



FEED MANAGEMENT

A tool for balancing nutrients on dairies and other livestock operations

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Many studies have shown that dairies consistently overfeed nutrients such as phosphorus (P) and potassium (K). This practice is expensive and potentially damaging to the environment and to animal health. This publication suggests ways to improve feed management and thus avoid overfeeding P and K. Proper ration balancing is good for the environment and for the producer's bottom line.

Phosphorus

Phosphorus is an important plant nutrient for growing dairy forages. Unfortunately, on many dairies, more P is excreted and stored in manure than can be used during a crop year. Application of P to crops at rates greater than crop needs allows P to accumulate in soil. Soils have the ability to store moderate overapplications of P for future crop production, but continued over-application can lead to losses of P to surface water.

Of all the essential dietary minerals for dairy cattle, P represents the greatest potential risk for environmental damage via pollution of surface water. In Oregon, most dairy producers report that surface water borders their farm property, creating a high risk of water contamination.

The concentration of P in manure is positively correlated to the concentration of P in the diet. Therefore, feeding P in excess

of requirements results in greater excretion of P. Thus, managing dietary P levels to reduce P excretion should help minimize water contamination.

Over the past decade, numerous field studies and surveys have reported overfeeding of P to lactating dairy cows. Dairy producers around the country were reported to feed as much as 40 percent above the level recommended by the National Research Council (NRC).

A recent survey of dairy herds in Virginia showed that the average P concentration in the diet was 0.49 percent, while calculated requirements averaged only 0.34 percent. In many herds, P could be reduced by 45 percent if diets were formulated to meet NRC requirements. By formulating rations more precisely, dairies in this survey could reduce the P in manure by 71 percent and save \$8 to \$15 per cow in feed costs each year.

Research conducted in 2003 indicated that Oregon producers were overfeeding P by 18 percent. The average dairy in this study needed 100 more acres to agronomically apply the P being overfed.

Much of the overfeeding has been attributed to a 1951 publication that reported improved conception rates in dairy cattle that consumed higher levels of P. However, this improvement

occurred in cows consuming P-deficient diets (less than 0.25 percent). Therefore, over the past 50 years, the importance of dietary P for reproductive performance has been overemphasized. Recent studies have shown no beneficial effect on reproduction or production when recommended dietary P concentrations are exceeded.

Even without overfeeding, there is potential for concentrating P on the farm. Consider a 400-cow dairy. If we assume a P requirement of 0.4 percent and animals eat 50 pounds of dry matter daily, each animal needs 0.2 pound P per day. Multiplying by 400 cows and 365 days shows that the dairy will consume 29,200 pounds of P in feeds each year. If cropping on the farm removes 35 pounds P per acre per year, the dairy needs 835 acres of cropland to utilize this P, or more than 2 acres per cow!

The good news is that not all consumed P is excreted in manure. However, a dairy cow absorbs only about 30 percent of feed P to support her body maintenance and production. Thus, she excretes 70 percent. This seems like a low absorption rate, but 45 to 60 percent of consumed P is indigestible without special extraction prior to feeding. Animals fed deficient or marginally deficient diets absorb more P, so overfeeding this nutrient reduces the absorption rate and adds more P to the manure.

Thus, it is clear that strategies to avoid excess P in the diet are essential to reducing the potential for excess P accumulation on the dairy.

Potassium

When applied in excess, some nutrients accumulate within plants instead of in the soil. One such nutrient is potassium (K); forages are able to consume K in excess of plant need. When excess K is applied to soil, it is taken up by the plant and harvested with the forage.

Although K is not an environmental concern, it has been implicated in the incidence of metabolic disease around the time of calving. Forages are the primary ingredients of the



prepartum cow's diet, and the use of high-K forages increases the incidence of milk fever, which can lead to other metabolic diseases.

In 1998, Oregon dairy producers were overfeeding K in dry cow rations by 2.5-fold. Potassium continues to be overfed in the diets of both lactating and dry cows. Of particular concern is the increase in overfeeding that has occurred in dry cow diets during the past 5 years. The ability to grow low-K forages for dry cow rations will continue to challenge the industry.

Sources of excess nutrients

Much of the P and K brought onto a dairy is in livestock feeds. Research in 1992 looked at whole-farm balances for three dairies and a beef operation in an Oregon watershed listed as water-quality-impaired due to P. The dairies each milked about 100 cows, raised their own heifers, produced part of their forages, and grew crops for sale. Not surprisingly, much of their imported P came from feeds brought onto the farm (Table 1).

Table 1. Phosphorus imported onto livestock operations, Washington County, Oregon, 1992.

	Total P (lb)	Feed P (lb)	Feed P (%)
Dairy 1	3,383	2,400	71
Dairy 2	13,321	6,500	49
Dairy 3	10,354	5,700	55
Cow/calf beef	1,040	1,000	96

Using feed management to avoid overfeeding

In 2003, the U.S. Environmental Protection Agency released new guidelines for Concentrated Animal Feeding Operations and Animal Feeding Operations (CAFOs/AFOs). Under these guidelines, CAFOs/AFOs are required to develop a Nutrient Management Plan (NMP). One type of NMP is a Comprehensive Nutrient Management Plan (CNMP) as defined by USDA's Natural Resources Conservation Service.

There are six core elements of a CNMP: (1) feed management, (2) manure and wastewater handling and storage, (3) nutrient management, (4) land treatment, (5) record keeping, and (6) other manure and wastewater utilization options.

As noted above, feed represents the largest import of nutrients to the farm (followed by commercial fertilizer). Most animal livestock and poultry operations could reduce imports of nutrients in feed, particularly nitrogen and phosphorus. Good ration balancing includes giving credit to the minerals in all feeds, developing rations to consistently meet animal requirements, and avoiding the use of “insurance” supplementation.

Some or all of the following feed management strategies can become part of a farm's NMP:

- Formulate diets closer to animal requirements. Most species require a P concentration of 0.16 to 0.4 percent of ration dry matter. Many traditional feed sources contain adequate or abundant P for supporting animal growth and milk production. Table 2 shows typical P values of feeds. (All feeds, especially by-products, vary in nutrient content. It is wise to analyze each feed ingredient to know its nutrient content, including P.)

Table 2. Typical P content of selected feeds.

Feed	% P (dry matter basis)
Almond hulls	0.13
Barley grain	0.39
Brewer's grains	0.67
Canola meal	1.10
Cereal silage	0.31
Cool-season grass	0.23
Corn grain	0.30
Corn silage	0.26
Distiller's grain	0.83
Legume hay	0.26
Oats	0.40
Soy hulls	0.17
Soybean meal	0.70
Wheat bran	1.18
Wheat midds	1.02
Whole cottonseed	0.60

- Analyze livestock drinking water to determine the mineral content and adjust the diet to account for this source of nutrients.
- Decrease crude protein levels in feed and supplement with amino acids.
- Manipulate the crude protein and energy (carbohydrate and fat) content of the diet to enhance the availability of amino acids.
- Use highly digestible feeds, as appropriate.
- Consider potential impacts of alternate feed ingredients (e.g., by-products) on the nutrient content of excreted manures.
- Use concentrates and forages grown on-farm to minimize the quantity of nutrients imported and maximize the recycling of nutrients on-farm.
- Use phytase and decrease the supplemental phosphorus content of the diet for nonruminants.
- If P is being overfed, decrease P in the diet.
- Use growth enhancers as allowed by law.
- Implement phase feeding. Consider nutrient requirements based on stage of growth, intended purpose of the animal, and type of production (e.g., meat, milk).

- Implement split-sex feeding.
- Use other feed management or diet manipulation techniques that have demonstrated the ability to decrease manure nutrient content.

Record keeping

Review farm feeding practices periodically to determine whether adjustments or modifications are needed. Records can help monitor progress in feed management. Useful records might include:

- Feed analyses and ration formulation (including formulations used before and after implementing a new feeding strategy).

Routinely analyze feed to document the rates at which nitrogen and phosphorus were fed. When rates fed differ from the planned rates, records should indicate the reasons for the differences.

- Manure analyses—to determine manure nutrient content (both before and after implementing a new feeding strategy).
- Soil tests—to determine accumulation or depletion of P and K in the soil (both before and after implementing a new feeding strategy). Remember that soil composition does not change overnight; it takes years to reflect dietary changes.

Conclusion

As farms increase animal numbers relative to the acres of land managed, it becomes more important to evaluate and manage the whole-farm nutrient balance. This management involves both reducing mineral imports through a feed management program *and* increasing nutrient exports off the farm.

Reduce P and K brought onto the farm

- Test soils and target manure applications to reduce use of purchased fertilizers.
- Balance rations often to precisely meet P requirements by production stage. Don't ignore the P provided in by-product feeds. Avoid free-choice and ready-to-use minerals not matched to feeds. Supplemental K is not required on most farms.
- Plant appropriate varieties of forages or cereal grains for higher yield and quality.

Increase P and K sent off the farm

- Maintain an efficient herd or flock for best conversion of feed to animal product.
- Develop a manure management system that allows for export of manure off-farm. Composting dries the product, reduces volume, and is more acceptable to users. Lagoon sludge is rich in P; find a place for it off the farm.
- Consider planting cash crops that pull P and K out of soils.
- Prevent animal mortality. Dispose of carcasses off-farm when possible.
- Contract graze with other producers when forage exceeds farm needs.

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