

Range Cow Nutrient Requirements during Production Periods

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Improvement in profit margins from beef production requires a reduction in forage-feed costs because these costs comprise 60% to 65% of the production costs of cow-calf operations. Traditional pasture-forage management practices used to provide feed for range cows are inefficient in the capture of the forage nutrients produced on a land base and in the conversion of those nutrients into a saleable commodity like calf weight. High forage-feed costs result.

The basic concepts for traditional management practices were developed during the early stages of the beef industry in the Northern Plains when the dry matter requirements for the livestock were the major consideration and the cost of land area per animal added little to the total production costs. The traditional practices brought numerous family operations in the region through depression, drought, severe winter storms, wild fires, and other natural and man-made calamities but are not adequately serving producers facing current conditions. The old practices ineffectively address two major changes that have occurred. The first major change is that the modern fast-growing, high-performance cattle are genetically different from the old-style cattle. Modern cattle have higher rates of weight gain, produce greater quantities of milk, are larger and weigh more, and deposit less fat on their bodies. Modern animals have higher levels of nutrient requirements, which traditional practices do not efficiently meet. The second major change is that the swine, poultry, and dairy industries have switched to efficient feed management systems that evaluate feed costs by the cost per unit of weight of the nutrients. This shift has reduced production costs for these industries and increased competition for the beef industry. With traditional practices, the beef industry cannot reduce production costs enough to remain competitive.

Feed management systems for beef production in the Northern Plains need to be changed and improved. The modern animal, which has reduced body fat, performs best when provided with the required quantities of nutrients throughout the production year, and feed costs are lower when greater quantities of the produced nutrients are efficiently captured from the land base.

The nutrients beef animals require are energy, protein, minerals, vitamins, and water. The quantities of each nutrient required vary with cow size, level of milk production, and production period. Forages provide primarily energy and protein and also some portion of the required minerals and vitamins. The amounts of minerals deficient in forage can be supplied by a free-choice salt/mineral program. Vitamin A can be supplemented if carotene is low in range cow feeds. Adequate quantities of clean water must be provided for satisfactory animal performance.

Forage dry matter intake is influenced primarily by cow size. Larger cows need more feed than smaller cows for satisfactory reproductive and production performance. Daily dry matter intake is generally around 2% of body weight but ranges from 1.5% to 3.0% of body weight (Holecheck et al. 1995) and can be affected by the quality or the water content of forage and by environmental conditions. The dry matter intake requirement for beef cows is the quantity of forage dry matter that contains the required amount of energy (NRC 1996).

Modern high-performance cows produce greater quantities of milk than the old-style cows. Higher milk production requires that cows consume more energy, protein, calcium, and phosphorus for satisfactory performance (NRC 1996). Forages that do not meet these nutrient requirements cause loss of cow weight and reduced milk production.

The quantity of nutrients range cows require is not consistent throughout the year. The level of nutrients required above maintenance levels varies with the changes in nutrient demand from milk production for the nursing calf as it grows and with the changes in nutrient demand of the physiological preparation for breeding and the development of the fetus that will be the next calf (BCRC 1999). The various combinations of these changing nutritional requirements (table 1) are separated into four production periods: dry gestation, third trimester, early lactation, and lactation, which is subdivided into spring, summer, and fall portions.

The dry gestation production period has the lowest nutrient requirements because there is no nursing calf or milk production and the developing

fetus is still small during middle gestation and does not have high nutrient demands. Heavy cows can lose weight during this period without detrimental future effects on reproduction and production performance. Cows with moderate body condition should maintain body weight because the cost to replace lost pounds is greater during other production periods. Thin cows should gain weight during this period because each pound gained requires less feed and costs less than weight gained during other production periods.

The third trimester production period has increased nutrient requirements. Although the cow has no calf at her side and is not producing milk, the developing fetus is growing at an increasing rate. The weight gain from the fetus and related fluid and tissue is about one pound per day during the last 2 or 2.5 months, when the fetus is growing very rapidly (BCRC 1999). It is important that higher-quality forage that meets the nutritional requirements be provided during this period to maintain the weight of cows in moderate or good body condition and to ensure a strong, healthy calf. Feeding forages containing insufficient nutrients during this period causes a reduction in cow body condition and results in delayed estrual activity and a delay in rebreeding.

The early lactation production period has the greatest nutritional requirements of the production periods because the birth of the calf initiates production of increasing amounts of milk and the reproductive organs require repair and pre-conditioning to promote the rapid onset of the estrus cycle. Cows gaining weight during this period produce amounts of milk at or near the animals' genetic potential. Cows increasing in body condition will have adequate time to complete at least one estrus cycle prior to the start of the breeding season; this rapid recovery improves the percentage of cows that conceive in the first cycle of the breeding season (BCRC 1999). Feeding forages containing insufficient nutrients during this period causes a reduced cow body condition that results in milk production at levels below the animals' genetic potential and in a delayed onset of estrual activity so that the period between calving and the first estrus cycle is lengthened and conception rates in the cow herd are reduced.

The spring portion of the lactation production period has nutritional requirements slightly reduced from those of the previous period. The quantity of milk produced continues to increase until the peak is reached during the later part of the second month or the early part of the third month after calving (BCRC 1999). Cows gaining weight during this period produce amounts of milk at or near

the animals' genetic potential. Providing harvested or pasture forages with high nutrient content prior to and during breeding season stimulates ovulation in the cows: cows with improving body condition start estrus cycles earlier and can rebreed in 80 to 85 days after calving (BCRC 1999). The rate of calf weight gain continues to increase during the spring period. Calves that are around a month old in early May have developed enough to take advantage of the greater quantities of milk produced by cows grazing high-quality forage on domesticated grass spring complementary pastures and add weight at high rates.

The summer portion of the lactation production period has nutritional requirements above maintenance. The greater part of the additional nutrients is for the production of milk for the nursing calf, and a smaller amount is for the support of an embryo at the early stages of development. The nutritional quality of the forage during the summer plays a role in maintaining the pregnancy. Cows maintaining or improving body condition have lower rates of embryo loss than cows losing body condition (BCRC 1999). The quantity of milk produced during the summer period declines from peak levels. The nutritional quality of the forage affects the rate of decrease. If the forage quality is at or above the animals' nutritional requirements, cows can maintain milk production near their genetic potential during most of the lactation period (BCRC 1999). Cows with higher milk production produce heavier calves at weaning. Cows grazing pasture treatments with forage quality insufficient to meet animal nutritional requirements have milk production below their genetic potential and produce calves that are lighter at weaning and have higher costs per pound of weight gained.

The fall portion of the lactation production period has nutritional requirements above maintenance. The greater part of the additional nutrients is for the production of milk for the nursing calf, and a smaller amount is for development of the fetus. The nutritional quality of the forage affects the quantities of milk produced. If forage quality is at or near animal nutritional requirements, milk production can be fairly high and rate of calf weight gain can be satisfactory (BCRC 1999). Forage quality of mature perennial grasses on traditionally managed pastures is below the requirements of a lactating cow. Forage-feed costs increase when the nutrient quality of the grass or forage provided does not meet the nutritional requirements of the cow. Cows lose body weight and body condition when body reserves are converted into milk production. The level of milk production and the rate of calf weight gain are low; the result is higher costs per pound of calf weight gained.

The time of year during which the cow production periods occur is set by the calving date, which is determined by the breeding date. The sequences of production periods of cows with calving dates in January to April are shown in table 2. The date of calving should be selected so that the nutritional requirements of the cow during her production periods are synchronized with the nutritional quality of the grass and forage resources. The nutritional quality of the common domesticated grassland and native rangeland pastures in the Northern Plains (Whitman et al. 1951, Manske 1999a, b) matches the nutritional requirements of the lactation production periods of cows with calving dates in January through April (figs. 1-4). The nutritional requirements of cows with calving dates in late spring, summer, or fall are not synchronized with the changes in nutritional quality of perennial forages on grazinglands (figs. 5-12). Forage from sources other than perennial grass grazinglands is required to provide low-cost nutrients for cows with calving dates later than April.

Tables 3 to 14 show cow nutrient requirements from grazingland forage or harvested forage during the production periods for 1000-pound, 1200-pound, and 1400-pound cows with calving dates in January to April. The 1200-pound cow with a calf born in mid March will be used as the example throughout this report. The 12-month nutritional requirements for a 1200-pound cow (table 10) are 9489 pounds of forage dry matter, 5217.2 pounds of energy as TDN, 835.8 pounds of crude protein, 24.1 pounds of calcium, and 16.7 pounds of phosphorus. The 12-month forage-feed costs for a cow depend on the amount paid for each pound of nutrient.

Accurate evaluations of costs among various management treatments and forage types are based on costs per pound of nutrient. Cost per pound of crude protein could be used in cost comparisons for different forage types. Small but positive profit margins can be achieved for beef production during a low market with calf weight value at \$0.70 per pound at weaning time when the average calf weaning weight is 535 pounds and the pasture-forage costs are 60% of total beef production costs with average forage-feed costs of \$0.62 per day, forage dry matter costs of \$48.00 per ton, and crude protein costs of \$0.25 per pound.

Nutritional requirements for beef cows are determined on a dry-matter basis. Almost all forages consumed by range cows have some water content. Table 15 shows the wet weight equivalent of forages with various water contents. Cows can consume a greater weight of wet forage than of dry forage (BCRC 1999).

Forage dry matter intake of grazing animals is affected by the size of the cow. Large cows consume more forage than medium- and standard-sized cows. A more accurate estimate of daily or monthly forage demand of livestock on grazinglands can be determined with the metabolic weight of the animal rather than its live weight. Metabolic weight is live weight to the 0.75 power (NRC 1996). A 1000-pound cow with a calf is the standard, which is defined as 1.00 animal unit (AU) and has a daily dry matter allocation of 26 pounds of forage (Bedell 1998). The metabolic weight of a 1200-pound cow with a calf is 1.147 animal unit equivalent (AUE), which has a daily dry matter allocation of 30 pounds of forage. The metabolic weight of a 1400-pound cow with a calf is 1.287 animal unit equivalent (AUE), which has a daily dry matter allocation of 33 pounds of forage (Manske 1998a). The amount of forage dry matter consumed in one month by one animal unit, a 1000-pound cow with a calf, is an animal unit month (AUM) (Bedell 1998). During the grazing season from May through November, the length of the average month is 30.5 days (Manske 1998b).

Range cow nutritional requirements change with cow size, milk production level, and production period. Coordination of pasture and forage quantity and quality with dietary quantity and quality improves efficiency of nutrient capture and conversion, resulting in lower pasture-forage costs.

Acknowledgment

I am grateful to Sheri Schneider for assistance in production of this manuscript and for development of the tables and figures. I am grateful to Amy M. Kraus for assistance in preparation of this manuscript.

Table 1. Intake nutrient requirements in pounds per day for range cows with average milk production during 12 months of production periods (data from NRC 1996).

| | Dry Gestation | 3 rd Trimester | Early Lactation | Lactation (Spring, Summer, Fall) |
|---------------|---------------|---------------------------|-----------------|-------------------------------------|
| 1000 lb cows | | | | |
| Dry matter | 21 | 21 | 24 | 24 |
| Energy (TDN) | 9.64 | 10.98 | 14.30 | 13.73 |
| Crude protein | 1.30 | 1.64 | 2.52 | 2.30 |
| Calcium | 0.03 | 0.05 | 0.07 | 0.06 |
| Phosphorus | 0.02 | 0.03 | 0.05 | 0.04 |
| 1200 lb cows | | | | |
| Dry matter | 24 | 24 | 27 | 27 |
| Energy (TDN) | 11.02 | 12.62 | 15.85 | 15.23 |
| Crude protein | 1.49 | 1.87 | 2.73 | 2.51 |
| Calcium | 0.04 | 0.06 | 0.08 | 0.07 |
| Phosphorus | 0.03 | 0.04 | 0.05 | 0.05 |
| 1400 lb cows | | | | |
| Dry matter | 27 | 27 | 30 | 30 |
| Energy (TDN) | 12.42 | 14.28 | 17.40 | 16.71 |
| Crude protein | 1.67 | 2.13 | 2.94 | 2.70 |
| Calcium | 0.04 | 0.07 | 0.08 | 0.08 |
| Phosphorus | 0.03 | 0.05 | 0.06 | 0.05 |

Table 2. Twelve-month range cow production period sequences for calf birth dates in January to April.

| 12-Months | Calf Birth Month | | | |
|-----------|-------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|
| | January | February | March | April |
| late Nov | RATION (cont') 3rd Trimester 3.0m, 90d | RATION 3rd Trimester 3.0m, 90d | Dry Gestation 1.0m, 32d | RATION Dry Gestation 2.0m, 62d |
| Dec | | | RATION | |
| Jan | Calf Birth | | 3rd Trimester 3.0m, 90d | |
| Feb | Early Lactation 1.0m, 32d | Calf Birth | | 3rd Trimester 3.0m, 90d |
| Mar | Lactation 2.5m, 75d | Early Lactation 1.0m, 32d | Calf Birth | |
| Apr | | Lactation 1.5m, 45d | Early Lactation 1.5m, 45d | Calf Birth |
| May | | | | Early Lactation 0.5m, 15d |
| Jun | PASTURE Lactation (spring) 1.0m, 31d | PASTURE Lactation (spring) 1.0m, 31d | PASTURE Lactation (spring) 1.0m, 31d | PASTURE Lactation (spring) 1.0m, 31d |
| Jul | Lactation (summer) 4.5m, 137d | Lactation (summer) 4.5m, 137d | Lactation (summer) 4.5m, 137d | Lactation (summer) 4.5m, 137d |
| Aug | | | | |
| Sep | | | | |
| Oct | Calf age-9m Calf Weaning | | | |
| early Nov | RATION 3rd Trimester 3.0m, 90d | Lactation (fall) 1.0m, 30d Calf age-9m Calf Weaning | Lactation (fall) 1.0m, 30d Calf age-8m Calf Weaning | Lactation (fall) 1.0m, 30d Calf age-7m Calf Weaning |
| | | | | |

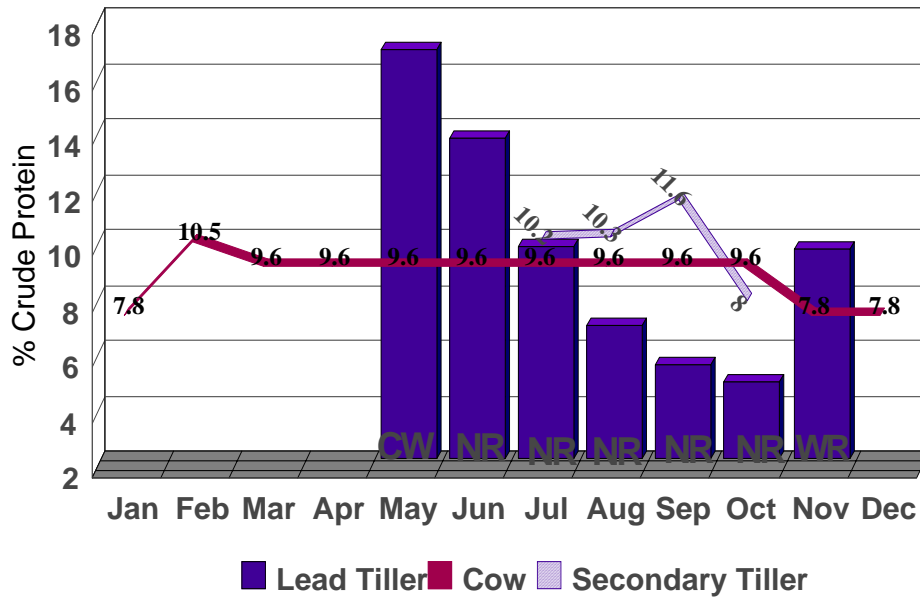


Fig. 1. Cow nutritional requirements for calf birth in January and pasture nutritional quality.

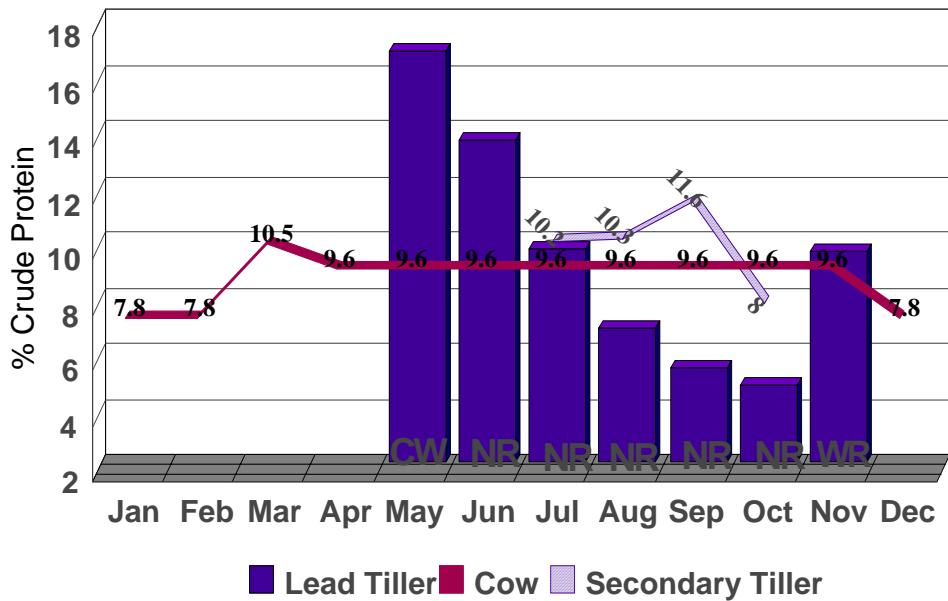


Fig. 2. Cow nutritional requirements for calf birth in February and pasture nutritional quality.

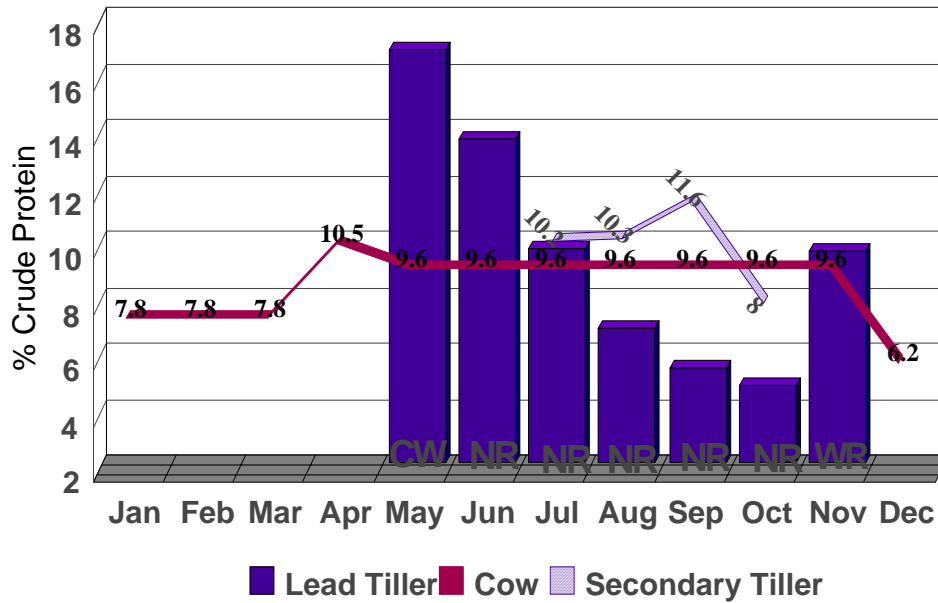


Fig. 3. Cow nutritional requirements for calf birth in March and pasture nutritional quality.

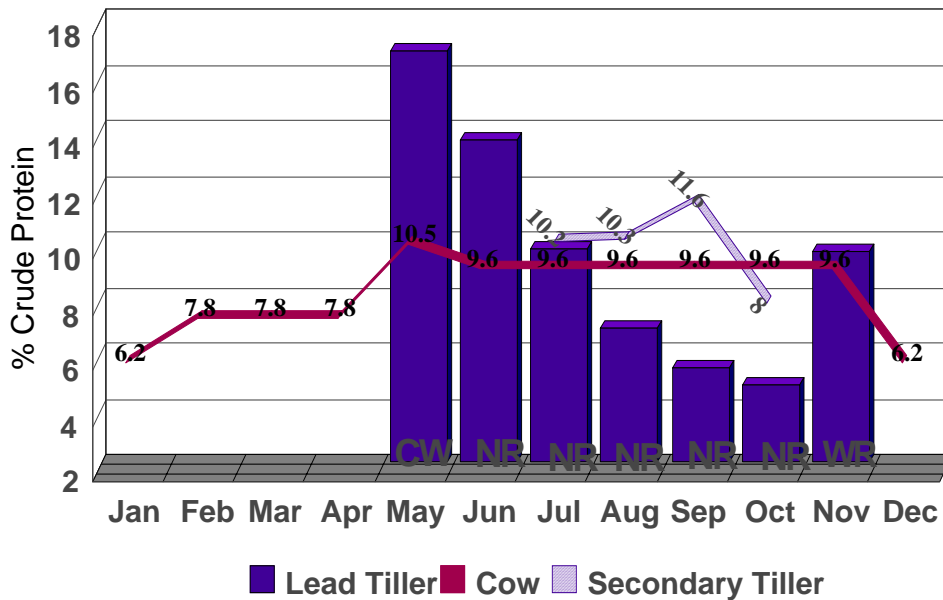


Fig. 4. Cow nutritional requirements for calf birth in April and pasture nutritional quality.

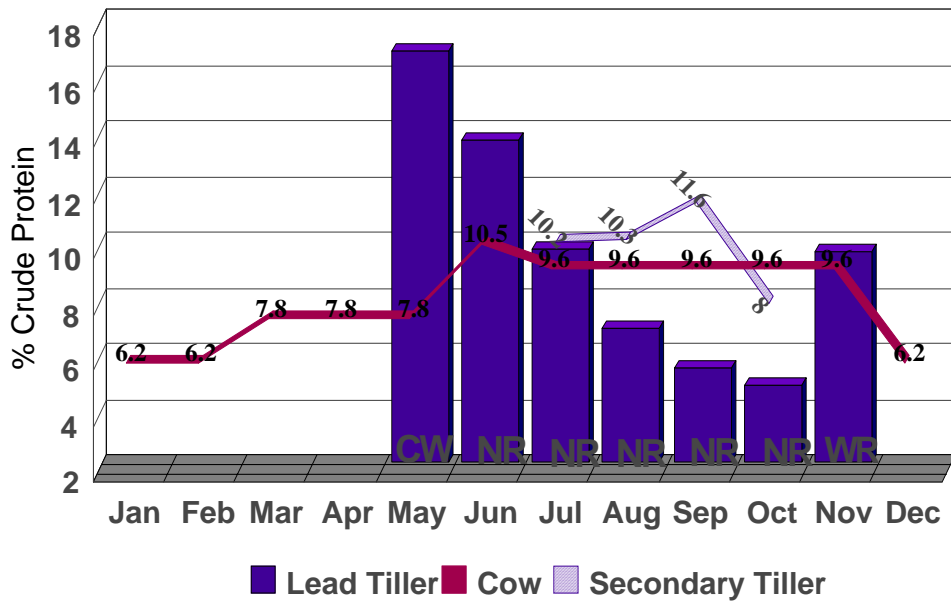


Fig. 5. Cow nutritional requirements for calf birth in May and pasture nutritional quality.

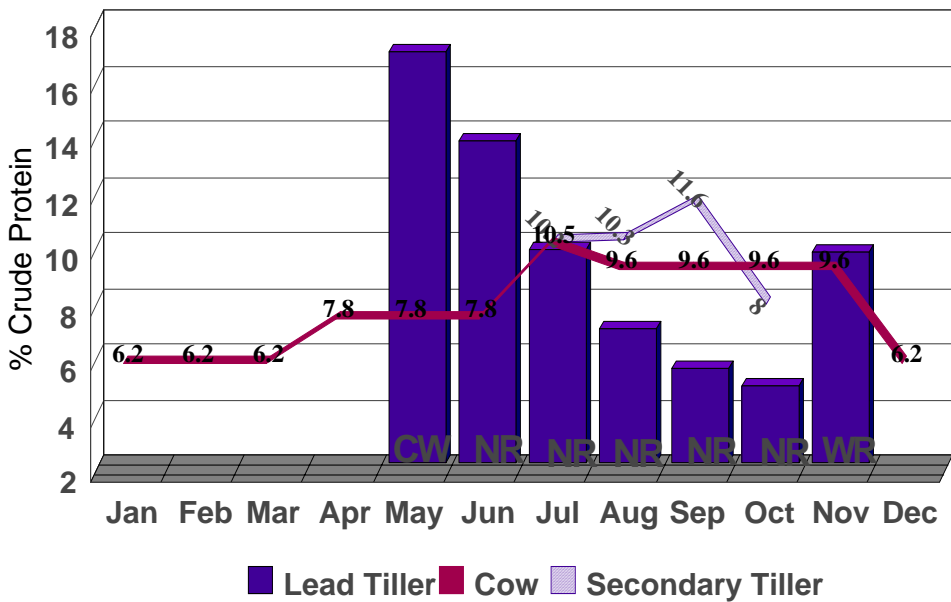


Fig. 6. Cow nutritional requirements for calf birth in June and pasture nutritional quality.

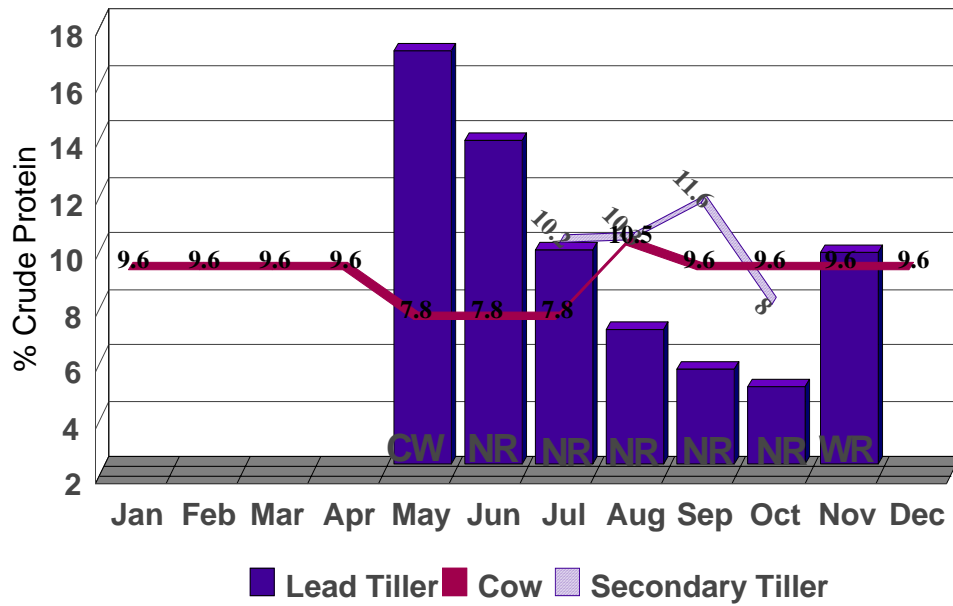


Fig. 7. Cow nutritional requirements for calf birth in July and pasture nutritional quality.

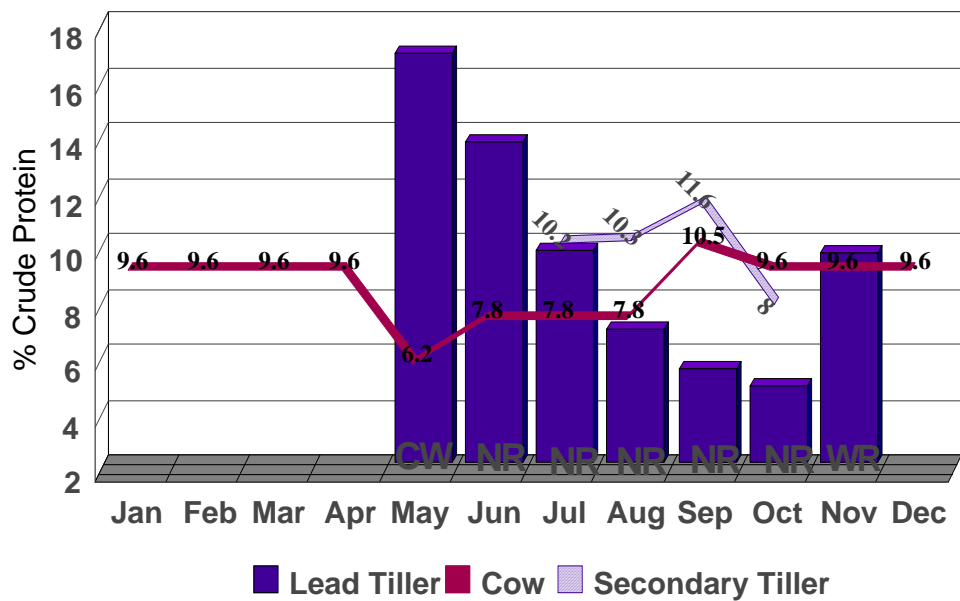


Fig. 8. Cow nutritional requirements for calf birth in August and pasture nutritional quality.

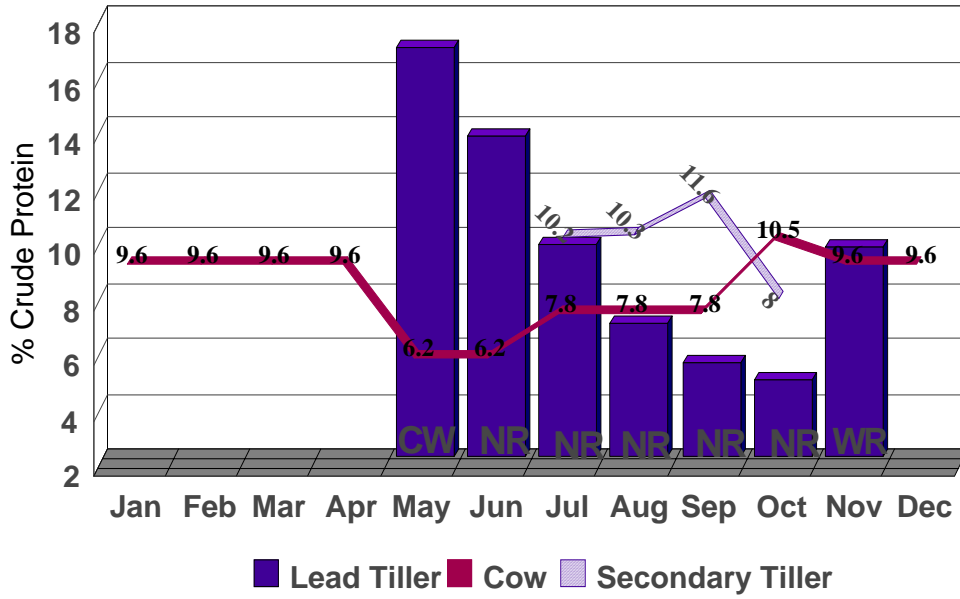


Fig. 9. Cow nutritional requirements for calf birth in September and pasture nutritional quality.

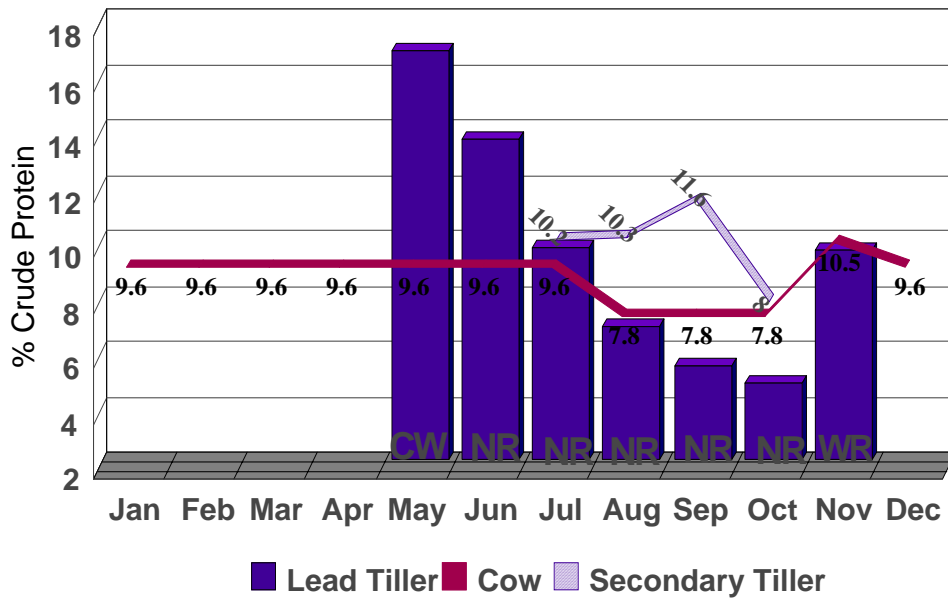


Fig. 10. Cow nutritional requirements for calf birth in October and pasture nutritional quality.

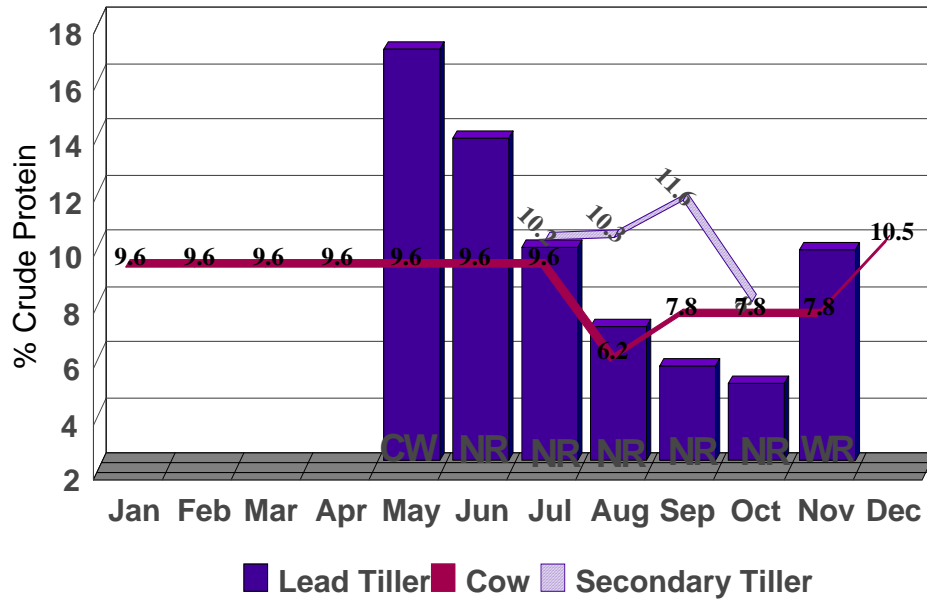


Fig. 11. Cow nutritional requirements for calf birth in November and pasture nutritional quality.

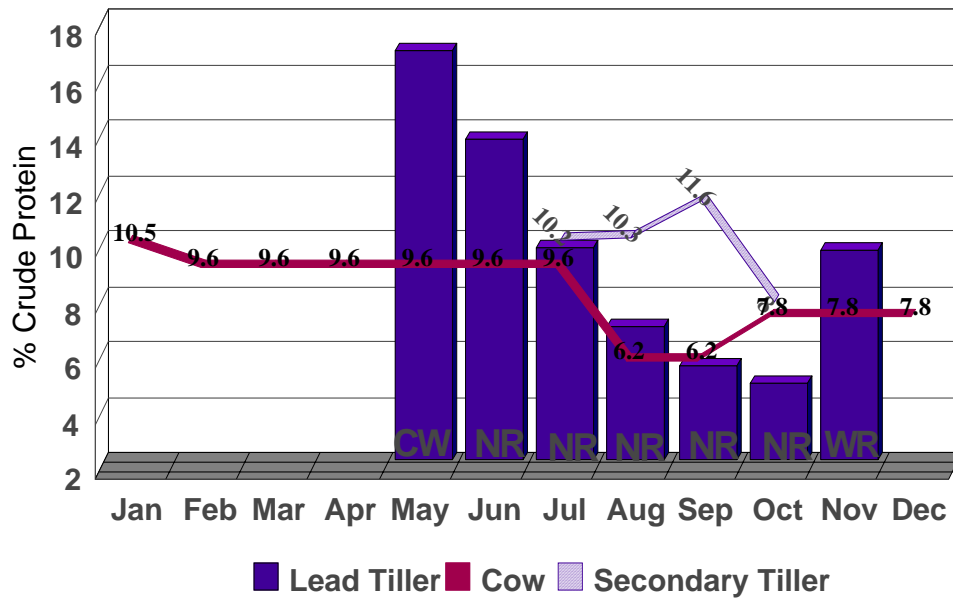


Fig. 12. Cow nutritional requirements for calf birth in December and pasture nutritional quality.

Table 3. Twelve-month nutrient requirements for 1000-pound range cows with calf birth dates in January.

| | Dry Gestation | | 3 rd Trimester | | Early Lactation | | Lactation | | | |
|------------------------------------------|---------------|---------|---------------------------|---------|---------------------|---------|----------------------|----------------|----------------|--------------|
| | Ration | Pasture | Ration | Pasture | Ration | Pasture | Ration | Spring Pasture | Summer Pasture | Fall Pasture |
| Days | | | 90 | | 32 | | 75 | 31 | 137 | |
| Daily Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | | 21 | | 24 | | | | 24 | |
| Energy (TDN) | | | 10.98 | | 14.30 | | | | 13.73 | |
| Crude Protein | | | 1.64 | | 2.52 | | | | 2.30 | |
| Calcium | | | 0.05 | | 0.07 | | | | 0.06 | |
| Phosphorus | | | 0.03 | | 0.05 | | | | 0.04 | |
| Production Period Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | | 1890 | | 768 | | 1800 | 744 | 3288 | |
| Energy (TDN) | | | 988.20 | | 457.60 | | 1029.75 | 425.63 | 1881.01 | |
| Crude Protein | | | 147.60 | | 80.64 | | 172.50 | 71.30 | 315.10 | |
| Calcium | | | 4.50 | | 2.24 | | 4.50 | 1.86 | 8.22 | |
| Phosphorus | | | 2.70 | | 1.60 | | 3.00 | 1.24 | 5.48 | |
| 12-Month Requirements in Pounds | | | | | | | | | | |
| | | | Totals for Rations | | Totals for Pastures | | Totals for 12 Months | | | |
| Dry Matter | | | 4458 | | 4032 | | 8490 | | | |
| Energy (TDN) | | | 2475.55 | | 2306.64 | | 4782.19 | | | |
| Crude Protein | | | 400.74 | | 386.40 | | 787.14 | | | |
| Calcium | | | 11.24 | | 10.08 | | 21.32 | | | |
| Phosphorus | | | 7.30 | | 6.72 | | 14.02 | | | |

Table 4. Twelve-month nutrient requirements for 1200-pound range cows with calf birth dates in January.

| | Dry Gestation | | 3 rd Trimester | | Early Lactation | | Lactation | | | |
|------------------------------------------|---------------|---------|---------------------------|---------|---------------------|---------|----------------------|----------------|----------------|--------------|
| | Ration | Pasture | Ration | Pasture | Ration | Pasture | Ration | Spring Pasture | Summer Pasture | Fall Pasture |
| Days | | | 90 | | 32 | | 75 | 31 | 137 | |
| Daily Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | | 24 | | 27 | | | | 27 | |
| Energy (TDN) | | | 12.62 | | 15.85 | | | | 15.23 | |
| Crude Protein | | | 1.87 | | 2.73 | | | | 2.51 | |
| Calcium | | | 0.06 | | 0.08 | | | | 0.07 | |
| Phosphorus | | | 0.04 | | 0.05 | | | | 0.05 | |
| Production Period Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | | 2160 | | 864 | | 2025 | 837 | 3699 | |
| Energy (TDN) | | | 1135.80 | | 507.20 | | 1142.25 | 472.13 | 2086.51 | |
| Crude Protein | | | 168.30 | | 87.36 | | 188.25 | 77.81 | 343.87 | |
| Calcium | | | 5.40 | | 2.56 | | 5.25 | 2.17 | 9.59 | |
| Phosphorus | | | 3.60 | | 1.60 | | 3.75 | 1.55 | 6.85 | |
| 12-Month Requirements in Pounds | | | | | | | | | | |
| | | | Totals for Rations | | Totals for Pastures | | Totals for 12 Months | | | |
| Dry Matter | | | 5049 | | 4536 | | 9585 | | | |
| Energy (TDN) | | | 2785.25 | | 2558.64 | | 5343.89 | | | |
| Crude Protein | | | 443.91 | | 421.68 | | 865.59 | | | |
| Calcium | | | 13.21 | | 11.76 | | 24.97 | | | |
| Phosphorus | | | 8.95 | | 8.40 | | 17.35 | | | |

Table 5. Twelve-month nutrient requirements for 1400-pound range cows with calf birth dates in January.

| | Dry Gestation | | 3 rd Trimester | | Early Lactation | | Lactation | | | |
|------------------------------------------|---------------|---------|---------------------------|---------|---------------------|---------|----------------------|----------------|----------------|--------------|
| | Ration | Pasture | Ration | Pasture | Ration | Pasture | Ration | Spring Pasture | Summer Pasture | Fall Pasture |
| Days | | | 90 | | 32 | | 75 | 31 | 137 | |
| Daily Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | | 27 | | 30 | | | | 30 | |
| Energy (TDN) | | | 14.28 | | 17.40 | | | | 16.71 | |
| Crude Protein | | | 2.13 | | 2.94 | | | | 2.70 | |
| Calcium | | | 0.07 | | 0.08 | | | | 0.08 | |
| Phosphorus | | | 0.05 | | 0.06 | | | | 0.05 | |
| Production Period Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | | 2430 | | 960 | | 2250 | 930 | 4110 | |
| Energy (TDN) | | | 1285.20 | | 556.80 | | 1253.25 | 518.01 | 2289.27 | |
| Crude Protein | | | 191.70 | | 94.08 | | 202.50 | 83.70 | 369.90 | |
| Calcium | | | 6.30 | | 2.56 | | 6.00 | 2.48 | 10.96 | |
| Phosphorus | | | 4.50 | | 1.92 | | 3.75 | 1.55 | 6.85 | |
| 12-Month Requirements in Pounds | | | | | | | | | | |
| | | | Totals for Rations | | Totals for Pastures | | Totals for 12 Months | | | |
| Dry Matter | | | 5640 | | 5040 | | 10680 | | | |
| Energy (TDN) | | | 3095.25 | | 2807.28 | | 5902.53 | | | |
| Crude Protein | | | 488.28 | | 453.60 | | 941.88 | | | |
| Calcium | | | 14.86 | | 13.44 | | 28.30 | | | |
| Phosphorus | | | 10.17 | | 8.40 | | 18.57 | | | |

Table 6. Twelve-month nutrient requirements for 1000-pound range cows with calf birth dates in February.

| | Dry Gestation | | 3 rd Trimester | | Early Lactation | | Lactation | | | |
|------------------------------------------|---------------|---------|---------------------------|---------|---------------------|---------|----------------------|----------------|----------------|--------------|
| | Ration | Pasture | Ration | Pasture | Ration | Pasture | Ration | Spring Pasture | Summer Pasture | Fall Pasture |
| Days | | | 90 | | 32 | | 45 | 31 | 137 | 30 |
| Daily Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | | 21 | | 24 | | | | 24 | |
| Energy (TDN) | | | 10.98 | | 14.30 | | | | 13.73 | |
| Crude Protein | | | 1.64 | | 2.52 | | | | 2.30 | |
| Calcium | | | 0.05 | | 0.07 | | | | 0.06 | |
| Phosphorus | | | 0.03 | | 0.05 | | | | 0.04 | |
| Production Period Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | | 1890 | | 768 | | 1080 | 744 | 3288 | 720 |
| Energy (TDN) | | | 988.20 | | 457.60 | | 617.85 | 425.63 | 1881.01 | 411.90 |
| Crude Protein | | | 147.60 | | 80.64 | | 103.50 | 71.30 | 315.10 | 69.00 |
| Calcium | | | 4.50 | | 2.24 | | 2.70 | 1.86 | 8.22 | 1.80 |
| Phosphorus | | | 2.70 | | 1.60 | | 1.80 | 1.24 | 5.48 | 1.20 |
| 12-Month Requirements in Pounds | | | | | | | | | | |
| | | | Totals for Rations | | Totals for Pastures | | Totals for 12 Months | | | |
| Dry Matter | | | 3738 | | 4752 | | 8490 | | | |
| Energy (TDN) | | | 2063.65 | | 2718.54 | | 4782.19 | | | |
| Crude Protein | | | 331.74 | | 455.40 | | 787.14 | | | |
| Calcium | | | 9.44 | | 11.88 | | 21.32 | | | |
| Phosphorus | | | 6.10 | | 7.92 | | 14.02 | | | |

Table 7. Twelve-month nutrient requirements for 1200-pound range cows with calf birth dates in February.

| | Dry Gestation | | 3 rd Trimester | | Early Lactation | | Lactation | | | |
|------------------------------------------|---------------|---------|---------------------------|---------|---------------------|---------|----------------------|----------------|----------------|--------------|
| | Ration | Pasture | Ration | Pasture | Ration | Pasture | Ration | Spring Pasture | Summer Pasture | Fall Pasture |
| Days | | | 90 | | 32 | | 45 | 31 | 137 | 30 |
| Daily Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | | 24 | | 27 | | | | 27 | |
| Energy (TDN) | | | 12.62 | | 15.85 | | | | 15.23 | |
| Crude Protein | | | 1.87 | | 2.73 | | | | 2.51 | |
| Calcium | | | 0.06 | | 0.08 | | | | 0.07 | |
| Phosphorus | | | 0.04 | | 0.05 | | | | 0.05 | |
| Production Period Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | | 2160 | | 864 | | 1215 | 837 | 3699 | 810 |
| Energy (TDN) | | | 1135.80 | | 507.20 | | 685.35 | 472.13 | 2086.51 | 456.90 |
| Crude Protein | | | 168.30 | | 87.36 | | 112.95 | 77.81 | 343.87 | 75.30 |
| Calcium | | | 5.40 | | 2.56 | | 3.15 | 2.17 | 9.59 | 2.10 |
| Phosphorus | | | 3.60 | | 1.60 | | 2.25 | 1.55 | 6.85 | 1.50 |
| 12-Month Requirements in Pounds | | | | | | | | | | |
| | | | Totals for Rations | | Totals for Pastures | | Totals for 12 Months | | | |
| Dry Matter | | | 4239 | | 5346 | | 9585 | | | |
| Energy (TDN) | | | 2328.35 | | 3015.54 | | 5343.89 | | | |
| Crude Protein | | | 368.61 | | 496.98 | | 865.59 | | | |
| Calcium | | | 11.11 | | 13.86 | | 24.97 | | | |
| Phosphorus | | | 7.45 | | 9.90 | | 17.35 | | | |

Table 8. Twelve-month nutrient requirements for 1400-pound range cows with calf birth dates in February.

| | Dry Gestation | | 3 rd Trimester | | Early Lactation | | Lactation | | | |
|------------------------------------------|---------------|---------|---------------------------|---------|---------------------|---------|----------------------|----------------|----------------|--------------|
| | Ration | Pasture | Ration | Pasture | Ration | Pasture | Ration | Spring Pasture | Summer Pasture | Fall Pasture |
| Days | | | 90 | | 32 | | 45 | 31 | 137 | 30 |
| Daily Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | | 27 | | 30 | | | | 30 | |
| Energy (TDN) | | | 14.28 | | 17.40 | | | | 16.71 | |
| Crude Protein | | | 2.13 | | 2.94 | | | | 2.70 | |
| Calcium | | | 0.07 | | 0.08 | | | | 0.08 | |
| Phosphorus | | | 0.05 | | 0.06 | | | | 0.05 | |
| Production Period Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | | 2430 | | 960 | | 1350 | 930 | 4110 | 900 |
| Energy (TDN) | | | 1285.20 | | 556.80 | | 751.95 | 518.01 | 2289.27 | 501.30 |
| Crude Protein | | | 191.70 | | 94.08 | | 121.50 | 83.70 | 369.90 | 81.00 |
| Calcium | | | 6.30 | | 2.56 | | 3.60 | 2.48 | 10.96 | 2.40 |
| Phosphorus | | | 4.50 | | 1.92 | | 2.25 | 1.55 | 6.85 | 1.50 |
| 12-Month Requirements in Pounds | | | | | | | | | | |
| | | | Totals for Rations | | Totals for Pastures | | Totals for 12 Months | | | |
| Dry Matter | | | 4740 | | 5940 | | 10680 | | | |
| Energy (TDN) | | | 2593.95 | | 3308.58 | | 5902.53 | | | |
| Crude Protein | | | 407.28 | | 534.60 | | 941.88 | | | |
| Calcium | | | 12.46 | | 15.84 | | 28.30 | | | |
| Phosphorus | | | 8.67 | | 9.90 | | 18.57 | | | |

Table 9. Twelve-month nutrient requirements for 1000-pound range cows with calf birth dates in March.

| | Dry Gestation | | 3 rd Trimester | | Early Lactation | | Lactation | | | |
|------------------------------------------|---------------|---------|---------------------------|---------|---------------------|---------|-----------|----------------------|----------------|--------------|
| | Ration | Pasture | Ration | Pasture | Ration | Pasture | Ration | Spring Pasture | Summer Pasture | Fall Pasture |
| Days | | 32 | 90 | | 45 | | | 31 | 137 | 30 |
| Daily Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | 21 | 21 | | 24 | | | | 24 | |
| Energy (TDN) | | 9.64 | 10.98 | | 14.30 | | | | 13.73 | |
| Crude Protein | | 1.30 | 1.64 | | 2.52 | | | | 2.30 | |
| Calcium | | 0.03 | 0.05 | | 0.07 | | | | 0.06 | |
| Phosphorus | | 0.02 | 0.03 | | 0.05 | | | | 0.04 | |
| Production Period Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | 672 | 1890 | | 1080 | | | 744 | 3288 | 720 |
| Energy (TDN) | | 308.48 | 988.20 | | 643.50 | | | 425.63 | 1881.01 | 411.90 |
| Crude Protein | | 41.60 | 147.60 | | 113.40 | | | 71.30 | 315.10 | 69.00 |
| Calcium | | 0.96 | 4.50 | | 3.15 | | | 1.86 | 8.22 | 1.80 |
| Phosphorus | | 0.64 | 2.70 | | 2.25 | | | 1.24 | 5.48 | 1.20 |
| 12-Month Requirements in Pounds | | | | | | | | | | |
| | | | Totals for Rations | | Totals for Pastures | | | Totals for 12 Months | | |
| Dry Matter | | | 2970 | | 5424 | | | 8394 | | |
| Energy (TDN) | | | 1631.70 | | 3027.02 | | | 4658.72 | | |
| Crude Protein | | | 261.00 | | 497.00 | | | 758.00 | | |
| Calcium | | | 7.65 | | 12.84 | | | 20.49 | | |
| Phosphorus | | | 4.95 | | 8.56 | | | 13.51 | | |

Table 10. Twelve-month nutrient requirements for 1200-pound range cows with calf birth dates in March.

| | Dry Gestation | | 3 rd Trimester | | Early Lactation | | Lactation | | | |
|------------------------------------------|---------------|---------|---------------------------|---------|---------------------|---------|-----------|----------------------|----------------|--------------|
| | Ration | Pasture | Ration | Pasture | Ration | Pasture | Ration | Spring Pasture | Summer Pasture | Fall Pasture |
| Days | | 32 | 90 | | 45 | | | 31 | 137 | 30 |
| Daily Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | 24 | 24 | | 27 | | | | 27 | |
| Energy (TDN) | | 11.02 | 12.62 | | 15.85 | | | | 15.23 | |
| Crude Protein | | 1.49 | 1.87 | | 2.73 | | | | 2.51 | |
| Calcium | | 0.04 | 0.06 | | 0.08 | | | | 0.07 | |
| Phosphorus | | 0.03 | 0.04 | | 0.05 | | | | 0.05 | |
| Production Period Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | 768 | 2160 | | 1215 | | | 837 | 3699 | 810 |
| Energy (TDN) | | 352.64 | 1135.80 | | 713.25 | | | 472.13 | 2086.51 | 456.90 |
| Crude Protein | | 47.68 | 168.30 | | 122.85 | | | 77.81 | 343.87 | 75.30 |
| Calcium | | 1.28 | 5.40 | | 3.60 | | | 2.17 | 9.59 | 2.10 |
| Phosphorus | | 0.96 | 3.60 | | 2.25 | | | 1.55 | 6.85 | 1.50 |
| 12-Month Requirements in Pounds | | | | | | | | | | |
| | | | Totals for Rations | | Totals for Pastures | | | Totals for 12 Months | | |
| Dry Matter | | | 3375 | | 6114 | | | 9489 | | |
| Energy (TDN) | | | 1849.05 | | 3368.18 | | | 5217.23 | | |
| Crude Protein | | | 291.15 | | 544.66 | | | 835.80 | | |
| Calcium | | | 9.00 | | 15.14 | | | 24.14 | | |
| Phosphorus | | | 5.85 | | 10.86 | | | 16.71 | | |

Table 11. Twelve-month nutrient requirements for 1400-pound range cows with calf birth dates in March.

| | Dry Gestation | | 3 rd Trimester | | Early Lactation | | Lactation | | | |
|------------------------------------------|---------------|---------|---------------------------|---------|---------------------|---------|-----------|----------------------|----------------|--------------|
| | Ration | Pasture | Ration | Pasture | Ration | Pasture | Ration | Spring Pasture | Summer Pasture | Fall Pasture |
| Days | | 32 | 90 | | 45 | | | 31 | 137 | 30 |
| Daily Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | 27 | 27 | | 30 | | | | 30 | |
| Energy (TDN) | | 12.42 | 14.28 | | 17.40 | | | | 16.71 | |
| Crude Protein | | 1.67 | 2.13 | | 2.94 | | | | 2.70 | |
| Calcium | | 0.04 | 0.07 | | 0.08 | | | | 0.08 | |
| Phosphorus | | 0.03 | 0.05 | | 0.06 | | | | 0.05 | |
| Production Period Requirements in Pounds | | | | | | | | | | |
| Dry Matter | | 864 | 2430 | | 1350 | | | 930 | 4110 | 900 |
| Energy (TDN) | | 397.44 | 1285.20 | | 783.00 | | | 518.01 | 2289.27 | 501.30 |
| Crude Protein | | 53.44 | 191.70 | | 132.30 | | | 83.70 | 369.90 | 81.00 |
| Calcium | | 1.28 | 6.30 | | 3.60 | | | 2.48 | 10.96 | 2.40 |
| Phosphorus | | 0.96 | 4.50 | | 2.70 | | | 1.55 | 6.85 | 1.50 |
| 12-Month Requirements in Pounds | | | | | | | | | | |
| | | | Totals for Rations | | Totals for Pastures | | | Totals for 12 Months | | |
| Dry Matter | | | 3780 | | 6804 | | | 10584 | | |
| Energy (TDN) | | | 2068.20 | | 3706.02 | | | 5774.22 | | |
| Crude Protein | | | 324.00 | | 588.04 | | | 912.04 | | |
| Calcium | | | 9.90 | | 17.12 | | | 27.02 | | |
| Phosphorus | | | 7.20 | | 10.86 | | | 18.06 | | |

Table 12. Twelve-month nutrient requirements for 1000-pound range cows with calf birth dates in April.

| | Dry Gestation | | 3 rd Trimester | | Early Lactation | | Lactation | | | |
|------------------------------------------|---------------|---------|---------------------------|---------|---------------------|---------|----------------------|----------------|----------------|--------------|
| | Ration | Pasture | Ration | Pasture | Ration | Pasture | Ration | Spring Pasture | Summer Pasture | Fall Pasture |
| Days | 62 | | 90 | | 15 | 15 | | 16 | 137 | 30 |
| Daily Requirements in Pounds | | | | | | | | | | |
| Dry Matter | 21 | | 21 | | 24 | | | | 24 | |
| Energy (TDN) | 9.64 | | 10.98 | | 14.30 | | | | 13.73 | |
| Crude Protein | 1.30 | | 1.64 | | 2.52 | | | | 2.30 | |
| Calcium | 0.03 | | 0.05 | | 0.07 | | | | 0.06 | |
| Phosphorus | 0.02 | | 0.03 | | 0.05 | | | | 0.04 | |
| Production Period Requirements in Pounds | | | | | | | | | | |
| Dry Matter | 1302 | | 1890 | | 360 | 360 | | 384 | 3288 | 720 |
| Energy (TDN) | 597.68 | | 988.20 | | 214.50 | 214.50 | | 219.68 | 1881.01 | 411.90 |
| Crude Protein | 80.60 | | 147.60 | | 37.50 | 37.50 | | 36.80 | 315.10 | 69.00 |
| Calcium | 1.86 | | 4.50 | | 1.05 | 1.05 | | 0.96 | 8.22 | 1.80 |
| Phosphorus | 1.24 | | 2.70 | | 0.75 | 0.75 | | 0.64 | 5.48 | 1.20 |
| 12-Month Requirements in Pounds | | | | | | | | | | |
| | | | Totals for Rations | | Totals for Pastures | | Totals for 12 Months | | | |
| Dry Matter | | | 3552 | | 4752 | | 8304 | | | |
| Energy (TDN) | | | 1800.38 | | 2727.09 | | 4527.47 | | | |
| Crude Protein | | | 265.70 | | 458.40 | | 724.10 | | | |
| Calcium | | | 7.41 | | 12.03 | | 19.44 | | | |
| Phosphorus | | | 4.69 | | 8.07 | | 12.76 | | | |

Table 13. Twelve-month nutrient requirements for 1200-pound range cows with calf birth dates in April.

| | Dry Gestation | | 3 rd Trimester | | Early Lactation | | Lactation | | | |
|------------------------------------------|---------------|---------|---------------------------|---------|---------------------|---------|-----------|----------------------|----------------|--------------|
| | Ration | Pasture | Ration | Pasture | Ration | Pasture | Ration | Spring Pasture | Summer Pasture | Fall Pasture |
| Days | 62 | | 90 | | 15 | 15 | | 16 | 137 | 30 |
| Daily Requirements in Pounds | | | | | | | | | | |
| Dry Matter | 24 | | 24 | | 27 | | | | 27 | |
| Energy (TDN) | 11.02 | | 12.62 | | 15.85 | | | | 15.23 | |
| Crude Protein | 1.49 | | 1.87 | | 2.73 | | | | 2.51 | |
| Calcium | 0.04 | | 0.06 | | 0.08 | | | | 0.07 | |
| Phosphorus | 0.03 | | 0.04 | | 0.05 | | | | 0.05 | |
| Production Period Requirements in Pounds | | | | | | | | | | |
| Dry Matter | 1488 | | 2160 | | 405 | 405 | | 432 | 3699 | 810 |
| Energy (TDN) | 683.24 | | 1135.80 | | 237.75 | 237.75 | | 243.68 | 2086.51 | 456.90 |
| Crude Protein | 92.38 | | 168.30 | | 40.95 | 40.95 | | 40.16 | 343.87 | 75.30 |
| Calcium | 2.48 | | 5.40 | | 1.20 | 1.20 | | 1.12 | 9.59 | 2.10 |
| Phosphorus | 1.86 | | 3.60 | | 0.75 | 0.75 | | 0.80 | 6.85 | 1.50 |
| 12-Month Requirements in Pounds | | | | | | | | | | |
| | | | Totals for Rations | | Totals for Pastures | | | Totals for 12 Months | | |
| Dry Matter | | | 4053 | | 5346 | | | 9399 | | |
| Energy (TDN) | | | 2056.79 | | 3024.84 | | | 5081.63 | | |
| Crude Protein | | | 301.63 | | 500.28 | | | 801.91 | | |
| Calcium | | | 9.08 | | 14.01 | | | 23.09 | | |
| Phosphorus | | | 6.21 | | 9.90 | | | 16.11 | | |

Table 14. Twelve-month nutrient requirements for 1400-pound range cows with calf birth dates in April.

| | Dry Gestation | | 3 rd Trimester | | Early Lactation | | Lactation | | | |
|------------------------------------------|---------------|---------|---------------------------|---------|---------------------|---------|----------------------|----------------|----------------|--------------|
| | Ration | Pasture | Ration | Pasture | Ration | Pasture | Ration | Spring Pasture | Summer Pasture | Fall Pasture |
| Days | 62 | | 90 | | 15 | 15 | | 16 | 137 | 30 |
| Daily Requirements in Pounds | | | | | | | | | | |
| Dry Matter | 27 | | 27 | | 30 | | | | 30 | |
| Energy (TDN) | 12.42 | | 14.28 | | 17.40 | | | | 16.71 | |
| Crude Protein | 1.67 | | 2.13 | | 2.94 | | | | 2.70 | |
| Calcium | 0.04 | | 0.07 | | 0.08 | | | | 0.08 | |
| Phosphorus | 0.03 | | 0.05 | | 0.06 | | | | 0.05 | |
| Production Period Requirements in Pounds | | | | | | | | | | |
| Dry Matter | 1674 | | 2430 | | 450 | 450 | | 480 | 4110 | 900 |
| Energy (TDN) | 770.04 | | 1285.20 | | 261.00 | 261.00 | | 267.36 | 2289.27 | 501.30 |
| Crude Protein | 103.54 | | 191.70 | | 44.10 | 44.10 | | 43.20 | 369.90 | 81.00 |
| Calcium | 2.48 | | 6.30 | | 1.20 | 1.20 | | 1.28 | 10.96 | 2.40 |
| Phosphorus | 1.86 | | 4.50 | | 0.90 | 0.90 | | 0.80 | 6.85 | 1.50 |
| 12-Month Requirements in Pounds | | | | | | | | | | |
| | | | Totals for Rations | | Totals for Pastures | | Totals for 12 Months | | | |
| Dry Matter | | | 4554 | | 5940 | | 10494 | | | |
| Energy (TDN) | | | 2316.24 | | 3318.93 | | 5635.17 | | | |
| Crude Protein | | | 339.34 | | 538.20 | | 877.54 | | | |
| Calcium | | | 9.98 | | 15.84 | | 25.84 | | | |
| Phosphorus | | | 7.26 | | 10.05 | | 17.31 | | | |

Table 15. Dry weight of forage and as fed weight of forage in pounds at various percent water content levels.

| % water | dry weight | dry weight | dry weight | dry weight | dry weight | dry weight |
|---------|------------|------------|------------|------------|------------|------------|
| 0 | 21 | 24 | 26 | 27 | 30 | 33 |
| | wet weight | wet weight | wet weight | wet weight | wet weight | wet weight |
| 5 | 22.1 | 25.3 | 27.4 | 28.4 | 31.6 | 34.7 |
| 10 | 23.3 | 26.7 | 28.9 | 30.0 | 33.3 | 36.7 |
| 15 | 24.7 | 28.2 | 30.6 | 31.8 | 35.3 | 38.8 |
| 20 | 26.3 | 30.0 | 32.5 | 33.8 | 37.5 | 41.3 |
| 25 | 28.0 | 32.0 | 34.7 | 36.0 | 40.0 | 44.0 |
| 30 | 30.0 | 34.3 | 37.1 | 38.6 | 42.9 | 47.1 |
| 35 | 32.3 | 36.9 | 40.0 | 41.5 | 46.2 | 50.8 |
| 40 | 35.0 | 40.0 | 43.3 | 45.0 | 50.0 | 55.0 |
| 45 | 38.2 | 43.6 | 47.3 | 49.1 | 54.5 | 60.0 |
| 50 | 42.0 | 48.0 | 52.0 | 54.0 | 60.0 | 66.0 |
| 55 | 46.7 | 53.3 | 57.8 | 60.0 | 66.7 | 73.3 |
| 60 | 52.5 | 60.0 | 65.0 | 67.5 | 75.0 | 82.5 |
| 65 | 60.0 | 68.6 | 74.3 | 77.1 | 85.7 | 94.3 |
| 70 | 70.0 | 80.0 | 86.7 | 90.0 | 100.0 | 110.0 |
| 75 | 84.0 | 96.0 | 104.0 | 108.0 | 120.0 | 132.0 |
| 80 | 105.0 | 120.0 | 130.0 | 135.0 | 150.0 | 165.0 |
| 85 | 140.0 | 160.0 | 173.3 | 180.0 | 200.0 | 220.0 |
| 90 | 210.0 | 240.0 | 260.0 | 270.0 | 300.0 | 330.0 |
| 95 | 420.0 | 480.0 | 520.0 | 540.0 | 600.0 | 660.0 |

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