Testing Strategies For Managing DCAD

DAIRYLAND
Laboratories, Inc.

Forages are typically the largest contributor to DCAD variation in dairy diets because they have the highest feeding rates and are produced under a wide variety of growing conditions including variations in soil types, climates, and fertility programs. Figure 1 illustrates the DCAD variation found in common dairy feeds. Alfalfa, small grain silage, and grass exhibit large variations. Corn grain has almost no variation and while SBM and DDG's do have substantial variation, their feeding rates are generally much lower than forages, so their impact is probably trivial in most diets.

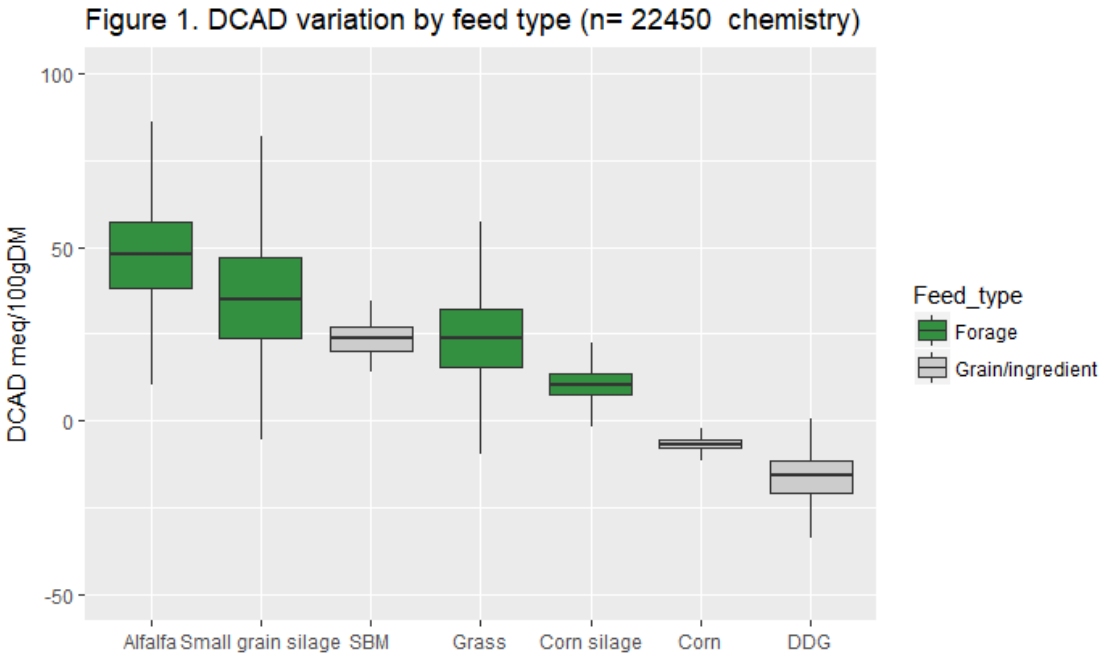


Figure 1: DCAD values for this article were calculated via Goff (2000): Meq[Na+ + K+ + 0.15Ca2+ + 0.15Mg2+ - (Cl- + 0.25S2- + 0.50P3-)]. This equation was chosen because it offered the ability to make comparisons using 7 minerals. Simpler equations using as few as 4 minerals are more commonly used and may be adequate.

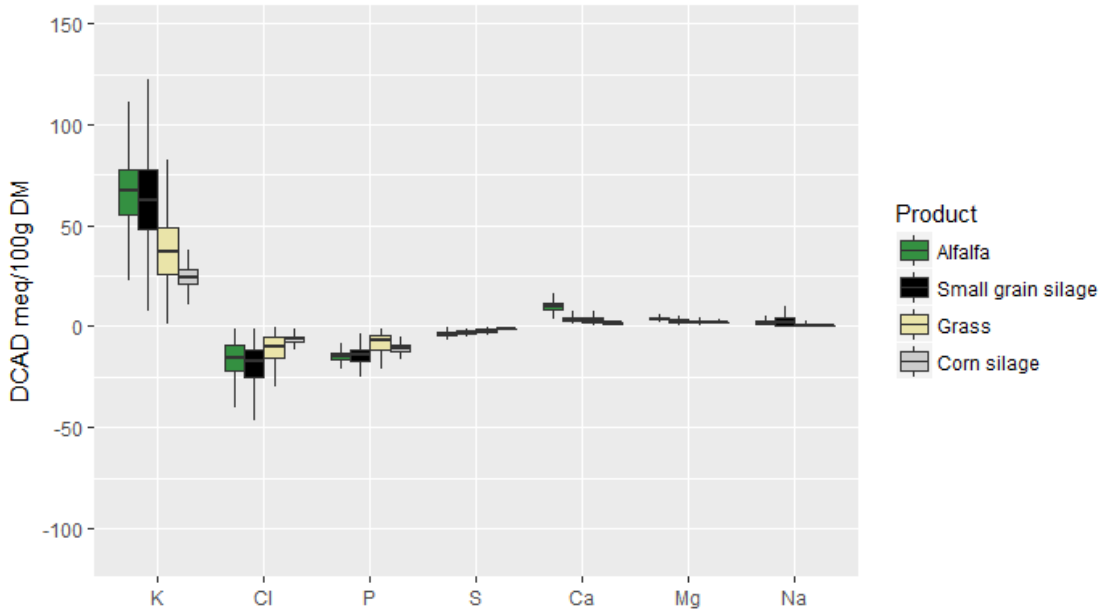
Figure 2 illustrates the fact that potassium is by far the biggest contributor to DCAD variation within forages, with chloride as a distant second influencer. While sodium and sulfur are important electrolytes, their variation within forages is so small that they rarely alter DCAD formulations.

217 E. Main · Arcadia, WI 54612
P (608) 323-2123 · F (608) 323-2184
www.dairylandlabs.com

Testing Strategies For Managing DCAD

DAIRYLAND
Laboratories, Inc.

Figure 2. DCAD contributions by mineral and feed type (n = 18724 chemistry)



For a DCAD formulation strategy to be successful we know that analyzing potassium and chloride in forages is crucial, but what testing methods makes the most sense?

The three most common methods available at commercial labs today are NIR, X-ray fluorescence, and ICP chemistry. While NIR is the least expensive, inorganic elements like minerals do not produce signals within NIR spectra. When NIR predicts mineral content, it's basically looking at broader patterns within the feed and making a rough estimate of the mineral content. X-ray fluorescence (XRF) offers the ability analyze minerals much more accurately than NIR, without requiring the technical expertise and safety considerations that ICP chemistry would imply. ICP chemistry is typically the reference method that both NIR and XRF are calibrate to.

When visiting with customers we find a few common myths or misconceptions about these technologies:

Myth #1 – XRF isn't sensitive enough or doesn't quantify all the variation in our forages.

Our take – XRF instruments basically come in high and low power varieties with price tags to match. Both varieties can be extremely close to the accuracy of ICP chemistry, but low power instruments require a lot more time per sample to achieve this. Additionally, XRF accuracy is directly related to the atomic weight of an element.

217 E. Main · Arcadia, WI 54612
P (608) 323-2123 · F (608) 323-2184
www.dairylandlabs.com

Testing Strategies For Managing DCAD

DAIRYLAND
Laboratories, Inc.

In other words, the higher an element is on the periodic table, the harder it is to analyze by XRF fluorescence. This is one reason XRF is rarely utilized for plant tissue analyses that require Boron (atomic weight = 10.8) but works very well for potassium (atomic weight = 39.1). For DCAD balancing, sodium is the most difficult mineral to analyze (atomic weight = 23.0), but as figure 2 illustrates, normal sodium variation in forages is not of great consequence. Like any method, shortcuts taken within the lab could reduce XRF's sensitivity, but the technology itself is capable of precision and accuracy that far exceed NIR or the requirements for diet formulation.

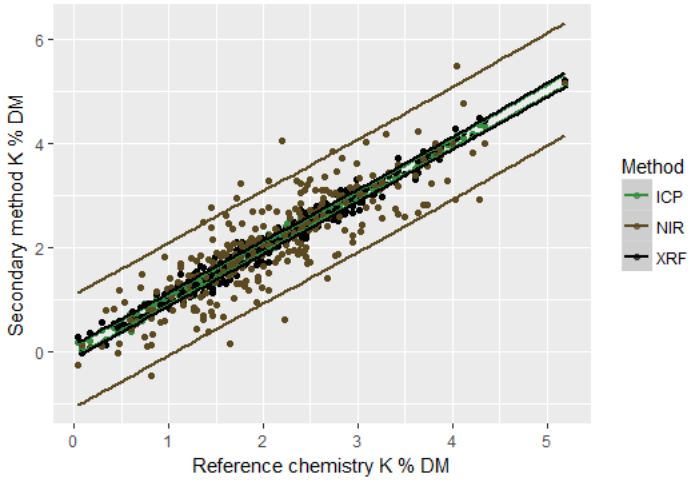
Myth #2 – I've seen sodium and chloride on NIR reports, so it must work.

Our take – The "great" thing about NIR is it will always produce a number regardless of its accuracy. While NIR can predict sodium and chloride just as well as other minerals, it doesn't predict any mineral very well. We've generally avoided reporting sodium and chloride by NIR because we feel strongly that if a customer wants to implement DCAD balancing, they need more accurate methods than NIR to do it well.

Myth #3 – X-ray is faster than ICP chemistry

Our take - An ICP can analyze a complete mineral profile in 40 seconds, while a high-power X-ray instrument would take 3-5 minutes and lower power instruments take significantly longer. X-ray is not faster, nor more accurate than ICP chemistry, it's just significantly easier to run. In high-throughput applications like soil and plant tissue analysis, ICP is by far that faster method.

Figure 3. Potassium accuracy by method (273 mixed hay)



When the goal is to manage DCAD variation, focusing on potassium and chloride variation will pay the most dividends. NIR accuracy for minerals is limited by the fact that minerals do not produce signal within the NIR spectra. ICP chemistry analyses are available through any Dairyland Laboratories, Inc. location, with next day turnaround for individual feeds and forages.