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INCREASE IN AVAILABLE SOIL PHOSPHORUS AT DEPTH IN SOME NORTH QUEENSLAND KRASNOZEMS

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SUMMARY

Lack of response to phosphate application of an established pasture on a soil with a low surface content of available phosphorus is attributed to the high content of available phosphorus at greater depth.

Experimental work on pasture topdressing on a North Queensland krasnozem soil derived from basalt produced anomalous results. In field trials with superphosphate on a soil carrying an 11-year-old, previously unfertilized pasture of guinea grass (*Panicum maximum* Jacq. var. *typica)* and centro (*Centrosema pubescens* Benth.), three harvests over 6 months failed to show any yield increases due to the applied fertilizer (B. Grof, unpublished data). This was surprising in view of the age of the pasture, the low value for "available" phosphorus in the surface 6 in. of soil (7 p.p.m. P), and the fact that large responses to superphosphate (Table 1) had been obtained with guinea grass and legumes in a pot trial with a similar soil.

Analyses of plant tops from each of the three harvests of the field trial (Table 2) showed the phosphorus content of unfertilized grass and legume plants to be 0·16 to 0·21%. As Vincente-Chandler *et al.* (1964) considered that a content of about 0·17% P in 60-day-old grass indicated an adequate supply of phosphorus for optimum growth, the North Queensland analyses showed that the plants were reasonably well supplied with soil phosphorus. A trend towards increasing phosphorus content of both grass and legume with increase in applied phosphorus suggested that the added phosphorus was available to the plants.

TABLE 1

DRY-MATTER YIELDS OF LEGUME SEEDLINGS GROWN IN POTS WITH ADDED PHOSPHORUS FERTILIZER

Applied P (lb/ac)	Dry-matter Yield of Legume (g/pot)
0	3·160
22	6·416
44	8·779
Necessary differences for significance	0·882 (5%)
	1·178 (1%)

TABLE 2

PHOSPHORUS CONTENT (% P) OF PLANT TOPS AT THREE HARVEST DATES

Cut No.	Species	Rate of Application (P lb/ac)				
		0	20	40	60	80
1	Guinea grass ..	0·17	0·22	0·26	0·27	0·30
	Centro	0·17	0·20	0·21	0·21	0·22
2	Guinea grass ..	0·17	0·21	0·24	0·27	0·28
	Centro	0·21	0·22	0·24	0·23	0·26
3	Guinea grass ..	0·16	0·23	0·22	0·23	0·24
	Centro	0·19	0·21	0·21	0·22	0·22

Since the pasture was vigorous and high-yielding (5 tons dry matter per acre in 6 months), and no soil deficiencies other than nitrogen and phosphorus had been shown in the krasnozems, it was concluded that lack of yield response to the application of superphosphate could be attributed only to the plants being adequately supplied with available phosphorus from the soil.

This was tested by analysing the soil of the experimental site to a depth of 38 in. The results shown in Table 3 indicate that available soil phosphorus as measured by extraction with 0·01N H_2SO_4 increases with depth.

TABLE 3

ANALYSES OF SOIL FROM THE EXPERIMENTAL SITE

Depth (in.)	pH	Available Phosphorus (p.p.m. P)	Total Nitrogen (N%)	Carbon (W and B) (C%)	Exchangeable Potassium (K^+m-equiv. %)
0–6	5·6	7	0·291	3·09	0·55
6–12	5·6	9	0·145	1·38	0·29
12–18	5·3	13	..	..	0·24
18–30	5·0	18	0·056	..	0·27
30–38	5·1	21	..	..	0·21

This suggests that established plants with an extensive root system are capable of exploiting the deeper reserves of phosphorus. In this connection, Nye and Foster (1961) have shown that perennial grasses in natural grassland in Ghana may derive over 30% of their phosphorus from below the 10-in. layer of soil, and Pereira (1953) showed that almost half the total weight of elephant grass roots in the Kikuyu red loam may be deeper than 12 in.

Limited sampling of krasnozems in the South Johnstone district of North Queensland (Table 4) suggests that increase of phosphorus content with depth is not uncommon and that the available phosphorus content at 30-36 in. may be as much as three times that in the top 6 in.

TABLE 4

AVAILABLE SOIL PHOSPHORUS (p.p.m. P) MEASUREMENTS IN SOME NORTH QUEENSLAND KRASNOZEMS
0·01 N H_2SO_4 extract

Depth (in.)	Site Number						
	1	2	3	4	5	6	7
0–6	4	7	7	13	13	18	11
30–36	10	15	21	41	24	17	14

In soils showing this phosphorus distribution, a better understanding of the relationship between soil analytical data and plant growth would result from the analysis of both surface and subsoil samples.

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