Impact of type of K fertilizer on DCAD of fen grassland in northeast Germany

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Abstract. A lower DCAD is required in the diet fed during the prepartum period, but increasing the DCAD of diets fed during lactation increased milk yield and dry matter intake (Overton 2020). We conducted 3 cutting date/type of fertilizer trials, harvested with 5, 4 and 3 cuts per year over 3 years. Compared to the chloride based K fertilizer, the application of a sulphate based K fertilizer did not change dry matter yield and fodder quality (NEL-, XP-content) but led to significant higher DCAD in the grass in cut 1 - 3 of all trials over 3 years. The increase of DCAD amounted to approximately 100 to 150 in the first, 50 to 100 in the second and 40 to 80 meq kg^{-1} DM in the third cut. The findings correspond to results from grassland on other soils in Germany.

Introduction

The concept of managing the dietary cation-anion difference (DCAD) for improved health and performance of dairy cows is well-established for more than 30 years. A lower DCAD is required in the diet fed during the prepartum period, but increasing the DCAD of diets fed during lactation increased milk yield and dry matter intake (Overton 2020). Compared to other feed, DCAD in grass silages of our fen grassland region varied to a larger extent, as between -338 and +447 within one farm in one year. In a 3 year cutting date experiment with 5, 4 and 3 cuts per year on fen grassland in northeast Germany, we revealed an impact of ground water table on DCAD over the years (Pickert *et al.* 2022). We used the same experiment to compare the impact of different K fertilizers on DCAD and applied potassium chloride and potassium sulphate.

Methods

The experiment was conducted at ZALF Research Station Paulinenaue (northeast Germany; 52°68´N, 12°72´E; 28.5–29.5m a.s.l.; mean annual temperature 9.2°C, mean annual precipitation 534mm) on drained fen grassland (*Eutric Histosol*; reed and sedges peat) from 2017 to 2019. The grass samples were taken from three (A, B and C) adjacently positioned K fertilizer trials (RCB design, four replications). Experiment A was harvested with five, B with four and C with three cuts per year. K was applied as potassium sulphate (41,5 % K) and potassium chloride (33,2 % K) with 200 kg K ha^{-1} in Spring. Application of Nitrogen and Phosphorus was constant in all K treatments. DCAD was calculated on the base of the Na, K, S and Cl contents in the grass DM (g kg^{-1} DM) with DCAD = (Na x 43,5 + K x 25,6) - (Cl- x 28,2 + S x 62,4) and given as meq kg-1 DM. The content of K, Na and S were analysed according to DIN EN ISO 11885 and Cl according to DIN 38405-D1-2. Statistical analysis was performed by Anova and pairwise comparisons (Tukey test, $\alpha = 0.05$) using SAS 9.4 software procedure MIXED (SAS Institute Inc., Cary, NC, USA).
The experiments also involved a 0 K treatment (1) and a treatment (4) where we split the potassium chloride application over three cuts (4), both not discussed in the paper.

Results and Discussion

Application of potassium significantly increased grassland yield in all three experiments. An application of a sulphate based K fertilizer did not change dry matter yield and fodder quality (NEL-, XP-content) but influenced DCAD in the grass swards, compared to the chloride based K fertilizer. The results showed that the application of K sulfate (K treatment 2) lead to higher DCAD than of K chloride (K treatment 3). The DCAD differences were significant in all cuts of experiment B and C and in cuts 1 and 2 of experiment A. The increase of DCAD amounted to approximately 100 to 150 in the first, 50 to 100 in the second and 40 to 80 meq kg^{-1} DM in the third cut (Table 1).

Table 1. Dietary Cation Anion Difference (DCAD) in different cuts depending on the K fertilization (1…4) in the three experiments (A…C) on fen grassland (averaged over the years 2017-2019)

experiment	A				B				C			
K	1	**2**	**3**	4	1	**2**	**3**	4	1	**2**	**3**	4
cut 1	+141b	**+235c**	**+143b**	+47a	+117ab	**+162b**	**+69a**	+82a	+37a	**+158b**	**+8a**	+28a
cut 2	+14ab	**+45b**	**-39a**	-48a	-63ab	**-13b**	**-102a**	-93a	-59a	**+16c**	**-29ab**	-8bc
cut 3	-25a	**+62b**	**+20ab**	+42ab	-53ab	**+17b**	**-40a**	-27ab	-7a	**+72b**	**-10a**	+11a
cut 4	-73a	**-45a**	**-74a**	-83a	-41ab	**-20b**	**-81a**	-59ab				
cut 5	-58a	**-30a**	**-57a**	-84a								

K1 = 0 K; K2 = potassium sulfate, Spring; K3 = potassium chloride; Spring; K4 = potassium chloride, splitting cut 1 – 3;
pairwise comparisons by Tukey's test procedure ($\alpha = 0.05$);
Different letters indicate significant differences between DCAD mean values within each experiment.

The first cut DCAD differences between the two fertilizer types correspond very well to the experimental results reported from mineral soil grassland (Loamy Sand – Sandy Loam) in a river flood plain by Greiner and Frey (2022). However, the DCAD differences in the subsequent cuts were much smaller in our experiments. The supply of the different anions with the two potassium fertilizers caused different DCAD in the grasslands swards even on very different soils. The soil type affects the amount of difference, particularly in the subsequent cuts.

Conclusions

On sites concerned, it seems possible to influence the DCAD in grassland swards by different types of potassium fertilizers. Use of potassium sulfate fertilizers instead of potassium chloride fertilizers can remarkably increase grassland DCAD. Decision will depend on site and economic evaluation.

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References

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