

# **Reed Canarygrass Response to Nitrogen and Chloride Fertilization**

William H. Miner Agricultural Research Institute  
P.O Box 90, Chazy, NY 12921

Everett D. Thomas  
Charlie J. Sniffen  
Carl J. Majewski  
Catherine S. Ballard.

## Introduction

Since 1995 the focus of forage research at Miner Institute has involved the fertilization of cool-season grasses for dry dairy cows. There has been considerable research on achieving maximum yield and nutrient concentration of grass fed to lactating dairy cows, but much less involving grass fertilization for dry cows. There is concern about the effect of high levels of potassium (K) in dry cow rations, especially for cows two to three weeks prepartum (also called “prefresh” dry cows).

Ruminant nutritionists have recommended that grass fields harvested and fed to dry cows should receive little or no manure or fertilizer. While cool-season forage grasses typically contain approximately 2.5% K (more if fertilized with potassium), the K concentration of rations fed to dry cows should not exceed 1.5%. Dry cow rations with high K concentrations are associated with post-calving metabolic disorders, most notably milk fever. Since dry cow rations contain a high proportion of forage, the K concentration of forages fed to dry cows should not exceed 2.0%.

Most dairy farms have a positive nutrient balance: More nutrients are purchased as feed and fertilizer than are sold as milk, cull livestock, and surplus crops. Therefore, it is often difficult to find fields on dairy farms with low soil K levels. According to Cornell University soil analysis summaries, the average soil potassium level in New York State is already high and will continue to increase. Providing rations for dry dairy cows by focusing only on low potassium forages may not be a realistic option on many farms.

## Relevant research

“Shawnee” orchardgrass, “Toro” timothy, and “Palaton” reed canarygrass were seeded at recommended rates in ten foot wide strips in July, 1994 in a Malone sandy loam soil with low P and K levels. Potassium fertilizer (0-0-60) was applied in September 1994 in strips 25 feet in length at four rates: 0, 80, 130, and 210 # K<sub>2</sub>O /acre. The plots were harvested twice each in 1995 and 1996, with the 1994 fertilizer treatments repeated in September 1995. Nitrogen and phosphorus were applied to all plots according to Cornell University soil test recommendations. The interval between first and second harvests in both years was 57 days.

All species had a poor yield response to K fertilization. While there was a statistically significant yield response at the highest K rate, this response was not economical: The cost of fertilizer K exceeded the value of the increased yield. Forage K concentration increased with each increment of K fertilizer in every harvest, and in all cases exceeded 2.3%. While timothy had the lowest K concentration, it was also lower in other nutrients used in balancing dry cow rations. Reed canarygrass was comparable to timothy in cation-anion balance, and because of its higher yield was the species used for subsequent dry cow forage research. Since low soil K levels resulted in grass K concentrations higher than desirable for dry cow rations, it was apparent that other fertilization strategies may be necessary to produce forages for prefresh dry cows.

## **Objective**

Evaluate the effect of nitrogen and chloride fertilizers in the production of cool-season forage grasses for dry dairy cows.

## **Procedures**

“Palaton” reed canarygrass established in 1994 was fertilized on April 23, 1998 in a randomized block design trial replicated four times. Treatments were: 100# nitrogen as ammonium nitrate (33.5-0-0); 50# chloride as urea-calcium chloride (8-0-0-25 Ca-44 Cl); both ammonium nitrate and urea-calcium chloride, and an unfertilized control. A second application of 100# of nitrogen as ammonium nitrate was applied immediately after first harvest to the plots that received ammonium nitrate in April. There was no second application of urea-calcium chloride. First harvest was on May 26, and second harvest on July 22, a harvest interval of 57 days.

A 3' x 10' strip was harvested from each plot. Forage was weighed and dried for yield and dry matter determination. Dried and ground samples were submitted to Cumberland Valley Analytical Services for nutrient analysis. Yield and nutrient composition data was analyzed as a split plot design with nitrogen (N) as the main plot effect and urea-calcium chloride (Cl) as the sub-plot effect. The statistical analysis was conducted using the SAS general linear models procedure (SAS, 1990). All means presented are least square means unless otherwise noted.

## **Results and Discussion**

The effects of nitrogen and chloride fertilization on forage yield and nutrient composition are presented in Table 1. Application of nitrogen fertilizer significantly increased forage yield for both harvests. Chloride fertilization had no yield effect when applied alone, but decreased forage yield when applied in combination with nitrogen. No explanation is known for this, but it is unlikely that chloride was harmful to the plant at the rate used; New Jersey research found higher corn grain yield and no significant effect on corn stover yield when chloride was applied at rates up to 400#/acre.

**Table 1. Reed canarygrass yield and nutrient composition**

	Cut	-N -Cl	-N +Cl	+N -Cl	+N +Cl	S.E.	N Effect	Cl Effect
Yield	1	0.92	0.88	1.86	1.48	.16	*	
	2	0.74	0.75	1.88	1.70	.06	**	
CP %	1	11.6	12.1	19.6	18.1	.71	***	
	2	13.6	12.8	16.7	17.6	.14	*	
K %	1	2.47	2.57	2.41	2.52	.16		
	2	2.37	2.49	2.11	2.27	.16		
Cl %	1	0.59	1.46	0.45	1.27	.09		***
	2	0.72	1.42	0.35	1.04	.04		*
DCAD	1	402	198	440	244	43		***
	2	326	186	409	264	45		

Miner Institute, 1998

\*, \*\*, \*\*\* Statistically significant at P<0.05, 0.01, and 0.005 respectively.

Nitrogen increased the crude protein content of reed canarygrass forage while chloride had no effect. Previous research at Miner Institute found that N fertilization decreased second harvest forage K concentration. In this trial, N fertilization resulted in a numerical decrease in K concentration for both first and second harvests, but the differences were not statistically significant (P> .05). The reduced second harvest forage K response to N fertilization in 1998 may have been due to the unusually wet conditions that occurred between first and second harvest.

Chloride fertilization significantly increased forage chloride concentration in both first and second harvests. Chloride concentrations of reed canarygrass fertilized with nitrogen were lower for both first and second harvests, but these differences were not statistically significant.

#### *Dietary cation-anion difference*

In balancing rations for dry dairy cows, the dietary cation-anion difference is used to determine the susceptibility of dry cows to milk fever. The cation-anion balance is thought to influence milk fever by affecting blood pH. Potassium, sodium, and chloride are absorbed with 100% efficiency, while other anions and cations are absorbed at lower efficiencies. While the original DCAD equation, still used in many ration balancing programs, is expressed as: (K + Na) – (Cl + S), recent research has improved the equation to reflect actual absorption of anions and cations by dry dairy cows. The revised equation is:

$$(K + Na + 0.15 Mg + 0.15 Ca) - (Cl + 0.25 S + 0.5 P).$$

According to Goff, the target DCAD for dry cow forages using the original equation is +200 mEq/kg, and using the revised equation the target is <+350 mEq/kg.

While N did not significantly affect DCAD, fertilization with chloride resulted in original (data not shown) and revised DCAD levels considered acceptable for prefresh dairy cows.

One of the reasons that chloride fertilization was effective at decreasing DCAD was the efficient removal of chloride by the root system of reed canarygrass, especially that fertilized with N (Table 2). The efficiency of Cl removal—and the difficulty in producing low-K forage grasses—is due at least in part to the extensive root system of established reed canarygrass (and to a similar extent, of other perennial grass species). The root systems of grasses utilize a high percentage of water-soluble nutrients. Even when available soil K levels are very low, the root system of established forage grasses is so efficient as to often result in higher forage K concentrations than are normally considered acceptable for dry cow rations. Eleven of the sixteen plots in this research trial had soil test K values classified as “low” or “very low” by the Cornell University Nutrient Analysis Laboratory. These plots produced reed canarygrass with tissue K averaging 2.37% for first harvest and 2.17% for second harvest. However, forage yields from low and very low soil test K plots were as high as from plots with higher soil test values. Cornell University research has also experienced good yield and winter survival of forage grasses in soils testing extremely low in available potassium.

**Table 2. Efficiency of chloride removal**

Chloride removal, pounds per acre						
Nitrogen	Chloride	First Harvest	Second Harvest	Total	Efficiency, %	
-	-	10.9	10.7	21.6		
-	+	16.8	13.2	30.0	16.8 <sup>1</sup>	
+	-	26.0	21.3	47.3		
+	+	37.6	35.4	73.0	51.4 <sup>2</sup>	

Miner Institute, 1998

<sup>1</sup>No nitrogen fertilizer

<sup>2</sup>With nitrogen fertilizer

### Future research needs

Growing conditions in 1998 were unusually dry in the weeks prior to first harvest. April-May precipitation totaled 2.5”, or 54% of normal. Conditions between first and second harvest were dry for the first two weeks and then very wet, with about 10” of precipitation from mid-June through early July. A second year of data is needed to validate the 1998 results. A similar trial will be initiated in 1999 using the same sources of nitrogen and chloride.

To be relevant to the dairy industry, high chloride forages must be palatable to dry dairy cows, and the chloride in the grass in a form available to the cow. Chloride fertilization will be of little value unless high chloride forages produce similar effects on blood pH as an equivalent amount of chloride fed as anionic salts. A field-scale application of chloride fertilizer should be done to produce enough quantity of high and low chloride grasses for a replicated dry cow feeding trial.

## References

1. Beede, D.K. Dietary cation-anion difference: preventing milk fever. *Feed Management* 43:28. 1992.
2. Cherney, J.H. Fall harvest and winterkill. *Farming*, September 1998, P. 6-7.
3. Goff, J.P., and R.L. Horst. Reducing metabolic disease in the dry period—theory and practical considerations.
4. Goff, J.P., Ruiz, R., and R.L Horst. Acidifying activity of anionic salts.1998.
5. Heckman, J.R. Corn responses to chloride in maximum yield research. *Agronomy Journal* 87:415-419. 1995.
6. Heckman, J.R. Corn stalk rot suppression and grain yield response to chloride. *Journal of Plant Nutrition* 21(1), 149-155. 1998.
7. Horst, R.L., and J.P Goff. Milk fever and dietary potassium.
8. Reid, W.S. Personal communication. 1998.
9. Thomas, E.D., Sniffen, C.J., Allshouse, R.D., Ballard, C.S, and C. J. Majewski. Fertilization of forage grasses for dry dairy cows. 1998 Forage and Grassland Council Proceedings, Volume 7, P.134-138.