MINERAL ELEMENTS FROM PASTURE FOR GRAZING SHEEP

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Abstract

Pasture was harvested monthly from sheeptrack and slope on a hillside set-stocked with sheep. The elements determined and the ranges of the monthly site averages for the macroelements (%DM) are: organic N(2.0-5.0), Ca(0.2-0.7), Mg(0.1-0.24), P(0.2-0.4), Na(0.07-0.22), K(1.2-3.0), Cl(0.6-1.2), Si(0.5-1.5), and for trace elements (mg kg⁻¹) Fe(400-3000), Mn(110-430), Zn(25-70) and Cu(5-10). The concentrations of all elements except Cl and Cu showed marked seasonal trends and varied up to twofold at a site.

The Ca, Mg, P and Na requirements of grazing sheep for maintenance, pregnancy, lactation and growth were obtained from previous metabolism studies. For example, the macroelement requirements of sheep for lactation are two to four times above that for maintenance. For the hill country pasture studied, we conclude that the sheep's requirements for P(1.3-5.4g per day) was more than adequately met, those for Ca (1.5-6g per day) and Mg(0.9-2.9g per day) were just met during June and July when the concentrations of Ca(0.2%) and Mg(0.11%) were at their lowest. The Na requirement (0.75-2.1g per day) was not met during June and July when the pasture Na concentration was 0.07%.

INTRODUCTION

The mineral composition of pasture usually changes with the seasons; the individual elements being affected differently (Metson and Saunders 1978). The mineral requirements of the grazing animal also change depending on whether it is pregnant, lactating or growing. The animal is mainly dependent on the pasture for the daily mineral intake, but the fluctuating composition is not usually considered in evaluating the mineral supply.

This paper relates pasture mineral composition data from a Wanganui hill farm to the current estimates of the grazing sheep's requirements for some of the macroelements.

EXPERIMENTAL

A hillside pasture inland of Wanganui (N 138/894959), on a soil of the Pqhangina Steepland association was set-stocked with sheep, usually rams, and sampled monthly. An area of the hillside 50m long and 30m high, 10m above the bottom of the slope, was divided into upper and lower halves. Pasture was plucked from the sheeptracks and the intervening slopes of each upper and lower half. Herbage was unwashed and included some soil but gloves were worn to prevent contamination from sodium and chloride in

sweat.

Total organic-nitrogen, calcium, magnesium, potassium, sodium, phosphorus, chloride, iron, manganese, zinc, copper and plant-silicon were determined (Reay and Waugh 1981) and elemental concentrations are expressed on a dry matter basis. The significance of harvest date, sheeptrack and height effects on mineral element concentrations was determined by factorial analysis of variance. Where element concentrations were not significantly different overall between sheeptrack and slope, or upper and lower hillsides, the averaged harvest values are presented.

SHEEP REQUIREMENTS

The mineral requirements of the sheep were determined from data collected from nutrition balance studies, slaughter experiments and radiosotope investigations. The data on the P requirements for maintenance (Grace 1980a 8b) as well as the Ca, P, Mg and Na requirements for growth were obtained from sheep receiving fresh herbage (Grace, unpublished). Other data were obtained from overseas studies where the sheep were fed hay or concentrate-type diets (Agricultural Research Council 1980). Much of this information is unavailable for the trace elements such as Fe, Mn, Se, I, Co and Mo and therefore their requirements for pregnancy, lactation and growth were not estimated.

TABLE 1: THE DAILY DIETARY REQUIREMENTS OF DRY MATTER (kg/d), Ca, P, Mg AND Na (g/d) FOR MAINTENANCE, PREGNANCY, LACTATION AND GROWTH OF SHEEP.

	Dry Matter	Ca	P	Mg	Na
Maintenance: 45kg ewe	0.9	1.5	1.3	0.9	1.3
Flushing: 45kg ewe gaining 0.1 kg/day	1.4	2.8	1.8	1.1	1.4
Early pregnancy: 45kg ewe	0.9	1.5	1.3	0.9	1.3
Late pregnancy: 45kg ewe	1.4	3.0	2.0	1.4	1.4
Lactation: suckling single	2.0	3.6	3.2	1.9	1.7
Lactation: suckling twins	2.9	6.0	5.4	2.9	2.1
Lamb: 20kg gaining 0.15 kg/day	1.3	3.0	1.9	0.7	0.75
Hogget: 35kg gaining 0.1 kg/day	1.2	2.2	1.4	0.8	1.1

The Ca, P, Mg and Na dietary requirements for maintenance, pregnancy, lactation and growth of sheep, presented in Table 1, were calculated from the amounts excreted in the urine, secreted into the digestive tract, accumulated in tissues during growth and foetal development and excreted in milk. The fraction of the ingested mineral element which is absorbed was taken as 0.6 for Ca and P, 0.17 for Mg and 0.9 for Na (ARC 1980).

RELATING PASTURE MINERAL SUPPLY AND ANIMAL REQUIREMENTS

A hill country pasture producing 10,500kg DM/ha/year, with seasonal maxima in the spring and autumn (Lancashire 1977) was matched with a stocking rate of 10.5 ewe equivalents (9 ewes and 2 hoggets) per hectare. The pasture mineral supply (g/ha/day) of Ca, Mg, P and Na was calculated from the average monthly pasture production (Lancashire 1977) and the mineral

FIG. 1: Element concentrations (% or mg/kg/ D W) in pasture samples plucked from a *se/* stocked hillside pasture. Average values at each harvest are shown where overall site averages did not differ significantly ($P < 0.05$). Vertical bars represent the LSD for harvest values.

composition for that month (Fig. 1). The mineral intake of the sheep (g/ha/day) was calculated as the product of the amount of pasture needed to meet their energy requirement for maintenance, pregnancy, lactation or growth (Rattray 1978), the mineral element concentrations in the pasture and the stocking rate. The mineral requirements of the sheep (g/ha/day) were calculated as the product of the daily requirement of a sheep and the stocking rate.

RESULTS AND DISCUSSION

SEASONAL VARIATION OF MINERAL-ELEMENT CONCENTRATIONS

The concentrations of the elements determined varied significantly ($P < 0.05$) with harvest time (Fig. 1). The ranges of monthly averages are shown below for samples taken from sheeptracks or slopes, or upper or lower hillsides, where the overall means of these differ significantly ($P < 0.05$). The macroelement concentrations were (%DM) organic N(2.0-5.0), Ca(0.2-0.7), Mg(0.1-0.24), P(0.2-0.4), Na(0.07-0.22), K(1.2-3.0), Cl(0.6-1.2), Si(0.5-1.5). Trace elements concentrations were (mg/ kg): Fe(400-3000), Mn(110-430) Zn(25-70) and Cu(5-10). All except Cl and Cu showed marked season trends. Nitrogen and P contents were highest in late autumn and in the early spring. The concentrations of K and Na were lower in the summer while the Ca and Mg concentrations were lowest in the late winter. Iron concentrations were highest in late winter and early spring, probably as a result of soil contamination. Manganese tended to be higher in the autumn and Zn peaked in the late autumn. Plant silicon concentrations were lowest in the spring and the late autumn. The seasonal changes observed were similar for pasture from sheeptracks and slopes, or upper and lower hillsides and are similar to those reported by Metson & Saunders (1978) for grasses. The changes are sufficiently large that at least four samplings in the spring, summer, autumn and winter would be required to establish the mineral composition of the pasture.

Nitrogen, P, and K concentrations were higher, and Ca was lower in herbage from sheeptracks compared with the slopes (Fig. 1). Such differences are similar to those found for grasses receiving urine (Metson & Saunders 1978; Joblin & Keogh 1980). Differences between upper and lower hillsides for Mn, Na, Cl and Cu indicate the importance of persistent local site effects on the pasture content of these elements.

THE MINERAL REQUIREMENTS OF SHEEP

The values of the dietary requirements (g/day) of grazing sheep are shown in Table 1.

The requirements for lactations are between two and four times that for maintenance, as milk contains considerable quantities of Ca, P, Mg and Na. Likewise the requirements for growth of some minerals are high and in the case of Ca and P, each 0.1 kg gain in body weight requires 1.1g Ca and 0.6g P.

EQUATING PASTURE MINERAL SUPPLY AND ANIMAL REQUIREMENTS

The amounts of Ca, P, Mg and Na (g/day) supplied by a hectare of pasture over a year, the amounts ingested with an adequate dry matter intake and those required over a year by 9 ewes and 2 hoggets grazing one hectare are presented in Fig. 2.

FIG. 2: The amounts (g/ha/day) of calcium, phosphorus, magnesium and sodium supplied by hillside pasture and ingested or required by grazing sheep.

The P profiles show that the P requirements of the sheep were met throughout the year even when the lowest pasture concentration was 0.2% DM. In the case of Ca and Mg, the sheep's requirements were met from pasture for most of the year. However in June and July, when the concentrations of Ca(0.21%) and Mg(0.11%) were lowest, the pasture only just met the sheep's demands for Ca and Mg. For Na, the pasture barely met requirements in February and not in June or July when the concentration fell below 0.1% and pasture intakes were barely sufficient to meet energy requirements. Further, in contrast to Ca and P for which there are reserves in

bone, the sheep's reserves of Na are very small so that short periods (i.e. 2-4 weeks) of Na insufficiency but not Ca and P insufficiency could affect the sheep's performance.

SOIL INGESTION

During the winter, grazing sheep can ingest large amounts of soil (200-300g/day, Healy 1972), but little is known about the effect of this ingestion on the absorption of Ca, P, Mg and Na. However, when sheep were given Egmont brown loam (N 129/721342) and Waikiwi silt loam (S 177/607123) with dried grass, the apparent absorption of Ca and Mg were increased somewhat but that of Na and K was unchanged (Grace and Healy 1974).

CONCLUSIONS

Marked changes in mineral concentrations were shown to occur on one farm such that mineral supply from pasture at certain times of the year did not meet estimated requirements of the sheep for all macroelements.

It is considered that this could occur in many farming situations and perhaps result in reduced animal performance.

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