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LAND & LIVESTOCK

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

In this issue of Dr. Dick Diven's (Agri-Concepts, Inc.) information we will look at the phosphorus (P) and calcium (Ca) needs of the cow through the production year and determine the amount she would obtain from the rangeland forage, smooth bromegrass hay, and the 30% protein supplement.

THE COW HERD

The cows have an average shrunk body weight (SBW) of 1200 pounds when in body condition score (BCS) 5.0. Thus their empty body weight (EBW) is 1021 pounds (1200 lb * 0.851). Calving season is 60 days; average calf birth weight 100 pounds; peak milk production at week 9 is 17.5 lb/day; calves weaned at eight months.

The production year scenarios we looked in Parts VI (Jan 2011) and VII (Jul 2011) were for a cow calving the first of Feb, Mar, Apr, May, or Jun with the provision of a 30% protein supplement when degradable intake protein (DIP) was insufficient. In addition, we looked at the same production scenarios but with the provision of smooth bromegrass hay instead of native range forage for the last month of gestation and the first three months of lactation if these occurred during the winter and early spring months.

Rangeland Forage Phosphorus Content

Western rangeland forage, especially grasses, generally are not very high in P due to high pH soils that limit its availability to the plants. Plant P content also declines as they mature, go dormant and are subjected to weathering. Thus highest P content in rangeland forage for the Northern Great Plains is generally in late spring and the lowest in early spring prior to green up. Average monthly P content (%) of rangeland grasses from pastures of the five Johnson County, Wyoming ranches sampled in 2002, 2003, and 2004 is shown in Table 1.

Beef Cow Phosphorus Needs

The amount of P a cow requires, like protein, is based on her energy needs and is estimated by multiplying constants times her Mcal NEm requirements. The constants for *maintenance* (M), *gestation* (G), and *lactation* (L) are 0.00426, 0.0048, and 0.00272, respectively. Table 1 shows the amounts of P (lb/day) a 1200 lb cow in BCS 5.5 at time of calving would require each month of the year.

The cow requires a diet that contains 0.14% P to meet her *maintenance* needs and by the time she reaches her 9th month of pregnancy it increases to 0.23%. Dr. Diven does not indicate where the constants to determine P needs come from but for *gestation* it resulted in 70% more than the amount the National Research Council suggests is needed (0.16%). If the amount of P provided by the forage and 30% protein supplement is close to that needed by the cow in her last trimester providing a P supplement may not be needed. The reason for not providing one is two-fold; 1) P is expensive so minimizing the amount spent on a supplement is desirable, and 2) the cow's Ca need is linked to her P requirement and thus if more P is supplied more Ca will be needed. That may or may not be a problem depending on forage Ca content but needs to be kept in mind to keep cost under control. We'll look at Ca needs following P.

Table 1: Rangeland grass phosphorus (P) content, amounts consumed from the grass and 30% protein supplement, the amount required by a 1200 lb shrunk body weight cow; body condition score 5.5 at calving in Feb, calf weaned in Oct, and amount of DiCal needed.

		P Consumed (lb/day)[2]			P Required (lb/day)				Balance	DiCal
Mon	P (%)	Grass	Protein	Total	(M)[3]	(G)[4]	(L)[5]	Total	(lb/day)	(lb/day)[6]
Feb	0.006	0.002	0.040	0.042	0.034		0.008	0.042	0.000	
Mar	0.005	0.001	0.045	0.046	0.034		0.016	0.050	-0.004	0.02
Apr	0.004	0.001	0.026	0.027	0.033		0.016	0.049	-0.022	0.11
May[1]	0.220	0.071		0.071	0.032		0.013	0.046	0.025	
Jun	0.160	0.052		0.052	0.035		0.010	0.045	0.007	
Jul	0.100	0.032		0.032	0.036		0.008	0.044	-0.012	0.06
Aug	0.090	0.025		0.025	0.038		0.005	0.043	-0.018	0.09
Sep	0.070	0.019		0.019	0.038	0.004	0.004	0.045	-0.026	0.13
Oct	0.060	0.014		0.014	0.038	0.006		0.044	-0.030	0.16
Nov	0.015	0.003	0.023	0.026	0.038	0.010		0.048	-0.022	0.11
Dec	0.010	0.002	0.027	0.029	0.037	0.017		0.054	-0.025	0.13
Jan	0.008	0.002	0.030	0.032	0.036	0.025		0.061	-0.029	0.16

[1] *Beginning of breeding period (approximately 83 days after calving)*

[2] P consumed from rangeland grasses and protein supplement: lb Dry Matter Intake * (% P/100)
Ex. Feb: Table 1, Part VII (July 2011) 26.4 lb grass * (0.006/100) = 26.4 * 0.00006 = 0.002 lb;
3.3 lb protein * 89% dry matter * (1.4/100) = 2.94 * 0.014 = 0.04 lb

[3] P required for maintenance (M): Mcal NEm (M) * 0.00426
Ex. Feb: Table 3, Part VII (July 2011) 7.9 * 0.00426 = 0.034 lb

[4] P required for gestation (G): Mcal NEm (G) * 0.0048
Ex. Sep: Appendix Table 3, Part V (Sep 2010) 0.72 * 0.0048 = 0.004 lb

[5] P required for lactation (L): Mcal NEm (L) * 0.00272
Ex. Feb: Appendix Table 6, Part V (Sep 2010) 3.10 * 0.00272 = 0.008 lb

[6] DiCal (Dicalcium phosphate): Balance when negative ÷ (%P/100); Ex. Apr: 0.022 ÷ 0.193 = 0.11 lb

Rangeland grasses contained an adequate amount of P to meet the cows' needs only in May and June (Table 1). However, broadleaf plants (forbs) generally contain more P than grasses, thus it is possible the cows could satisfy their P needs in Jul and Aug with consumption of forbs. We will, however, in this exercise provide a P supplement in all months that P is deficient in the rangeland grasses and the 30% protein supplement. The protein supplement contains 1.4% P (dry matter basis; 1.57% as is basis) thus it will help offset the deficiency in the grasses when it is provided but still not be enough, except in Feb and maybe in Mar for Feb calving cows (Table 1).

To determine how much of a P supplement is needed divide the amount lacking in the diet (Table 1: Balance column) by the %P in the supplement. For example, if we provide dicalcium phosphate (19.3% P Feed Library) as our P supplement we would need to provide each cow 0.11 lb/day in Apr (0.022 lb ÷ 0.193). As noted above a P supplement would possibly not be needed in Mar and would not be needed in May and June. It might be needed in Jul and Aug and we will consider so and it would be needed Sep-Jan. Whether they would need as much as 0.15 lb/day (0.029 ÷ 0.193) of the dicalcium phosphate in Jan during their 9th month of pregnancy is debatable as noted above but it would be advisable to provide them at least half this amount. Often the cows will tell you if they are obtaining enough of a supplement by not eating all that is provided. If they clean up what is offered increasing the amount until they leave some is a way of determining if their needs are being met.

Let's now look at how much P smooth bromegrass hay will provide the cows' and if a P supplement would be needed. Recall that except for the Jun calving cows, Feb-Apr calving cows are often kept in small pastures near ranch headquarters for at least their last month of pregnancy and up to their first three months of lactation. Thus these cows will require hay during this period as a substitute for the lack of available rangeland forage. The Feb, Mar, Apr, and May calving cows would be fed hay Jan – Apr, Feb – Apr, Mar – Apr, and in Apr, respectively.

Late bloom to mature smooth bromegrass hay from NE Wyoming contains around 0.22% P (hay studies conducted in Johnson and Sheridan Counties). Based on this P content smooth bromegrass hay would provide the Feb calving cows an adequate amount of P, except in their final month of gestation but as pointed out above they may not need as much as indicated (Table 2). Note: This deficiency is the same for all calving scenarios where smooth bromegrass hay is fed in the last month of pregnancy.

What affect does later calving have on the amount of P the cows require and the amount that needs to be supplemented? Very little with regard to both as their total annual P needs was a little over 17 pounds whether on rangeland year round of fed hay in the winter and early spring. The slight difference in cow P needs among the calving scenarios was due to changes in cow size over the year and resultant NEm (M) requirement. Total pounds of dicalcium phosphate needed per cow for year round on rangeland was: Feb – 29.7, Mar – 30.0, Apr – 30.2, May – 31.5, and Jun – 35.5 or 27.1 if the 30% protein supplement would have been provided these cows in Nov and Dec; Smooth bromegrass hay fed: Feb – 32.5, Mar – 29.6, Apr – 31.6, May – 32.3, and Jun 31.0. Thus, when cows calve has little effect on the total amount of P they need. Feeding hay instead of grazing rangeland may cost more but not necessarily when it comes to P supplementation.

Table 2: Rangeland grass or smooth bromegrass hay phosphorus (P) content, amounts consumed from the grass or hay and 30% protein supplement, the amount of P required by a 1200 lb shrunk body weight cow; body condition score 5.5 at calving in Feb, calf weaned in Oct, and amount of DiCal needed.

Mon	P (%)	P Consumed (lb/day)[2]			P Required (lb/day)				Balance (lb/day)	DiCal (lb/day)[6]
		Forage	Protein	Total	(M)[3]	(G)[4]	(L)[5]	Total		
Feb	0.200	0.053		0.053	0.034	0.000	0.008	0.042	0.011	
Mar	0.200	0.053		0.053	0.035	0.000	0.016	0.050	0.003	
Apr	0.200	0.053		0.053	0.035	0.000	0.016	0.050	0.002	
May[1]	0.220	0.071		0.071	0.035	0.000	0.013	0.048	0.023	
Jun	0.160	0.052		0.052	0.036	0.000	0.010	0.047	0.005	
Jul	0.100	0.032		0.032	0.037	0.000	0.008	0.045	-0.013	0.07
Aug	0.090	0.025		0.025	0.039	0.000	0.005	0.044	-0.019	0.10
Sep	0.070	0.019		0.019	0.039	0.003	0.004	0.046	-0.027	0.14
Oct	0.060	0.014		0.014	0.039	0.006	0.000	0.045	-0.031	0.16
Nov	0.015	0.003		0.003	0.039	0.010	0.000	0.049	-0.046	0.24
Dec	0.010	0.002		0.002	0.037	0.017	0.000	0.054	-0.052	0.27
Jan	0.200	0.043		0.043	0.035	0.025	0.000	0.060	-0.017	0.09

[1]*Beginning of breeding period (approximately 83 days after calving)*

[2]P consumed from rangeland grasses or smooth bromegrass hay: lb Dry Matter Intake * (% P/100)
Ex. Feb: Table 5, Part VII (July 2011) 26.4 * (0.200/100) = 26.4 * 0.002 = 0.053 lb
Note: No protein supplement was provided as the smooth bromegrass hay provided an adequate amount of protein to meet the cows' needs, although protein was provided later calving cows.

[3]P required for maintenance (M): Mcal NEm (M) * 0.00426
Ex. Feb: Table 6, Part VII (July 2011) 7.9 * 0.00426 = 0.034 lb

[4]P required for gestation (G): Mcal NEm (G) * 0.0048
Ex. Sep: Table 3, Part VII (July 2011) 0.7 * 0.0048 = 0.003 lb

[5]P required for lactation (L): Mcal NEm (L) * 0.00272
Ex. Feb: Table 3, Part VII (July 2011) 3.1 * 0.00272 = 0.008 lb

[6]DiCal (Dicalcium phosphate): Balance when negative ÷ (%P/100); Ex. Jul: 0.013 ÷ 0.193 = 0.07 lb

Beef Cow Calcium Needs

Calcium (Ca) requirements are related to P consumption. For every part P cattle consume they need to consume 1.5 to 2.0 times as much Ca for optimum performance. More Ca than this is permissible but it is recommended that it not exceed 6 times the amount of P consumed as reduced growth, feed efficiency and reproduction could occur.

From Table 1 we find that the Feb calving cows consumed 0.042 lb of P each day from the rangeland grasses and the 30% protein supplement in Feb. Thus their minimum Ca requirement would be 0.063 lb/day (0.042 * 1.5). Northeast Wyoming rangeland grasses in Feb contain around 0.40% Ca. In addition, the 30% protein supplement contains 0.32% Ca. The cows would have consumed about 0.11 lb of Ca from the rangeland grasses (26.4 lb * 0.004) and 0.009 lb from the protein supplement (2.9 * 0.0032) for a total of about 0.12 lb. Dividing the 0.12 lb of Ca consumed by the 0.042 lb of P consumed results in a Ca: P ratio of 2.7: 1.0, within the 1.5 to 6.0: 1.0 ratio range.

For the Feb calving cows the amount of Ca consumed each month from the rangeland grasses and 30% protein supplement is listed in Table 3. Dividing the amounts of Ca consumed from the grass and protein by the amounts of P consumed (Table 1) the Ca: P ratios were within the desired range of 1.5 to 6.0: 1.0, except in Aug, Sep, and Oct when it was above 6.0: 1.0 indicating that too much Ca was being consumed compared to the amount of P consumed. The reason for this is that the P content of the rangeland grasses was declining whereas their Ca content increased. Because of low P availability in soils of semi-arid regions, the amount of P absorbed by the grasses is limited and as a result becomes diluted within their tissues as they grow. Whereas Ca is high and readily available in these soils so as the plants grow they absorb more of it concentrating it in their tissues. However, as they go dormant and weather over the winter their Ca content does decline.

The provision of dicalcium phosphate to satisfy the cows' P needs resulted in lowering the Ca: P ratios even though the supplement contained slightly more Ca then P (22% Ca vs. 19.3% P). For each month dicalcium phosphate was provided the Ca: P ratio remained above 1.5: 1.0 and in Aug, Sep, and Oct it dropped to below 6.0: 1.0. In addition, regardless of the month the cows calved in the Ca: P ratios were within the desired range when dicalcium phosphate was provided to meet the cows' P needs.

Table 3: Rangeland grass calcium (Ca) content, amounts consumed from the grass, the 30% protein supplement, and dicalcium phosphate (DiCal), and Ca: P ratios for a 1200 lb shrunk body weight cow; body condition score 5.5 at calving in Feb, calf weaned in Oct.

Mon	Ca (%)	Ca Consumed (lb/day)[2]			Ca: P Ratio[3]	Ca from DiCal[4]	Total from all sources	Ca: P Ratio[5]
		Grass	Protein	Total				
Feb	0.40	0.106	0.009	0.12	2.7		0.12	2.7
Mar	0.35	0.092	0.010	0.10	2.2	0.004	0.11	2.2
Apr	0.30	0.079	0.006	0.09	3.2	0.024	0.11	2.3
May[1]	0.50	0.162		0.16	2.3		0.16	2.3
Jun	0.50	0.162		0.16	3.1		0.16	3.1
Jul	0.50	0.162		0.16	5.0	0.013	0.18	4.0
Aug	0.65	0.179		0.18	7.2	0.020	0.20	4.7
Sep	0.65	0.179		0.18	9.3	0.029	0.21	4.6
Oct	0.65	0.156		0.16	10.8	0.035	0.19	4.3
Nov	0.65	0.140	0.005	0.15	5.5	0.024	0.17	3.5
Dec	0.60	0.130	0.006	0.14	4.7	0.029	0.16	3.1
Jan	0.55	0.119	0.007	0.13	4.0	0.035	0.16	2.6

[1]*Beginning of breeding period (approximately 83 days after calving)*

[2]Ca consumed from rangeland grasses and protein supplement: lb Dry Matter Intake * (% Ca/100)
Ex. Feb: Table 1, Part VII (July 2011) 26.4 lb grass * (0.40/100) = 26.4 * 0.004 = 0.106 lb;
3.3 lb protein * 89% dry matter * (0.32/100) = 2.94 * 0.0032 = 0.009 lb

[3]Ca: P ratio of range grass and protein supplement: Total Ca consumed ÷ Total P consumed (Table 1)
Ex. Feb: 0.115 ÷ 0.042 = 2.7: 1.0

[4]Ca consumed from dicalcium phosphate: Table 1, Dical (lb/day) * (22%/100) percent Ca in the DiCal
Ex. Mar: 0.02 lb of DiCal * 0.22 = 0.004 lb

[5]Ca: P ratio from all feed sources: Total Ca consumed from all sources ÷ Total P required (Table 1)
Ex. Mar: 0.11 ÷ 0.05 = 2.2: 1.0

What about the cows receiving hay in lieu of rangeland grazing? Smooth bromegrass hay from this region contains around 0.40% Ca similar to weathered rangeland grass. Table 4 shows the amount of Ca in the rangeland grasses and smooth bromegrass hay and the amount consumed by the Feb calving cows' from these forages. Resultant Ca: P ratios were within the 1.5 to 6.0: 1.0 range, except Aug through Dec, being exceptionally high in Nov and Dec. This is due to the very low P content of the rangeland grasses compared to their Ca content. Thus provision of a P supplement is very much warranted to avoid health issues.

The dicalcium phosphate lowered Ca: P ratios to below 6.0: 1.0 even in Nov and Dec and they were above 1.5: 1.0 in all months. Again, regardless of the month the cows calved in the Ca: P ratios were within the desired range when dicalcium phosphate was provided to meet the cows' P needs.

Next time we'll look at how to determine the cow's requirements for the rest of the macro minerals; potassium, magnesium, sodium, and sulfur and if the rangeland grasses or smooth bromegrass hay meet her needs and after that the micro minerals.

Table 4: Rangeland grass or smooth bromegrass hay calcium (Ca) content, amounts consumed from the grass or hay, the 30% protein supplement, and dicalcium phosphate (DiCal), and Ca: P ratios for a 1200 lb shrunk body weight cow; body condition score 5.5 at calving in Feb, calf weaned in Oct.

Mon	Ca (%)	Ca Consumed (lb/day)[2]			Ca: P Ratio[3]	Ca from DiCal[4]	Total from all sources	Ca: P Ratio[5]
		Forage	Protein	Total				
Feb	0.40	0.106		0.11	2.1		0.11	2.1
Mar	0.40	0.106		0.11	2.1		0.11	2.1
Apr	0.40	0.106		0.11	2.1		0.11	2.1
May[1]	0.50	0.162		0.16	2.3		0.16	2.3
Jun	0.50	0.162		0.16	3.1		0.16	3.1
Jul	0.50	0.162		0.16	5.0	0.015	0.18	4.0
Aug	0.65	0.179		0.18	7.2	0.022	0.20	4.6
Sep	0.65	0.179		0.18	9.3	0.031	0.21	4.6
Oct	0.65	0.156		0.16	10.8	0.035	0.19	4.2
Nov	0.65	0.117		0.12	43.3	0.053	0.17	3.5
Dec	0.60	0.108		0.11	60.0	0.059	0.17	3.1
Jan	0.40	0.086		0.09	2.0	0.020	0.11	1.8

[1]*Beginning of breeding period (approximately 83 days after calving)*

[2]Ca consumed from rangeland grass or smooth bromegrass hay: lb Dry Matter Intake * (% Ca/100)
Ex. Feb: Table 1, Part VII (July 2011) 26.4 lb hay * (0.40/100) = 26.4 * 0.004 = 0.106;
Note: No protein supplement was provided as the smooth bromegrass hay provided an adequate amount of protein to meet the cows' needs. However, in other calving scenarios it is provided and the pounds of Ca it provides is determined thus: lb protein * 89% dry matter * (0.32/100)

[3]Ca: P ratio of forage and protein supplement: Total Ca consumed ÷ Total P consumed (Table 2)
Ex. Feb: 0.11 ÷ 0.053 = 2.1: 1.0

[4]Ca consumed from dicalcium phosphate: Table 2, Dical (lb/day) * (22%/100) percent Ca in the DiCal
Ex. Jul: 0.07 lb of DiCal * 0.22 = 0.015

[5]Ca: P ratio from all feed sources: Total Ca consumed from all sources ÷ Total P required (Table 2)
Ex. Jul: 0.18 ÷ 0.045 = 4.0: 1.0

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