



# Optimizing Phosphorus Supplementation of the Beef Cow

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## **Introduction**

In the cow-calf operation, profitability is primarily determined by four factors; weaning rate, weaning weight, total feed costs, and calf price. While the latter is often difficult to control, weaning rate, weaning weight, and total feed costs are influenced by management decisions made by the cow-calf operator. The most effective strategy to maximize weaning rate and weaning weight while optimizing total feed costs is to ensure that we meet the nutrient requirements of the cow during all phases of her production cycle with minimal overfeeding of nutrients.

The majority of costs associated with meeting the requirements of the beef cow are related to providing adequate energy and protein. However, optimization of the mineral program can greatly influence weaning rate, weaning weight, and total feed costs. The macro-mineral phosphorus (P) is of particular concern due to its significant role in reproductive efficiency, because it is the element most likely deficient in grazing cattle, and because it is relatively high in cost to supplement. Thus, choosing the optimum level of P supplementation is critical. This can be accomplished by determining the P requirement of the cow, determining the P supplied by the feedstuffs, and then choosing the proper product to meet the animal requirements.

## **Role of Phosphorus**

Phosphorus is an essential macro-mineral that is involved in many metabolic, neurological, and cellular functions. Phosphorus is most known for its role in development and maintenance of healthy bones and teeth in conjunction with calcium. Phosphorus also functions in energy utilization and cell growth and differentiation. Additionally, P is involved in maintenance of acid-base and osmotic balance and is required by ruminal microorganisms for normal growth.

## **Phosphorus Deficiency**

Meeting the P requirement of the beef cow is essential to cow-calf profitability. In beef cows, P deficiency can result in decreased appetite, reduced conception rates, reduced milk production, and reduced growth and feed efficiency in the calves of deficient cows. Grossly deficient cows may appear lethargic and gaunt, have a rough hair coat, and are more prone to bone fractures. However, marginally deficient cows may appear normal but have impaired production.

## **Phosphorus Sources**

Phosphorus is found in almost every feedstuff consumed by beef cows. However, the level varies by type and maturity of feedstuff. For comparison, we can divide feedstuffs into three general P level classes; low (<0.2% P), moderate (0.2% to 0.3% P), and high (>0.3% P). Feedstuffs classified as low P generally will not meet the P requirement of a beef cow except during the second trimester. Unfortunately, many of our native pastures and harvested grasses along with most crop residues fall into the low P category. Feedstuffs classified as moderate P will generally meet the P requirement of the beef cow except during early lactation. Moderate P feedstuffs include many of our improved grass pasture and legume species such as brome and alfalfa. Grains tend to be moderate to high in P but the feeding of grain should be based on the need to provide energy. Feedstuffs

classified as high P can meet the P requirement of the beef cow in all production phases as long as they are not diluted by lower P feedstuffs. Ethanol co-products such as corn gluten feed and distiller's grains tend to be high in P. As with grains, the feeding rate of co-products should not be based on meeting P requirements but on the need for other nutrients such as protein and/or carbohydrates to provide energy.

Common feedstuffs fed to beef cows can vary greatly in P content. Thus, having an estimate of the basal P level provided by the feedstuffs being fed to cows is essential to choosing the proper level of P supplementation. When supplemental P is prescribed, it can be delivered through hand-fed supplements or free-choice products such as Sweetlix<sup>®</sup> loose minerals or mineral pressed blocks.

### **Phosphorus Requirement**

The P requirement of the beef cow varies depending on the stage of reproduction, age, and peak milk production. Younger cows and heavier milking cows have higher P requirements than older or poorer milking cows. As with most nutrient requirements of the beef cow, P requirement is at its lowest during the second trimester of pregnancy and peaks during peak lactation (Figure 1). For a 1200 pound cow, the phosphorus requirement ranges from a low of 13.1 g/day (0.12% of diet dry matter) to a high of 30.8 g/d (0.23% of diet dry matter) for superior milking ability (30 lb/d peak milk).

### **Meeting Phosphorus Requirement**

Providing the proper level of P to the beef cow can help maximize cow-calf profitability. Since P was first identified as playing a role in reproductive efficiency, the race has been on to feed more and more P to the cow herd. Feedstuffs certainly vary in P content and cows certainly vary in their absolute requirement for P but supplementing P at levels much above published requirements does not make economic sense. Phosphorus is the most expensive macro-nutrient commonly supplemented to the beef cow, thus some common sense in determining the level of P to supplement should be in order. A safety factor of 20% should be more than sufficient to cover variation in feedstuff P levels, animal P requirement, and individual intake of feedstuffs and mineral.

Let's take a look at a few examples. First, consider a 1200 pound cow with a peak lactation of 20 lb/d. During the second trimester, the target (including a 20% safety factor) is 15.8 g/d or 0.15% of diet dry matter (based on 24 lb dry matter intake). So if the cow was consuming a diet of 0.15% P or greater, there would be no need for P supplementation. However, consider the same cow grazing corn stalks late season or being fed prairie hay (0.1% P). To get to the target of 15.8 g/d, she would need an additional 5 g/day. If we use a 4 oz/hd/d mineral the target P intake could easily be met with a 6% P level.

Now let's look at the same cow during peak lactation. The target (including a 20% safety factor) is 31.8 g/d or 0.25% of diet dry matter (based on 27.8 lb dry matter intake). If the cow is consuming forage that is only 0.2% P, we would need to provide 7 g/d of supplemental P to meet the target. This could be accomplished by feeding of an 8% P mineral at 4 oz/hd/d.

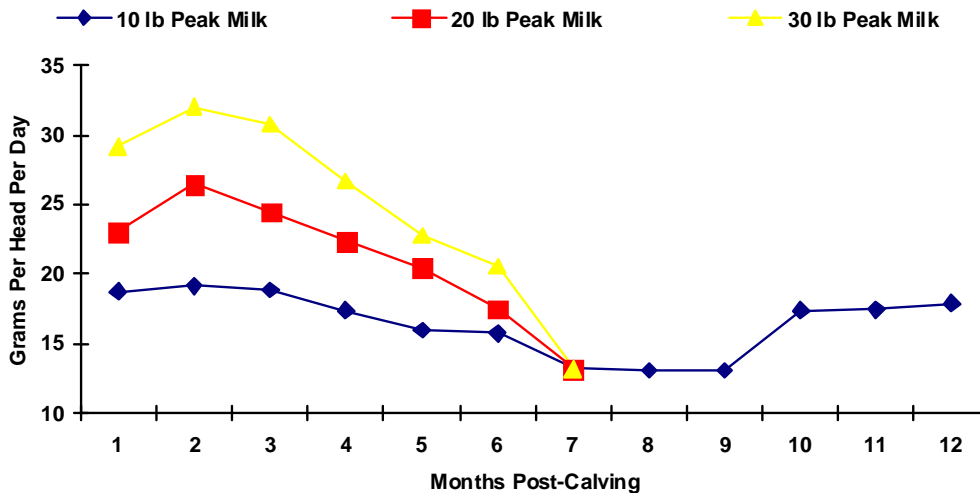
Finally, let's look at an extreme. Assume that a superior milking cow (30 lb/d peak milk) is consuming a diet that contains only 0.2% P. The P target (including a 20% safety factor) is 38.9 g/d or 0.28% of diet dry matter (based on 30.6 lb dry matter intake). To hit the P target with a 4 oz/hd/d mineral, it would take a 12% P. It is interesting to note that it takes an extreme case to show a need for a 12% P mineral even though 12% P minerals would account for the majority of minerals sold in the Midwest. This underlines the need to critically analyze the P needs of the beef cow herd and balance these needs against the P provided by the diet before determining what level of supplemental P to provide to the cows. Figure 2 shows how common forages stack up against the P requirement (including a 20% safety factor) at various stages of production and how an 8% or 12% P mineral can be incorporated to obtain the desired target intake of P.

## Summary

Cow-calf profitability is highly reliant on maximizing weaning rate and weaning weight while controlling total feed costs. Phosphorus is an essential element that must be provided in adequate quantities to the beef cow in order to maximize reproduction and calf performance. However, P is a very expensive nutrient. Understanding of the P requirements of the beef cow and the P provided by the diet of the beef cow are crucial to making proper decisions about supplementing P to the cow herd.

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Figure 1. Phosphorus Requirements (1200 lb cow; NRC, 1996)



**Figure 2: Meeting Phosphorus Requirements**  
 (1200 lb cow, 20 lb peak milk, 20% safety factor)

