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DIAGNOSIS OF PHOSPHORUS DEFICIENCY IN GRAZING BEEF CATTLE

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SUMMARY

The phosphorus concentrations in the faeces of beef cattle grazing on low-phosphorus soils were low compared with those in faeces of cattle grazing on high-phosphorus soils. Cattle on one property with low-phosphorus soils exhibited symptoms of phosphorus deficiency. Blood inorganic phosphorus concentrations were generally of similar magnitude between properties.

Introduction

Malan, Green, and du Toit (1928) reported that cattle grazing on pastures of low phosphorus content had low concentrations of inorganic phosphorus in their blood, but only some of these cattle exhibited deficiency symptoms. Watkins and Knox (1948) reported very low inorganic phosphorus concentrations in the blood of apparently healthy cattle, but their data suggest that the dietary phosphorus intakes were low. There was also an indication that reproduction of the cattle may have been impaired. O'Moore (1952) found that deficiency symptoms persisted in cattle long after the blood inorganic phosphorus concentrations had risen in response to dietary phosphorus supplementation. All of these observations indicate that blood inorganic phosphorus concentration is more closely related to phosphorus intake than to the phosphorus status of cattle.

Theiler and Green (1932) referred to very low inorganic phosphorus concentrations in the blood of cattle which had pronounced symptoms of phosphorus deficiency. Unpublished data from the Biochemical Laboratory, Queensland Department of Primary Industries indicate that in severe deficiency, inorganic phosphorus concentrations in the blood of cattle grazing on phosphorus-deficient soils frequently fall to levels as low as 1 mg P per 100 ml whole blood. Even though very low inorganic phosphorus concentrations in blood may not always be associated with gross symptoms, they could be expected to be associated with low phosphorus intakes. These, if persistent, could lead to symptoms of phosphorus deficiency.

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The only investigations of the relationship between blood inorganic phosphorus concentrations and total phosphorus intakes have been made with hand-fed cattle. It is not possible to directly determine the phosphorus intake of cattle kept under extensive grazing conditions, but an indirect approach is to analyse faeces. Faecal phosphorus concentration has been shown to be related to pasture phosphorus concentration, and from statistical data presented by Moir (1960*b*), in which an overall relationship was estimated by component analysis, it is calculated that 76% of the variation in faecal phosphorus concentration could be accounted for by variation in pasture phosphorus concentration. Further, Moir (1960*e*) showed that inferences about the total phosphorus intake could be made from a knowledge of faecal phosphorus and faecal protein concentrations.

The objective of the present investigation was to assess the value of blood, faecal and soil analyses as aids in diagnosing suspected cases of phosphorus deficiency in grazing beef cattle.

Methods

The phosphorus and protein concentrations in organic-matter faeces of cattle grazing native or unimproved pasture on four beef properties in Queensland were determined on samples collected from 6–10 animals at fortnightly or monthly intervals, using the methods of sampling and analysis described by Moir (1960*a*, 1960*b*). Blood samples were taken from the same animals whose faeces were sampled on three of these properties and blood inorganic phosphorus was determined by the method of Moir (1954). The method for determining available soil phosphorus was based on the extraction of soil samples with 0·01N sulphuric acid followed by colorimetric estimation of extracted phosphorus.

TABLE 1

SOIL AND FAECAL PHOSPHORUS CONCENTRATIONS

Property*	Available Soil P (p.p.m.)	Year	Mean Percentages of P in Organic-matter Faeces			
			Jan. to Mar.	Apr. to June	July to Sept.	Oct. to Dec.
A	18	1963	..	0·26	0·18	0·27
		1964	0·42	0·29	0·19	..
B	16	1964	..	0·30	0·21	0·37
		1965	0·33	0·27	0·22	..
C	99	1964	0·65	0·52	0·44	0·63
D	100	1961	0·70	0·44	0·37	0·76

* Property A—Bohle River, Townsville.

Property B—Swan's Lagoon Cattle Field Research Station, Millaroo.

Property C—Animal Husbandry Research Farm, Brisbane.

Property D—" Brian Pastures " Pasture Research Station, Gayndah.

Results and Discussion

Table 1 gives the mean phosphorus concentrations in organic-matter faeces for 3-monthly periods, together with the concentrations of available phosphorus in the soils. Soil and faecal phosphorus concentrations are of similar magnitude between properties C and D. These levels are high and no symptoms of phosphorus deficiency were observed on either of these properties. Soil and faecal phosphorus concentrations on properties A and B are low relative to those on the other properties and deficiency symptoms were observed in cattle on property A. Craven (1964) reported osteophagia and botulism in cattle from property A and showed that phosphorus supplementation reduced the incidence of botulism. Theiler and Green (1932) suggested that osteophagia in the absence of gross symptoms was probably associated with deficiency in its early stages and it is therefore likely that the phosphorus deficiency on property A was of a comparatively mild degree. The lowest faecal phosphorus concentrations were recorded on property A, and the mean concentrations of 0·18 and 0·19% P in organic-matter faeces recorded in the July to September period in 2 years on property A may reflect pasture phosphorus concentrations which were just below the level required by these cattle to prevent symptoms in the form of osteophagia.

TABLE 2

BLOOD INORGANIC PHOSPHORUS CONCENTRATIONS

Property	Year	Mean Concentrations of Inorganic P in Blood (mg P/100 ml whole blood)			
		Jan. to Mar.	Apr. to June	July to Sept.	Oct. to Dec.
A	1963	..	4·0	3·3	4·2
	1964	4·5	3·9	3·5	..
B	1964	..	3·9	4·4	4·3
	1965	5·1	5·6	3·9	..
C	1964	4·2	4·0	4·3	4·3

Table 2 gives the mean concentrations of inorganic phosphorus in blood for 3-monthly periods on three of the properties. These concentrations do not satisfactorily discriminate between the properties on low and high phosphorus soils. Although the lowest levels were recorded on the property on which osteophagia was observed, these levels are well above those reported by Watkins and Knox (1948) for cattle which did not exhibit deficiency symptoms.

It is concluded that when osteophagia is observed in cattle, soil and faecal phosphorus concentrations, irrespective of the blood inorganic phosphorus concentrations, might serve to distinguish between osteophagia resulting from a dietary phosphorus deficiency and a pica of different origin. When soil and faecal phosphorus concentrations are low there is a distinct possibility that the health of animals might benefit from a phosphorus supplement even when deficiency symptoms are not observed. This would almost certainly be so when the blood inorganic phosphorus concentration is also low.

When faecal analysis is used as an aid in diagnosing suspected field cases of phosphorus deficiency, an additional analysis of faecal protein can provide information on the crude protein percentage and dry matter digestibility of the pasture diet (Moir 1960*e*). Faecal protein concentrations recorded in Table 3 indicate that the crude protein percentages and dry-matter digestibilities of the pasture were generally higher on property A than on properties B and D. Qualitatively, the pasture on property A therefore had a higher potential for production and this in combination with low pasture phosphorus concentration could have been a predisposing factor in the development of phosphorus deficiency symptoms on this property.

TABLE 3

FAECES PROTEIN CONCENTRATIONS

Property	Year	Mean Percentages of Protein in Organic-matter Faeces			
		Jan. to Mar.	Apr. to June	July to Sept.	Oct. to Dec.
A	1963	..	11·7	9·6	9·4
	1964	14·6	11·5	10·0	..
B	1964	..	7·0	7·8	13·8
	1965	12·6	8·7	8·2	..
C	1964	12·6	12·8	14·2	18·9
D	1961	12·0	8·6	6·7	14·5

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