

# MINERAL COMPOSITION OF PERENNIAL PASTURE SPECIES GRAZED BY DAIRY COWS IN SOUTH-EASTERN AUSTRALIA

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## ABSTRACT

On four occasions, the mineral composition of white clover (*Trifolium repens* L.), perennial ryegrass (*Lolium perenne* L.) and paspalum (*Paspalum dilatatum* Poir.), and their morphological components, were monitored as they regrew after defoliation. The four periods coincided with spring, summer, summer/autumn and autumn. White clover generally had more phosphorus, potassium, calcium and magnesium than did the grasses. Ryegrass, on the other hand, had higher concentrations of sodium than either white clover or paspalum. When compared with requirements for lactating dairy cows, it appeared that phosphorus was the major mineral in the pasture on offer with potential to adversely affect milk production. However, the ability of cows to select particular species and/or morphological components could modify this conclusion.

## KEYWORDS

Dairy cows, grazing, irrigated perennial pastures, mineral composition

## INTRODUCTION

The quantities of supplements fed to dairy cows in south-eastern Australia have increased rapidly since the early 1980's (Doyle *et al.* 1996), such that about 20% of a cow's diet now comes from cereal grains, mixed concentrates, pasture hay and silage, maize silage and byproducts. Whilst the majority of supplements are used to improve the energy nutrition of dairy herds, farmers tend to rely on the pasture feedbase to balance the total diet for protein, fibre and minerals.

In our pasture-based dairy systems, there is considerable controversy as to whether additional mineral supplements are needed to balance diets for high producing dairy cows. This is due principally to the lack of information on the mineral content of local feedstuffs, particularly grazed pasture. In order to help farmers make informed decisions on their cows' requirements for supplemental minerals, an investigation was undertaken at Kyabram Dairy Centre (36° 18' S., 145° 03' E.), in northern Victoria, to provide data on the mineral composition of the three major species in irrigated perennial pastures, white clover (cv. Haifa), perennial ryegrass (cv. Nui) and paspalum.

## MATERIALS AND METHODS

On four occasions (spring (Oct/Nov), summer (Dec/Jan), summer/autumn (Feb/Mar) autumn (Apr/May)), perennial pasture at the Kyabram Dairy Centre was defoliated with a mower. Subsequently, the nutritive characteristics of white clover, ryegrass and paspalum in these plots were monitored as they regrew.

Pasture samples were harvested by cutting to ground level every week during periods of regrowth, except for the first week after defoliation. Each species was sorted into leaf, stem, flowers and dead material. After drying at 60°C for 72 h, and grinding through a 0.5 mm screen, samples were analysed for phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg) and sodium (Na) by an automated X-ray fluorescence spectrometer.

## RESULTS AND DISCUSSION

The range in concentrations of minerals in the three pasture species are given in Table 1. White clover generally had more P, K, Ca and Mg than the grasses. Ryegrass, on the other hand, had higher

concentrations of Na than either white clover or paspalum. The results also indicate the relatively low variability in the concentrations of all minerals in paspalum, and the high variability in ryegrass.

Mineral requirements in lactating dairy cows vary with stage of lactation and level of milk production, although there are large discrepancies in published estimates. Nonetheless, it is worth considering the mineral concentrations of the three species in relation to some published recommendations, presented in Table 2, which can suggest likely mineral deficiencies. If these requirements are compared with the data presented in Table 1, it is probably only K and Mg that are in adequate supply in all pasture species. Ca appears to be in luxury levels in white clover, while ryegrass has adequate Na. If variations in the availabilities of minerals in the cow and the possible effects of interactions between minerals are ignored, P is the major mineral that has potential to adversely affect milk production. This conclusion applied to each of the pasture species examined. While doubt may exist about the adequacy of this mineral in a pasture only diet, where large amounts of supplements are fed to dairy cows, P limitations may become more evident, although this will obviously depend on the mineral composition of the supplements used.

Cows do not eat all the pasture that is on offer, they select various species and plant parts depending on grazing conditions. Consideration of plant fractions can give an indication of the limits of selection by grazing cows, particularly leaf characteristics because leaves reside at the top of a sward. The mineral composition of the leaves of each pasture species is presented in Table 1. When compared with whole plant mineral concentrations, leaf was not always the richest source of a mineral. P, Ca and Mg were more concentrated in the leaves of all species than in the whole plant. With K and Na, on the other hand, ryegrass always had higher levels in leaves than in the whole plant while white clover was the opposite. Stem was most important in the resulting balancing act between leaf and whole plant composition; where leaf was higher than whole plant in an individual mineral, stem was lower, and vice versa. While dead material often constituted a major proportion of the herbage, its mineral composition often followed the middle road.

Where a mineral has its highest concentration in the leaves, lax grazing management or the use of short pastures should result in higher concentrations in the pasture eaten than that on offer. This has particular significance for P with its potential for insufficiency. W.J. Wales (unpublished results) found that cows selected diets which had between 112 and 127% more P than the feed on offer in a recent grazing experiment in which daily pasture allowance increased from 15 to 40 kg DM/day. Otherwise, it is the species composition of a pasture that will have the greatest impact on the supply of minerals for grazing dairy cows.

## REFERENCES

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**Table 1**  
Variations in the mineral content (% of DM) of the leaf fraction of white clover, ryegrass and paspalum throughout the year, compared with that of the whole plant.

Mineral	Species	Whole plant	Leaf composition at various times of the year			
			Spring	Spring/summer	Summer/autumn	Autumn
Phosphorus	White clover	0.31-0.36	0.36	0.34	0.38	0.42
	Ryegrass	0.26-0.39	0.50	0.34	0.40	0.40
	Paspalum	0.21-0.26	-	0.27	0.22	0.32
Potassium	White clover	2.77-3.26	2.68	2.68	2.47	3.06
	Ryegrass	1.53-2.51	3.87	2.90	3.03	3.88
	Paspalum	1.81-2.25	-	2.67	2.50	2.66
Calcium	White clover	0.89-1.32	1.08	1.16	1.25	1.09
	Ryegrass	0.43-0.55	0.43	0.35	0.32	0.36
	Paspalum	0.30-0.38	-	0.32	0.36	0.26
Magnesium	White clover	0.31-0.48	0.31	0.48	0.49	0.34
	Ryegrass	0.26-0.36	0.30	0.31	0.32	0.32
	Paspalum	0.24-0.32	-	0.29	0.26	0.28
Sodium	White clover	0.09-0.20	0.20	0.23	0.10	0.07
	Ryegrass	0.20-0.34	0.26	0.54	0.49	0.45
	Paspalum	0.13-0.14	-	0.09	0.07	0.12

**Table 2**  
Mineral requirements (% of DM) for a 450 - 500 kg cow producing 25 L of milk/day.

Mineral	United States	United Kingdom	New Zealand
	(NRC 1989)	(Underwood 1981)	(Holmes and Wilson 1987)
Phosphorus	0.36	0.33	0.39
Potassium	0.90	0.80-1.00	0.54
Calcium	0.57	0.41	0.39
Magnesium	0.20	0.10-0.30	0.20
Sodium	0.18	0.15	0.12