	6.8	6.8	6.4	5.5	5.5	5.0	5.0
30	Cu: Mo	≥ 4: 1	37	25	25	25	25	25	25	25	25

References

[NRC] National Research Council. 1996 (Update 2000). Nutrient Requirements of Beef Cattle (7th revised edition). Washington, DC, USA: National Academy Press. 234 p.
Note: Appendix Table 1 – Feed Library pp. 192 – 203.

Sims, D.D. 2009. Feeding the Beef Cowherd *for Maximum Profit.* SMS Publishing, Amarillo, TX 79114.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Glen Whipple, Director, University of Wyoming Extension, University of Wyoming, Laramie, Wyoming 82071.