Iowa State Research Farm Progress Reports

2008

Development of Methodologies to Reduce the DCAD of Hay for Transition Dairy Cows

Ronald L. Horst
USDA National Animal Disease Center

Kenneth T. Pecinovsky
Iowa State University, kennethp@iastate.edu

Jesse Goff
USDA National Animal Disease Center

Development of Methodologies to Reduce the DCAD of Hay for Transition Dairy Cows

Abstract

Ration formulation for dairy cows prior to parturition must control the diet cation-anion difference (DCAD) if hypocalcemia and milk fever are to be avoided. One key to reducing hypocalcemia is to avoid incorporation of high K forages into the ration. The excessive K content of these forages can cause metabolic alkalosis in the cow and subsequently hypocalcemia and milk fever. Alfalfa and other cool season grasses are often used in dairy rations. Reducing K content of forages can be achieved by restricting K fertilization so that soils do not support luxury K consumption by the crops. Because K is the major cation contributing to high DCAD diets, an obvious solution is to limit K fertilization to avoid luxury consumption of K by the forage crop. However,some forages may have reduced yield and increased winter kill if K concentrations are < 2.0%, particularly alfalfa. Thus, producing alfalfa with less than 2% K may not be profitable, especially in northern regions. In addition to decreasing forage K, the producer can also increase the Cl content of the forages, the resulting DCAD will be more favorable for the late gestation cow.

Keywords

Animal Science

Disciplines

Agricultural Science | Agriculture | Animal Sciences

Development of Methodologies to Reduce the DCAD of Hay for Transition Dairy Cows

Ronald Horst, NADC collaborator
Ken Pecinovsky, farm superintendent
Jesse Goff, collaborator
Department of Animal Science

Introduction

Ration formulation for dairy cows prior to parturition must control the diet cation-anion difference (DCAD) if hypocalcemia and milk fever are to be avoided. One key to reducing hypocalcemia is to avoid incorporation of high K forages into the ration. The excessive K content of these forages can cause metabolic alkalosis in the cow and subsequently hypocalcemia and milk fever. Alfalfa and other cool season grasses are often used in dairy rations. Reducing K content of forages can be achieved by restricting K fertilization so that soils do not support luxury K consumption by the crops. Because K is the major cation contributing to high DCAD diets, an obvious solution is to limit K fertilization to avoid luxury consumption of K by the forage crop. However, some forages may have reduced yield and increased winter kill if K concentrations are < 2.0%, particularly alfalfa. Thus, producing alfalfa with less than 2% K may not be profitable, especially in northern regions. In addition to decreasing forage K, the producer can also increase the Cl content of the forages, the resulting DCAD will be more favorable for the late gestation cow.

This study tests the hypothesis that withholding K fertilization in combination with chloride fertilization of forage crops will result in decreased K and increased Cl in the forage and produce a more favorable DCAD which will act as an aid in reducing hypocalcemia. DCAD (meq/kg) in this study was defined as (meq/kg K + meq/kg Na) – (meq/kg Cl + meq/kg SO_4).

Materials and Methods

In August 2002, four forage species were seeded at a rate of 18 lb/acre (100 gm/plot) in four blocks of 4- 3 × 16 m plots at the Northeast Research and Demonstration Farm, Nashua, IA. The four forage species to be evaluated were: 1) Smooth Bromegrass – Barton (SB); 2) Orchardgrass – Napier (OG); 3) Reed Canarygrass – Palatine (RC); and 4) Alfalfa – Somerset (AF).

In the spring of 2003 and each subsequent year, grass plots were fertilized with nitrogen at a rate equivalent to 100 lb/acre. Throughout the summer of 2003, plots were clipped in two cuttings to a height of 2 in. In the spring of 2004, 2005, and 2006, each plot was divided into four subplots that were randomly treated with one of four potassium/chloride treatments including:

K_2O as K_2CO_3, lb/ac	Chloride as $CaCl_2$, lb/ac
0	0
200	0
0	100
200	100

During the summer of 2004, 2005, and 2006, each plot was harvested to a height of 2 in. with a Carter Harvester in three cuttings at a date when the alfalfa was at the bud stage of maturity. Forage was weighed for determination of yield and subsampled. Sampled forage was dried at 60°C, ground, and analyzed for Ca, Mg. Na, K, Cl, P, and S to quantify the DCAD. In addition, samples were analyzed for NDF and CP.

Results and Discussion

One of the objectives of this experiment was to determine if withholding K fertilization would result in a decreased K content of the various hays. The second objective was to see if the chloride content of the forage could be increased. Ultimately, the goal was to produce low DCAD forages for use in close-up cow diets.

Alfalfa. In the alfalfa plots not receiving K fertilization (Control and $CaCl_2$) the K content of the plants across all cuttings and all three years was lower relative (Control, 1.38%; $CaCl_2$, 1.26%,) to those receiving K (K_2O, 1.83% and K_2O + $CaCl_2$, 1.82%). Numerically the K content of plots fertilized with $CaCl_2$ had the lowest K concentration.

With regards to plant Cl content, the alfalfa plots fertilized with $CaCl_2$ alone or in combination with K_2O resulted in a 2-3 fold elevation in tissue chloride in all the hays tested. This effect was observed for each of the three cuttings and continued all three years. Mean treatment values across all three cuttings and years were control, 0.28%; $CaCl_2$, 0.78%; K_2O, 0.26%; K_2O + $CaCl_2$ 0.73%.

DCAD was also reduced with $CaCl_2$ treatment alone. The combination of K_2O and $CaCl_2$ resulted in an attenuation of this effect. DCAD of plots was Control + 244, K_2O = + 360, $CaCl_2$ = +77 and both K_2O + $CaCl_2$ = +227.

Orchardgrass. In the orchardgrass plots not receiving K fertilization (Control and $CaCl_2$) the K content of the plants across all cuttings and all three years was lower relative (Control, 2.04%; $CaCl_2$, 1.90%,) to those receiving K (K_2O, 2.62% and K_2O + $CaCl_2$, 2.58%). Numerically the K content of plots fertilized with $CaCl_2$ had the lowest K concentration.

With regards to plant Cl content, the orchardgrass plots fertilized with $CaCl_2$ alone or in combination with K_2O resulted in a 2-3 fold elevation in tissue chloride in all the hays tested. This effect was observed for each of the three cuttings and held up all three years. Mean treatment values across all cutting and species were control, 0.32%; $CaCl_2$, 1.20%; K_2O, 0.31%; K_2O + $CaCl_2$ 1.14%.

DCAD was also reduced with $CaCl_2$ treatment alone. The combination of K_2O and $CaCl_2$ resulted in an attenuation of this effect. DCAD of plots was Control + 289, K_2O = + 368, $CaCl_2$ = +74 and both K_2O + $CaCl_2$ = +256.

Reed Canarygrass. In the reed canarygrass plots not receiving K fertilization (Control and $CaCl_2$) the K content of the plants across all cuttings and all three years was lower relative (Control, 1.96%; $CaCl_2$, 1.94%,) to those receiving K (K_2O, 2.36% and K_2O + $CaCl_2$, 2.47%). Numerically the K content of plots fertilized with $CaCl_2$ had the lowest K concentration.

With regards to plant Cl content, the reed canarygrass plots fertilized with $CaCl_2$ alone or in combination with K_2O, resulted in a 2-3 fold elevation in tissue chloride in all the hays tested. This effect was observed for each of the three cuttings and continued all three years. Mean treatment values across all cutting and years were control, 0.39%; $CaCl_2$, 1.43%; K_2O, 0.46%; K_2O + $CaCl_2$ 1.33%.

DCAD was also reduced with $CaCl_2$ treatment alone. The combination of K_2O and $CaCl_2$ resulted in an attenuation of this effect. DCAD of plots was Control + 289, K_2O = + 367, $CaCl_2$ = -11 and both K_2O + $CaCl_2$ = +163.

Smooth Bromegrass. In the smooth bromegrass plots not receiving K fertilization (Control and $CaCl_2$) the K content of the plants across all cuttings and all three years was lower relative (Control, 1.84%; $CaCl_2$, 1.77%,) to those receiving K (K_2O, 2.44% and K_2O + $CaCl_2$, 2.44%). Numerically the K content of plots fertilized with $CaCl_2$ had the lowest K concentration.

With regards to plant Cl content, the smooth bromegrass plots fertilized with $CaCl_2$ alone or in combination with K_2O, resulted in a 2-3 fold elevation in tissue chloride in all the hays tested. This effect was observed for each of the three cuttings and continued all three years. Mean treatment values across all cutting and years were control, 0.33%; $CaCl_2$, 0.92%; K_2O, 0.32%; K_2O + $CaCl_2$ 0.96%.

DCAD was also reduced with $CaCl_2$ treatment alone. The combination of K_2O and $CaCl_2$ resulted in an attenuation of this effect. DCAD of plots was Control + 282, K_2O = + 435, $CaCl_2$ = + 94 and both K_2O + $CaCl_2$ = +255.

Conclusions

These data suggest that withholding K fertilization in combination with Cl fertilization may be an effective means of increasing the Cl and ultimately decreasing the DCAD content of several species of hay without sacrificing yield. There were large effects of year and cutting on hay yield, protein and NDF content. However, there were no effects of treatment with chloride on yield, protein or NDF content when compared with control plots. The effect of Cl fertilization on hay quality and palatability is currently unknown though we are currently growing larger amounts of these forages for inclusion into the diet of close-up cows to test this approach for the control of milk fever in dairy cows.