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THE EFFECTS OF TOPDRESSING DAIRY PASTURES IN THE WAIKATO WITH SODIUM CHLORIDE

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Abstract

Recent dairy farm survey data suggest the sodium (Na) concentration in pastures could be too low to maintain stock health on a number of farms. Trials have been established on three major soil groups in the Waikato to study: (a) the rates of NaCl rauired to raise Na concentrations in pasture; (b) the time required to do this; (c) the duration of the response; and (d) the effect of KCl on Na uptake. Na uptake in pasture was rapid initially, reaching a peak some 6 weeks after application. Thereafter the Na concentration in pasture declined gradually but after 30 weeks was still some 2 to 3 times the initial Na concentration. Soil Na levels followed a similar trend.

Conclusions to date suggest an annual topdressing of NaCl at 100 kg/ha will provide an adequate Na concentration in the pasture for animal health and production on a range of Waikato soils. In practice salt can be applied alone or mixed with other fertilisers. Where potassium is already high some replacement of NaCl for KCl in the fertiliser mixture can be considered. Regular monitoring by pasture analysis is recommended. Although salt applications will increase the Na content in the pasture, animal responses to Na supplementation have yet to be conclusively demonstrated. Research is planned with dairy cows in the Waikato to investigate this important aspect.

Keywords: Salt, sodium chloride, pasture sodium, ryegrass, white clover pastures, topdressing, dairy cows

INTRODUCTION

The importance of salt (NaCl) in the diet of grazing animals has been recognised for many years. Reference to the use of salt for cattle can be found as early as 150 BC. A response in milk production of dairy cattle given a salt supplement was shown by Babcock (1905). Later work (Aines & Smith 1957) showed sodium (Na) rather than chlorine to be the cause of the milk production response.

Direct supplementation of salt to animals is probably the most effective method of correcting a deficiency, but the use of salt as a fertiliser is an alternative method. It relies on being able to increase Na concentration in the leaves of pasture plants. Estimates of adequate or deficient Na concentrations in mixed pasture needed to maintain health and production are shown in Table 1 (Towers & Smith 1983).

Table 1: Estimates of pasture Na concentrations required to maintain stock health and production

	% Na on DM basis	
	Adequate	Deficient
Lambs	0.07	0.04
Ewes (lactating)	0.09	0.05
Cattle	0.10	0.06
Dairy cows (lactating)	0.12	0.09

A recent survey of 312 North Island dairy farms (Carruthers *et al.* 1987) indicated that pasture on 19% of Taranaki farms, 38% of Bay of Plenty farms and 22% of Waikato farms was deficient in Na (below 0.10% Na). In September 1987

three field trials were begun in the Waikato to determine rates of NaCl required to increase Na concentrations in pasture, the time to do this, the duration of the effect and the influence of added K on the increase in Na concentration. The results of the first 30 weeks of the study are reported.

METHODS

Three trial sites were chosen on the basis of low pasture Na levels (<0.10% Na). All were on dairying pastures and included a yellow-brown pumice soil 10 km south of Putaruru (site 1); a yellow-brown loam 4 km west of Tirau (site 2); and a peat soil 8 km south-west of Cambridge (site 3). At each site 5 rates of NaCl (0, 50, 100, 200 and 400 kg/ha) and 2 rates of KCl (0 and 140 kg/ha) were applied in a split-plot design with rates of KCl as main treatments and rates of NaCl as sub treatments. Plot size was 5 x 2 m. The trials began in September 1987 and were operated under a 'mowing and clippings return' technique with approximately 35% of the clippings returned to each plot.

Measurements included pasture dry matter (DM) determinations on 8 cuts September 1987 to March 1988; K and Na determinations on pasture samples taken at 0, 6, 12, 20 and 30 weeks; MAF Soil Quick Tests for pH, Ca, P, K, Mg, Na on soil samples (O-8 cm) taken at similar intervals together with deep soil sampling (8-15 and 16-30 cm) on the control and 400 NaCl, 140 KCl treatments only.

Rainfall was measured at each site and the Na concentration of the rainwater determined.

RESULTS

Pasture production

Pasture production measured over 30 weeks totalled 10.3, 8.9 and 8.0 t/ha DM at sites 1, 2 and 3 respectively. NaCl had no effect on pasture production at sites 1 and 2 but for the first 4 months on site 3 pasture production was depressed by approximately 20%. There was no apparent reason for this initial depression. Pasture burning was not evident.

Sodium in pasture

The Na content in the pasture increased on all sites after NaCl application, reaching a peak after 6 weeks (Table 2). Thereafter the Na concentrations gradually declined on sites 1 and 3 but remained remarkably constant on site 2 (yellow-brown loam) up to 30 weeks after application. There was a strong linear relationship on all sites between Na content in pasture and rate of NaCl applied (r=0.99).

On sites 1 and 2, 100 kg NaCl/ha increased Na in pasture above 0.2% Na; on

Table 2: Effect of applied NaCl on the Na content of pasture on 3 soils

Kg NaCl/ha	50			100			200			400		
Soilgroup	YBP[1]	YBL[2]	Peat	YBP	YBL	Peat	YBP	YBL	Peat	YBP	YBL	Peat
	% Na on DM basis											
At start (Sept '67)	0.07	0.12	0.06	0.07	0.12	0.06	0.07	0.12	0.06	0.07	0.12	0.06
6 weeks (Oct '67)	0.15	0.21	0.12	0.23	0.22	0.14	0.24	0 2 7	0.23	0.34	0.39	0.28
30 weeks (March '88)	0.11	0.17	0.13	0.15	0.23	0.17	0.16	0.31	0.16	0.21	0.34	0.21

1 Yellow-brown pumice
2 Yellow-brown loam

site 3, 200 kg NaCl/ha was required to achieve a similar increase (Table 2). This suggests soil type will have an important effect on pasture Na increases to applied salt.

Sodium in soil

Applying NaCl increased soil Na concentrations (O-8 cm) on all sites and, as with the pasture Na, reached a peak 6 weeks after application and gradually declined thereafter (Table 3). After 30 weeks, however, soil Na levels were still approximately twice the initial values. Again there was a strong relationship between soil Na and rate of NaCl applied. Depth sampling to 30 cm on the 400 NaCl/140 KCl plots indicated definite leaching of Na through the profile (Table 4).

Table 3: Effect of applied NaCl on the soil Na levels

Kg NaCl/ha	50			100			200			400		
Soil group	YBP	YBL	Peat	YBP	YBL	Peat	YBP	YBL	Peat	YBP	YBL	Peat
At start (Sept '87)	5'	5	6	5	5	8	5	5	8	5	5	8
6 weeks (Oct '87)	8	9	17	15	12	22	16	16	27	24	24	40
30 weeks (March '68)	7	7	14	8	6	18	9	9	22	13	12	32

• Na (mg/l Of extract) MAF Quick Test

Table 4: Changes in soil Na levels at 3 deoths on the400 NaCl/140 KCl treatment

Period	Depth (cm)	Soil group YBP	YBL	Peat
At star-l	O-8	5'	5	9
	8-15	3	3	8
	15-30	4	2	8
6 weeks	O-8	25	23	32
	8-15	11	7	14
	15-30	9	8	9
30 weeks	O-6	13	11	33
	8-15	9	13	24
	15-30	7	12	12

• Na (mg/l of extract) MAF Quick Test

Effect of NaCl plus KCl application on Na levels in the pasture

Initial soil K Quick tests were medium-high on all sites (range 6-12) and plant K levels high to very high (range 3.6-4.3 %K). Such levels are typical of many Waikato and North Island dairy farms. The addition of 140 kg KCl/ha with NaCl in these situations had only a minimal effect on the plant Na levels, reducing them by 10-15% compared with no KCl addition. Other evidence suggests the addition of KCl will have a more detrimental effect on the Na pasture levels where initial K is lower (McNaught 8 Karlovsky 1964).

Recovery of applied Na

The percentage of applied Na recovered in soil and pasture (after 30 weeks) was 40%, 64% and 71% on sites 1, 2 and 3 respectively. If allowance is made for Na contribution from rainfall (15-25 kg Na) these figures are reduced to 21, 36 and 62% respectively. Actual recovery in the pasture was 14%, 19% and 9% for sites 1, 2 and

3 respectively. Such figures do not differ greatly from those for other applied nutrients, for example Mg (O'Connor et a/. 1981).

Variations in pasture Na concentrations

The Na content of pasture on the control (no NaCl) plots fluctuated widely over the 30-week sampling period (Table 5). Only some of the variation could be explained by seasonal and sample contamination. The analytical error was checked and found to be low. The data therefore suggest a 40-100% fluctuation in pasture Na concentrations is possible in trial situations. As it is likely that paddock sampling for advisory purposes will give even greater fluctuations in Na concentrations of pasture, this must be considered when making recommendations on the use of Na.

Table 5: Variations in the Na concentrations of pasture on Control (no NaCl) plots over 30 weeks

Date	YSP	Soil group YBL % Na OM basis	Peat
2 6 6 7	0 1 0	0.14	0.06
13 10.87	0.12	0.18	0.09
24.1 1.67	0 0 9	0.11	0.07
19. 1.88	0 1 3	0.13	0.1 1
29. 3.88	0.13	0.21	0.12

DISCUSSION

Field trial results suggest NaCl applied to pasture will rapidly increase the Na content of the pasture, reaching a peak about 6 weeks after application. The response lasts for at least 30 weeks but at a diminishing level. Even so, the pasture Na concentration associated with, for example, the 100 kg NaCl/ha rate after 30 weeks was still well above the level needed to prevent Na deficiency in stock and some 2-3 times greater than the initial Na level (Table 2). It is concuded that an annual topdressing of NaCl at 100 kg/ha will provide an adequate Na status in the pasture for animal health and production on a range of Waikato soils. There may be scope for reducing this input on some soils.

In practice salt can be applied directly to pasture or mixed in with phosphate fertilisers. Where pasture levels of K are already high, as on most dairy pastures, some replacement of NaCl for KCI in the fertiliser mixture could be considered. For example, a 30% potash superphosphate could become a 20% salt 10% potash superphosphate. Present results suggest uptake of Na in pastures already high in K is affected only marginally by added K in fertiliser. On pastures lower in K, for example many sheep/beef pastures, adding KCI with NaCl could reduce Na uptake (McNaught & Karlovsky 1964). In such cases a salt only or salt/phosphate fertiliser mixture is recommended. Soil and pasture Na should be monitored annually. Care should also be taken in grazing Na-treated pastures with pregnant *cows* as quite moderate increases in Na intake can depress plasma Mg levels and thereby increase the risk of hypomagnesaemic grass tetany (Smith et *al.* 1983). A Mg supplmentation programme for the cows should be implemented.

This study demonstrates that the Na content of pasture can be increased by salt applications. However animal production responses to improved pasture Na status have yet to be conclusively demonstrated.

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