## MINERAL CONTENT OF PASTURES INVESTIGATION AT THE CAWTHRON INSTITUTE, NELSON, N.Z.

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Communicated by H.O. Askew.

Work on the mineral content of pastures at the Cawthron Institute commenced in 1928, when a survey of the pastures of the Waimea County, *Nelson,* was undertaken.

In this County, there is a large Variety of soil types, some fertile and some relatively infertile, Chemical examinations of green growth from the different pastures showed that the best pastures were associated with soils normally considered fertile and that the pastures with the best reputations among stock-men were highest in their contents of minerals.

The analyses of a series of samples of, green pasture growth collected in the early autumn showed that Nelson pastures, considered satisfactory by stock-men, differed in several respects from the English cultivated pastures analysed by Godden of the Rowett Institute. In the Nelson pastures the phosphoric acid content was very much, higher than that of the lime, a reverse order to that found by Godden. In all cases, also the potash, chlorine, nitrogen, total- ash and soluble ash were greater than Godden's average figures. One striking result was the high percentage of crude protein found in these New Zealand pastures. The percentages outstrip the English figures, in one case reaching practically 36 percent. The main floral constituents of the Nelson pastures were perennial ryegrass and white clover, a mixture considered ideal for pastures.

The extremes of soil fertility, as judged by the conventional methods of soil analysis, were not reflected so markedly in the pasture analyses; above a certain fertility level, comparatively little difference in the chemical composition of good pasture types was found.

## OCCURRENCE OF EANTHIN CALCULI IN THE KIDNEYS OF SHEEP.

An interesting development of the pasture survey was the discovery that over a large area of country, known as the Moutere Hills soil type, xanthin calculus formation in the kidneys of sheep was more or less common. The trouble was greatest on farms where pastures were greatly deteriorated. On better farms located on this soil type the occurrence of xanthin calculi was uncommon.

Analyses of pasture samples from different farms on the Moutere Hills showed that where xanthin calculus trouble was common, the percentages of lime, phosphoric acid and protein were very low. Topdressing of the pastures with lime and phosphate greatly improved the health and rate of growth of sheep, and reduced the incidence of calculus, trouble.

## BUSH-SICKNESS.

In the Glenhope district, an ailment of sheep apparently identical with "bush-sickness" has been known for some time. Sheep in particular, go off rapidly in condition and frequently die within four months when their grazing is restricted to particular areas. Administration of ferric ammonium citrate caused a rapid recovery in the health and condition of the sheep.

An examination of pasture samples from "healthy" and "unhealthy" areas at Glenhope did not reveal any striking differences in the chemical composition which would explain the occurrence of "bush-sickness" on one pasture and not on others. The percentage of iron in the pasture samples - carefully picked so as to prevent contamination with soil - was approximately the same for both healthy and unhealthy types.

A comparison of soil samples taken from the unhealthy granite soil at Glenhope with those of typical "bush-sick" farms in the North Island, showed that in every case the percentage of iron extracted by weak acid (5% oxalic) was very low, Healthy soils differed from "bush-sick" soils in a much higher content of iron soluble in dilute acid. Much evidende has been obtained. pointing to the probability that iron compounds of the soil ingested by stock as a result of the contamination of the pastures with soil, forms on healthy soils an important part of the iron requirements of stock. On "bush-sick" soils the amount of iron provided for use by stock is probably much lower, owing to the relatively small amount of available soil iron compounds.

## INFLUENCE OF SEASON AND FERTILIZER ON THE YIELD AND COMPOSITION OF NELSON PASTURES.

Much time has been devoted to a careful study of the effect of season and manurial treatment on the yield and chemical. composition of different Nelson pastures. The experiments have shown the great importance of climatic conditions -in determining yield of pasture at different periods of the year. In the Nelson district cold temperature greatly curtails pasture production during the whole of the period commencing in the middle of April and extending to the middle of September. During June and July production of pasture is practically at a standstill even although liberal manurial treatment has been given .

Drought has a pronounced effect not only on pasture yield, but cm chemical composition. Low percentages of phosphoric acid and nitrogen in pasture grass invariably accompanied droughty soil conditions.

## USE OF NITROGENOUS MANURES.

A number of experiments has been instituted in order to, ascertain the effect of nitrogenous manures on both yield and chemical composition of different Nelson pastures.

In one experiment a comparison of the effect of the following nitrogenous manures has been made:- Sulphate of ammonia, sulphate of ammonia plus ground limestone, nitro-chalk, and calnitro, The manures were applied at the rate of 1 cwt. per- acre on three occasions during the season. The plots, replicated ten times, received a base treatment of superphosphate and sulphate of potash. The yield of dry matter for the whole season was 4,100 lb. (approx.) per acre for plots-receiving solely the base treatment with super. and potash. The following increases in dry matter production resulted with the different nitrogenous manures:- Sulphate of ammonia and calnitro.each 400 lb. dry matter per acre; sulphate of ammonia and ground limestone 350 lb. per acre, and nitro-chalk 230 lb, per acre.

The increases in dry matter production from the three'applications of the nitrogenous manures varied considerably. The best result was obtained from the spring application. The poorest increase resulted from the summer application. Ammonium sulphate gave the greatest increase under good rainfall, but calnitro and nitro-chalk showed to advantage when dry weather followed the topdressing of the plots. The above results were obtained on a good rye and clover pasture located on a heavy loam at Appleby.

In another experiment much detailed work has been done. concerning the effect of both season and fertilizer on yield and pasture composition (See Bull.26 Dept.S.I.R.). In continuation of these studies, the effect of single and repeated applications of ammonium sulphate has been under close observation. In certain cases as many as five applications of ammonium sulphate at the rate of 1 cwt. per acre were made. On other plots,. five applications of ammonium sulphate were made at the rate of 2 cwt. per acre.

The yield data from the plots showed that the value of ammonium sulphate for increasing pasture production was dependent on a number Of factors, among which might be mentioned: (1) The past manurial history of the pasture, (2) Rate and frequency of ammonium sulphate applications; (3) Time of application of ammonium sulphate. (4) Climatic conditions.

By far the best return from the use of ammonium sulphate was obtained from those plots where an application of nitrogenous manure at the rate of 1 cwt. per acre was made each spring during the last six years. The following figures concerning yield of pasture under particular manurial treatment show the very large increases which have been obtained by the regular use of 1 cwt. per acre of nitrogenous manure.

| Treatment per acre. | Production of dry matter lb. per acre. |
|---|---|
| Untreated .... | 4303 |
| Ammonium Sulphate 1 cwt. | 4988 |
| Superphosphate 2 cwt. | 4579 |
| Superhosphate 2 cwt.) Ammonium Sulphate 1 cwt) | 5203 |
| Superphosphate 2 cwt. Sulphate of potash ½ cwt. | |
| Ammonium sulphate 1 cwt. Superphosphate 2 cwt. Sulphate of potash ½ cwt. )* | 5448 |

Note: Previous to 1928 nitrate of soda was used instead of ammonium sulphate.

* Previous to present season received, in addition, 1 cwt. per acre of nitrogenous manure.

While the use of superphosphate has given a very small increase of only 276 lb. of dry matter per acre, ammonium sulphate shows an increase of over 680 lb. of dry matter. The highest yield was obtained from plots where the complete treatment consisting of super., potash and nitrogen was used. Previous experiments (Bull.26, Dept.S.I.R.,) have shown the great importance of potassic manures in maintaining pasture production on this soil type.

Although single applications of ammonium sulphate applied over a period of consecutive years have given notable increases in yield, the increase in dry matter resulting from five applications during the season of ammonium sulphate has not been so great per 1 cwt. of ammonium sulphate applied as that resulting from a single application. The past manurial treatment of the plots has proved an important factor in determining the magnitude of increase in dry matter production where a number of applications of ammonium sulphate has been made during the season. On plots formerly untreated, 4 cwt. of ammonium sulphate gave an increased yield of 871 lb. of dry matter per acre. The same quantity of ammonium sulphate applied to plots receiving a complete manure gave an increase of 589 lb. of dry matter. Plots formerly receiving superphosphate only gave an increase of 601 lb. of dry matter, while plots formerly receiving nitrogenous manure only, gave an increase of 1023 lb. of dry matter per acre.

One interesting feature connected with the use of ammonium sulphate was the marked response in growth of grasses, particularly perennial rye, and a suppression of clovers and broad-leaved weeds. This reduction, in the percentage of clovers and weeds was perhaps most noticeable on the plots which in the past had received no treatment. On these plots clovers and trefoil were always very conspicuous during mid-summer and autumn, and on this account suppression, where frequent applications of ammonium sulphate were made, could be more easily seen.

A botanical separation of hay crops cut from the plots which had been treated with ammonium sulphate during the previous season showed that the use of this fertilizer had very materially affected the flora. Some of the more striking features of these botanical separations are shown below.

EFFECT OF AMMONIUM SULPHATE ON BOTANICAL COMPOSITION OF HAY.

| Treatment | Grasses. | Cloven, | Weeds. |
|---|---|---|---|
| Untreated | 65.4 | 25.5 | 9.1 |
| Untreated plus repeated applications of nitrogen | 91.2 | 5.6 | 3.2 |
| Nitrogen, single application | 60.5 | 20.3 | 19.2 |
| Nitrogen, repeated applications | 92.5 | 4.9 | 2.6 |
| Superphosphate and potash | 75.0 | 25.5 | 5.2 |
| Super. and potash plus one application of nitrogen | 89.7 | 18.7 | 6.3 |
| Super. and potash plus repeated applications of nitrogen | 62.9 | 6.4 | 3.9 |
| Superphosphate alone | 90.5 | 24.5 | 12.6 |
| Super. plus repeated applications of nitrogen | | 6.3 | 3.2 |

The data in the table show that even with one application of ammonium sulphate at the rate of 1 cwt. per acre, the percentage of clovers in the produce is definitely lowered. Where five applications of ammonium sulphate were made in the previous season, the reduction in clovers and weeds is very marked and a great increase in percentage of grasses has taken place. The past manurial treatment of the plots has had little influence on clover suppression where repeated applications of ammonium sulphate have been made.

Chemical analyses of pasture samples from plots with different manurial treatment have shown increased amounts of lime, phosphate, potash and nitrogen when appropriate manures containing these plant foods have been used. In every case the analyses of pasture samples have shown the important effect of climatic conditions on the composition of the pasture. During drought periods nitrogen, phosphoric acid, potash and soluble ash percentages in the dry matter fell to low figures, while the lime content was markedly increased. At the end of the season when autumn rains came a growth of pasture rich in nitrogen was obtained, this being especially marked on plots where, owing to lack of moisture during the summer, the heavy dressings of sulphate of ammonia had not had an opportunity of exerting their full effect. During the greater part of the summer heavy dressings of ammonium sulphate did not increase the nitrogen content of the pasture. The relative percentage of lime in the treated pastures fell after-each application of ammonium sulphate, no doubt due to the depression in the percentage of clovers in pasture growth.