

Phosphorus Supplementation and Requirements

for Beef Cattle

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Phosphorus (P) is a macromineral that all animals require.

Biologically, this mineral is involved in many metabolic, neurological and cellular functions. Specifically, P plays a key role as an energy source (ATP) for cells, is involved in blood-buffering systems and activation of several B vitamins, and is a component of genetic materials (DNA and RNA). In addition, it works in conjunction with calcium (Ca) to develop and maintain healthy bones and teeth.

Phosphorus deficiency can result in reduced overall productivity in all types of cattle. In beef cows, signs of deficiency include reduced intake, reduced rate of gain of their calves, reduced conception rates, anestrus and reduced milk production. Phosphorus-deficient cattle will appear gaunt and lethargic and have a rough hair coat. Reduced reproductive performance, however, may be a secondary effect due to reduced energy and protein intake that a P deficiency caused.

Unfortunately, phosphorus deficiencies are common in native pastures and harvested forages. The phosphorus content of most plants in semiarid regions averages 0.30 percent during the vegetative state, and drops to 0.15 percent as grass matures (*Table 2*). A similar pattern in P content occurs in cured hays; the later hay is cut in the season (past boot stage), the more P concentration is reduced. In winter months and during times of drought,

when harvested forages are the primary source of feed, P may become deficient.

Feeding hays that have been fertilized with P can help, but additives (fluoride or aluminum carriers) included in these fertilizers make this source of phosphorus less available to the animal. Feed grains, such as corn, oats, wheat and barley, generally are much higher in P than Ca. Supplementing with concentrates during the winter months can help alleviate the reduction in forage P.

When providing supplemental phosphorus, consider two major factors. First, whether the source of P is available biologically (i.e., readily absorbed). Sources considered highly available include dicalcium phosphate (Dical; $\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$), ammonium phosphate (NH_3PO_4) and sodium phosphate (NaPO_4). Of these sources, Dical is the most commonly used and commercially available. Ruminants don't use anhydrous sources, or P associated with a metal (Fe, Al, etc.), very well.

Secondly, you must consider the ratio of Ca to P (Ca:P). Calcium works in conjunction with P to form bone. Because of the relationship between Ca and P, a proper balance must be maintained. Based on extensive research on these two minerals, optimal performance occurs when the Ca:P ratio in cattle diets is 1.5:1 to 2.0:1. When Ca:P ratios exceed 6:1, or P remains deficient, reduced growth, feed efficiency and reproduction will result. If the ratio approaches 1:1, or P intake exceeds Ca, (as seen in high-concentrate diets), urinary calculi (water belly) can develop in steers and bulls.

To further prevent an imbalance in Ca:P in high-concentrate diets, mineral supplements generally are quite low in P. Legume forages, such as alfalfa, are high in Ca (1.5 percent to 2.5 percent) and low in P (0.3 percent). When feeding or grazing legume-based forages, provide

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a mineral supplement that is higher in phosphorus than calcium to keep the Ca:P ratio in a reasonable range. Other dietary sources of P are cereal grains, oilseed meals and grain by-products, which all are relatively high in phosphorus (0.3 percent to 0.9 percent). When cattle are on high-concentrate diets, offer mineral supplements high in Ca to maintain the appropriate Ca:P ratio.

The stage of production, age and level of milk production all affect P requirements (*Table 1*). Growth in the first calf heifer plays a significant role in P demand for bone maturation. As a cow ages, P requirements increase because her ability to absorb P decreases (as much as 50 percent). Typically, these problems can start to occur in cows that are 5 to 6 years old. In addition, high-producing cows need additional P to meet the increased metabolic demands of milk production.

Cows' demand for P and the availability of P in the forages they consume change throughout the year. Fortunately, several mineral products can help balance a cow's diet during these times of change. The most common products used contain Ca:P ratios of 12:12, or 12 percent Ca and 12 percent P. However, other products are available to target P specifically. Some mineral supplements may have a ratio of 6:12, offering more phosphorus than calcium. High P supplements generally are more expensive and should be used only when needed; for example, when cattle are P deficient or when grazing legume pastures.

Consumption of these types of mineral products should be 2 to 3 ounces (or 56 to 84 grams) per head per day to meet nutritional requirements. If consumption is a problem, complete mixed minerals (mineral products that contain salt) can promote intake. For example, if the analysis on the mineral bag or feed tag shows a ratio of 7:7:40, this means the product contains 7 percent Ca, 7 percent P and 40 percent salt. Intakes should average 4 to 6 ounces (or 112 to 168 grams) per day with these products to ensure adequate overall mineral consumption.

Phosphorus is an important macromineral for beef cattle. Productivity can be compromised if requirements are not met. Attention to a well-planned supplementation program will yield dividends for beef cattle producers.

Table 1. Daily requirements^a of 1,200-pound cows and 960-pound heifers during pregnancy and lactation (Beef NRC, 2000).

Stage of Production	Phosphorus	
	Daily Intake ^b (g/d)	DM ^c %
First calf heifer		
Last trimester	24	0.22
Post-calving – 10 pounds milk/d	23	0.21
Mature cow		
Midtrimester	18	0.12
Last trimester	13	0.16
Post-calving – 10 pounds milk/day	19	0.17
Post-calving – 20 pounds milk/day	26	0.21

^a Values based on NRC, 2000.

^b 28.4 g/oz, and 16oz/lb, thus 454g/lb

^c DM = dry matter basis

Table 2. Seasonal changes in phosphorus and calcium concentrations^a in grass and legume forages.

Forage	Calcium	Phosphorus
	%	%
Alfalfa		
Fresh vegetative	1.50	0.33
Midbloom	1.37	0.22
Full bloom	1.19	0.24
Smooth brome grass		
Fresh vegetative	0.32	0.37
Hay sun-cured, midbloom	0.29	0.28
Mature	0.26	0.22

^a Values based on NRC, 2000

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