



CHAPTER 40

Forages for Cows in the Transition Period

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The traditional practice of setting aside old fields of hay to feed cows during their dry period helped to alleviate nutritional problems at calving. However, if we want to eliminate the problems of milk fever, we must do more. Adding anionic salts to cow rations during the transition period (the three weeks prior to calving) is one option, but can we produce hay that is specifically suited to the needs of cows in the transition period?

What is milk fever?

Milk fever is a metabolic disorder characterized by paralysis that occurs chiefly in highly productive multiparous cows a few hours after calving, when their demand for calcium (Ca) suddenly quadruples because of the start of lactation. Because the demand for Ca increases so sharply, cows cannot meet the requirement unless they are prepared for it. Blood Ca levels drop too low, and when there is clinical hypocalcaemia, large doses of Ca must be injected to enable the cows to recover. But when this kind of intervention

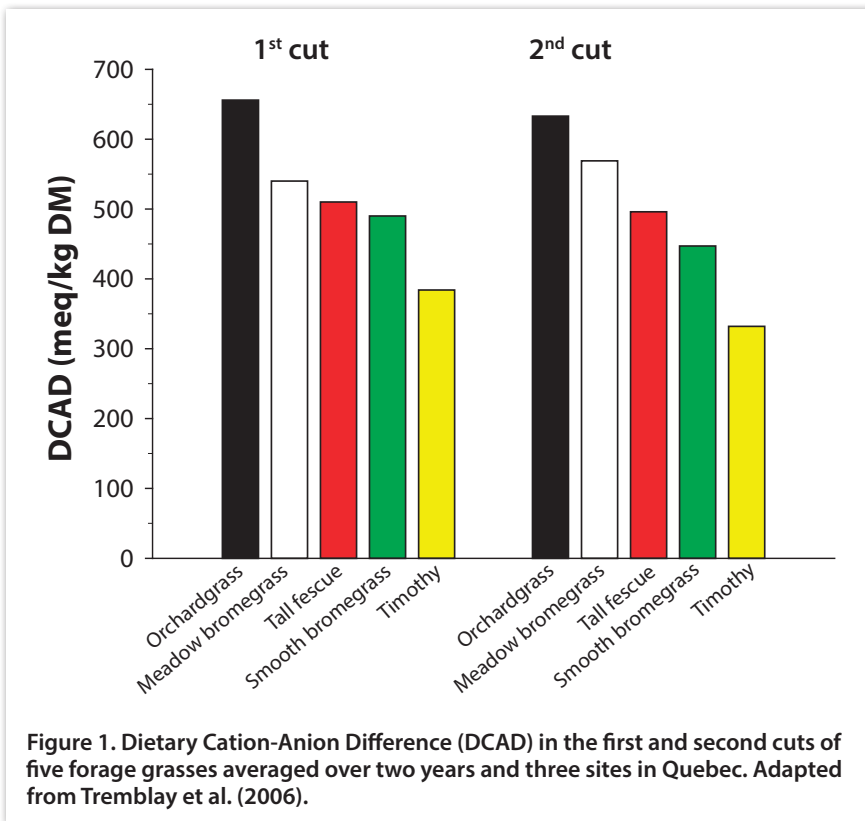
becomes necessary, the damage is unfortunately already done; the cow's feed intake and milk production are decreased, and secondary metabolic problems are more likely to develop.

Hypocalcaemia in dairy cows after calving is a problem worldwide. In Australia and the United States, it is estimated that 5–7% of dairy cows are affected by hypocalcaemia at a clinical level (milk fever) and 33–44% of dairy cows in Australia and New Zealand and 66% in the United States are affected by subclinical hypocalcaemia. To prevent these problems, cows must be properly prepared before calving.

A solution: low dietary cation-anion difference (DCAD) forage

Cows need to be conditioned to mobilize Ca from their bones and promote the absorption of Ca from the intestines as well as the resorption of Ca in the kidneys at the start of lactation to meet the sudden Ca demand. This conditioning can be accomplished by reducing the level of cations, primarily potassium (K⁺) and sodium (Na⁺), in

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transition period without affecting their feed intake.

Choose a field with low soil available K

The DCAD concerns four elements. The two elements that have the greatest effect are K^+ , a cation, which increases the DCAD, and Cl^- , an anion, which decreases it. Because the concentrations of K^+ in forages are 6–8 times higher than concentrations of Cl^- , variations in K^+ concentrations will have the greater impact on DCAD. Therefore, the first step in reducing the DCAD is to grow forages on soils with low-K contents since forages grown on soils with a low-K content generally have low-DCAD values.

Timothy, a grass species with low dietary cation-anion difference

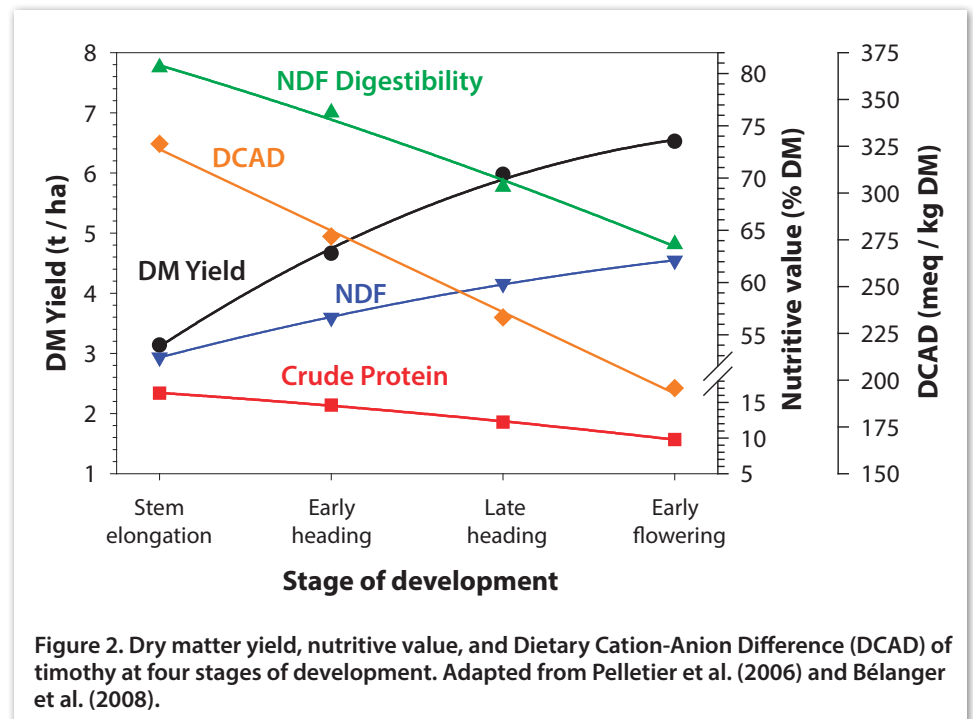
Forage species differ in level of DCAD. Legumes usually have greater DCAD than grasses because of higher K^+ concentrations so alfalfa is not recommended for cows in the transition period. Timothy is the preferred grass for transition cows in eastern Canada because it has the lowest DCAD of forages tested (Fig. 1). The K^+ concentration in timothy (2.4 for the first and 2.3% DM for the second cut) is far lower than that in orchardgrass (3.8 for the first and 3.6% DM for the second cut), which explains a large part of the two-fold difference in the DCAD between these two species. The K^+ concentrations and DCAD values of the other forage species (meadow

the cows' rations during the transition period, and/or by increasing the level of anions, mainly chloride (Cl^-) and sulphur (S^{2-}). The dietary cation-anion difference (DCAD) is calculated as: $DCAD = (Na^+ + K^+) - (Cl^- + S^{2-})$.

What we want is a ration with a slightly negative DCAD, of -20 to 0 milliequivalents per kg of dry matter (meq/kg DM). This low-DCAD causes a mild compensated metabolic acidosis in the cows, thus increasing the sensitivity of their tissues to parathormone, the hormone that controls the level of Ca in their blood. Anionic salts can be added to the ration to lower its DCAD, but these salts reduce the palatability of the ration, and if the DCAD in the basal ration exceeds 250 meq/kg DM, it is hard to add enough anionic salts to lower the DCAD to the recommended level without reducing the cows' feed intake.

As forage is the main feed offered to cows in the transition period, it should have a DCAD below 250 meq/kg DM and preferably close to zero, to minimize the amount of anionic salts needed. Low-DCAD forages can replace anionic salt supplementation and improve Ca metabolism in cows during the

transition period without affecting their feed intake.



bromegrass, smooth bromegrass and tall fescue) are intermediate between those of timothy and orchardgrass.

In Quebec, old fields produce good hay for transition cows because they often have an abundance of timothy, which typically outlives other seeded grasses and legumes.

Cultivars do not matter

Little information exists on cultivar differences for DCAD. In one study conducted in eastern Canada, cultivars of orchardgrass, meadow bromegrass, tall fescue, smooth bromegrass and timothy had similar DCAD. Hence, the choice of cultivar has no importance for the DCAD.

Choosing the first or second cut

Choice of first- or second-cut has far less effect on the DCAD than choice of forage species. In timothy, for example, DCAD of the second-cut was 52–85 meq/kg DM lower than that of the first-cut.

Thus, the second (summer) cut of timothy provides slightly better feed for transition cows, but second-cut generally produces a lower yield than first-cut timothy.

Low dietary cation-anion difference with a late harvest: to be used with caution!

The DCAD of timothy decreases as it matures. For instance, we found a decrease from 326 meq/kg DM at stem elongation to 196 meq/kg DM at the early flowering stage (Fig. 2). However, delaying harvest decreases nutritive value (lower digestibility and CP concentration, and greater NDF concentration) which reduces intake at a time that intake should be stimulated in preparation for calving. It is therefore recommended to not harvest timothy after the late heading stage when producing forages for transition cows.

Chloride fertilization reduces forage dietary cation-anion difference

Second-cut timothy has a DCAD of approximately 350 meq/kg DM, which is still far above the target value. Something more must therefore be done. Chloride fertilization increases the Cl concentration of timothy, and hence decreases the DCAD by as much as 266 meq/kg DM. The economically optimal rate of Cl application in spring ranges from 78–123 kg Cl/ha, depending on the K and Cl

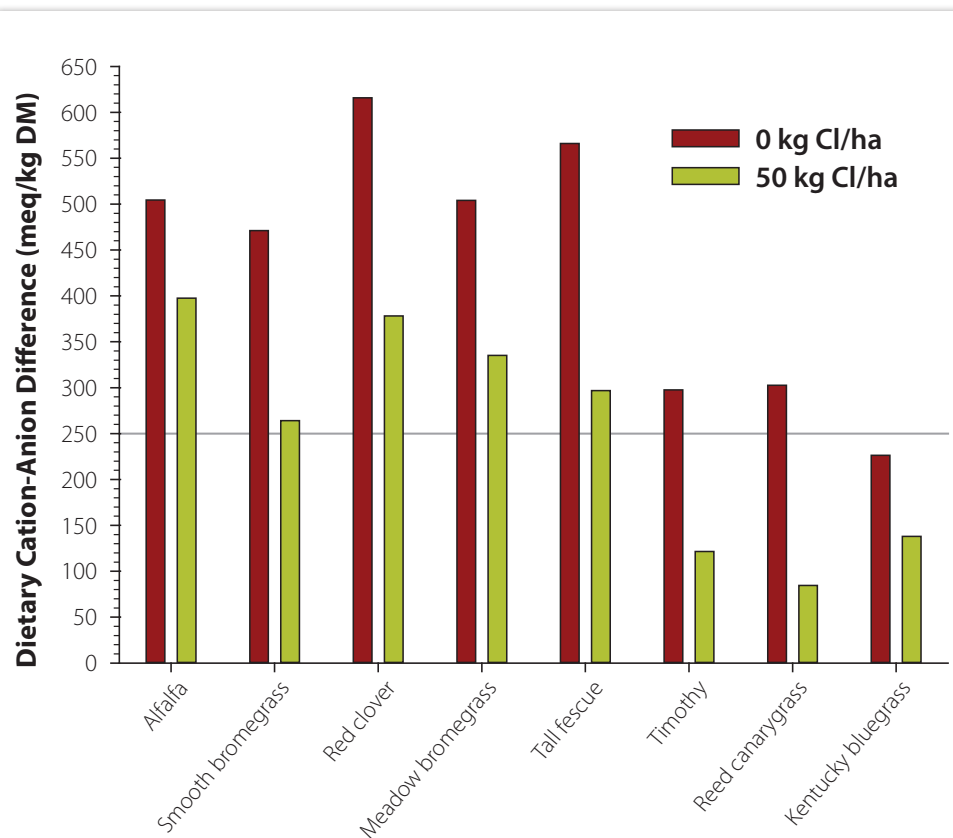


Figure 3. Forage Dietary Cation-Anion Difference (DCAD) in summer regrowth of eight forage species after an application of 0 or 50 kg of Cl/ha after the first harvest (Tremblay et al. 2013).

content of the soil and expected yield. Applications of 100 kg Cl/ha (160 kg CaCl₂/ha) in spring and/or 65 kg Cl/ha (100 kg CaCl₂/ha) after the first-cut are recommended to produce timothy with appropriate DCAD.

Of eight forage species fertilized with Cl only, timothy, reed canarygrass and Kentucky bluegrass had DCAD value lower than 250 meq/kg DM in both spring and summer harvests (Fig. 3). No substantial negative effects of Cl fertilization were observed on forage yield or nutritive value.

The additional cost of producing a low-DCAD hay therefore depends mainly on the price of chloride fertilizer. Based on simulation with a whole dairy farm model, low-DCAD forage, assuming no impact on feed intake, could improve a Quebec dairy operation's bottom line by an average of \$33/cow/year compared to anionic feed supplements. Furthermore, growing low-DCAD forages has only a minimal impact on chloride balance in an average dairy farm because large amounts of NaCl are fed to cows and potassium chloride is commonly used as a fertilizer.

For a herd of 50 lactating cows, the producer will have to set aside about 2.5 ha (6.2 ac) of low-K soil in order to produce the 13 metric tons DM (14.3 US T) of low-DCAD forage needed to feed the transition cows. Buying low-DCAD hay instead of DCAD salts may be an option if the price is competitive.

Nitrogen fertilization

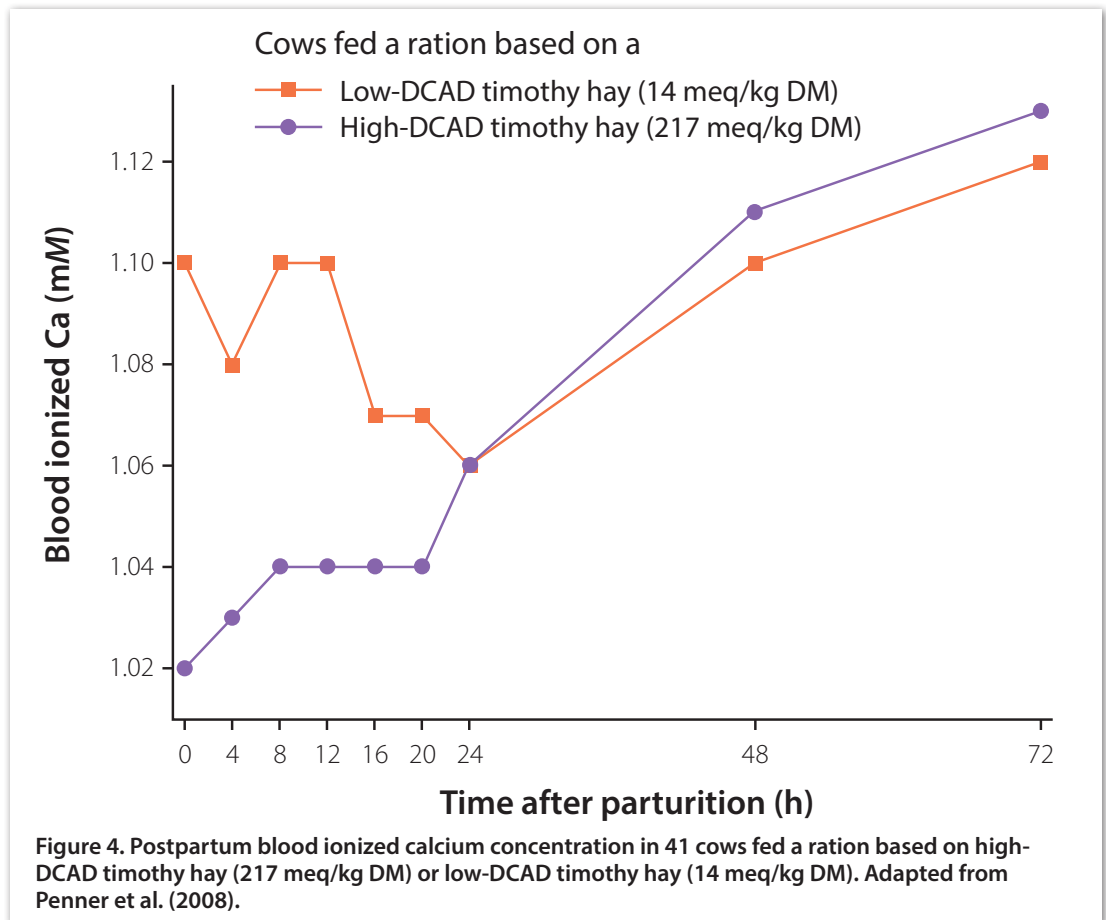
Nitrogen (N) fertilization has little effect on the DCAD of timothy when it is grown on K-poor soil and harvested at the heading stage. But N fertilization can cause an increase in DCAD when the timothy is grown on K-rich soil and harvested at earlier maturity. Because liquid and solid cattle manures are generally rich in K, application of inorganic N fertilizers is preferable to manure for low-DCAD crops. However, pig manure treated with a Ca-Cl₂-based coagulant can be a reasonable option because it is relatively rich in Cl and low in K.

What do the cows think?

So what happens if we feed dairy cows low-DCAD hay? A hypocalcaemia was simulated in six dry, non-gestating cows, by perfusing them with an agent that binds Ca²⁺ until their blood Ca²⁺ concentrations were reduced by half. Once perfusion was halted, the cows took half as much time for their Ca²⁺ concentrations to recover when they had been fed a low-DCAD timothy hay as when they had been fed a high-DCAD timothy hay, which clearly demonstrates the effectiveness of low-DCAD timothy hays in reducing the risk of milk fever. Low-DCAD timothy silage can also be used during the transition period.

Low-DCAD timothy hay fed to 41 dry and gestating dairy cows during the transition period reduced urine pH and blood bicarbonate concentration—two symptoms of mild compensated metabolic acidosis. This acidosis was associated with an increase in the blood concentration of Ca²⁺ at calving (Fig. 4); the feed intake of the cows fed on low-DCAD timothy hay was not affected, and the cows had a better ability to self-regulate calcium homeostasis at calving.

Finally, the optimum dietary Ca concentration to minimize the risk of hypocalcaemia in dairy cows is likely different depending on the DCAD value. A greater dietary Ca intake is desirable for cows fed diets with low-DCAD values.



Summary: Producing a low-dietary cation-anion difference forage

Producing a low-DCAD hay on your own farm to feed your cows during the two to three weeks before calving can be profitable. This practice can replace the use of anionic salts and improve the capability of your cows to maintain normal blood levels of Ca, without negative effects on their feed intake. To produce hay for cows in the transition period, choose any cultivar of timothy and choose a field where the level of available soil K is low. Chloride fertilization in spring (100 kg/ha or 90 lb/ac of Cl) may also be considered. If the farmer wishes to produce low-DCAD second-cut timothy, then 65 kg of Cl per hectare should be applied after the first cut. 🌿

References available online at www.farmwest.com

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