

Studies on the Nutrient Status of some Coconut Soils in Ceylon

5. The " Lateritic Gravel " on Mattegoda Estate (B) Optimum requirements of deficient nutrients

K. SANTHIRASEGARAM AND D. E. F. FERDINANDEZ

Coconut Research Institute, Lunuwila

(Received September, 1966)

I N T R O D U C T I O N

IN an earlier publication in this series Santhirasegaram *et al.*, (1965) reported results of preliminary studies on the nutrient status of the lateritic gravel at Mattegoda. It was shown that the soil was deficient in nitrogen, phosphorus, potassium, calcium, magnesium and boron. It is now standard practice to recommend the application of nitrogenous fertilizers in small and frequent doses. The present paper deals with the optimum requirements of the other deficient major nutrients. The minor nutrient, boron, which was also found to be deficient, is not dealt with as experience has shown that an application of three to six pounds of borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$) per acre would be adequate for optimum growth of plants.

The general technique and procedure followed in these experiments were similar to those with the preliminary experiments and have been fully described by Paltridge and Santhirasegaram (1957).

E X P E R I M E N T S

Experiment 1.—Optimum requirements of Phosphorous and Potassium

This was a 4^2 factorial of four levels of P(Nil, $\frac{3}{4}$, $1\frac{1}{2}$ and 3 cwt./ac $\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$) and four levels of K(Nil, $\frac{3}{4}$, $1\frac{1}{2}$ and 3 cwt./ac K_2SO_4) with two replicates of all treatments planted with *Paspalum commersonii*. A basal application of calcium carbonate (5 cwt./ac), magnesium sulphate ($\frac{1}{2}$ cwt./ac) and ammonium sulphate (5 cwt./ac) were applied at the time of planting. The experiment was harvested on one occasion.

Experiment 2.—Optimum requirements of Phosphorus, Potassium and Magnesium.

This was a 4^3 factorial experiment with four levels of P and K (Nil, 2, 4 and 6 cwt./ac) as $\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$ and K_2SO_4 respectively, and 4 levels of Mg (Nil, $\frac{1}{2}$, 1 and $1\frac{1}{2}$ cwt./ac) as $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ with two replicates of all treatments planted with *P. commersonii*. Nitrogen (5 cwt./ac. $(\text{NH}_4)_2\text{SO}_4$) and calcium (10 cwt./ac. CaCO_3) were applied as basal at time of planting. Half the dosage of nitrogen was reapplied prior to each harvest. The experiment was harvested on two occasions.

Experiment 3.—Optimum requirements of Calcium and Magnesium

This was a 4^2 factorial of 4 levels of Ca (Nil, 5, 10 and 15 cwt./ac. CaCO_3) and four levels of Mg (Nil, $\frac{1}{4}$, $\frac{1}{2}$ and 1 cwt./ac. $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$) with two replicates of all treatments planted with *P. commersonii*. A basal application of nitrogen (5 cwt./ac. $(\text{NH}_4)_2\text{SO}_4$), phosphorus (3 cwt./ac. $\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$) potassium (3 cwt./ac. K_2SO_4) was made at time of planting. Half the dosage of nitrogen was reapplied prior to each harvest. The experiment was harvested on three occasions.

RESULTS

Experiment 1

At the only harvest made with this experiment both phosphorus and potassium increased yields (*Table 1*). There was no interaction between the nutrients. In the absence of phosphorus there was little or no growth, but at the first level of applied phosphorus there was 279% increase in yield. Among the added levels there was an almost linear response (*Fig. 1*). In the case of potassium the differences were less marked, but the pattern of the response curve was similar. In view of these linear trends to relatively low levels of the nutrients, further observations on the experiment were discontinued and *Experiment 2*, with much higher levels of the nutrients were undertaken.

Experiment 2

Both phosphorus and potassium had significant effects and entered into interaction at both harvests (*Table 2*). Magnesium had no significant effect at the first harvest, but was effective at the second harvest and entered into interaction with potassium. The main effects of the three nutrients at the two harvests are shown in *Fig. 2*. As in the previous experiment, there was little or no growth in absence of added phosphate. There was an almost linear response up to 4 cwt./ac. $\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$ and then a tendency of decreasing responses. An almost similar effect was evident with potassium too. Magnesium gave highest response at the first added level ($\frac{1}{2}$ cwt./ac. $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$).

NUTRIENT STATUS OF SOME COCONUT SOILS IN CEYLON

In the interaction of potassium with phosphorous (*Fig. 3*) and magnesium (*Fig. 4*) there was an increase in response with increase in the level of the two nutrients.

Experiment 3

At the three harvests made in this experiment there was an increase in yield from the Nil treatment to the first added level of calcium and magnesium, but the effect did not reach significance. This shows more clearly in the total yield from the three harvests. In the case of calcium there was 21% increase in yield at the first level and then a progressive decrease (*Fig. 5*). Magnesium as in the previous experiment gave increasing yields up to $\frac{1}{2}$ cwt./ac. $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$. The lack of significance was due to considerable variability caused by the attack of some plants by aphids and low error degrees of freedom.

DISCUSSION

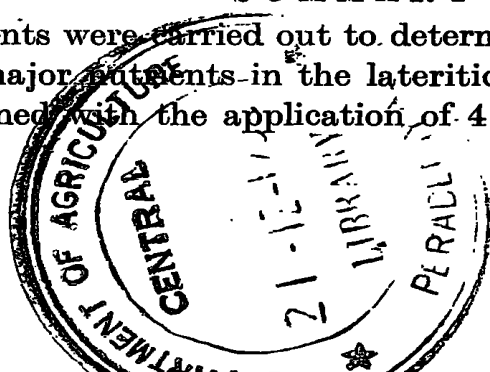
THE three experiments carried out to determine the optimum requirements of deficient major nutrients have shown that an initial application of around 4 cwt./ac. $\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$ and K_2SO_4 would be necessary for proper plant growth in this soil. There would also be a necessity to apply magnesium as $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ (56 lb/ac.) and calcium as CaCO_3 (5 cwt./ac). These were found to be optimum requirements with a basal application of nitrogen as $(\text{NH}_4)_2\text{SO}_4$ (5 cwt./ac.). As already pointed out the optimum level of nitrogen was not tested due to the observation that this nutrient needs to be applied in small and frequent doses.

Other crops in this location (*e.g.* coconuts) would also require application of N, P and K for proper growth. Nethsinghe (1962) has shown that coconut in this soil suffer from magnesium deficiency and application of this nutrient corrected the yellowing of leaves observed and increased yields. That coconut showed foliar symptoms of magnesium deficiency, but *P. commersonii* gave only a relatively small response to magnesium and exhibited no foliar symptoms is of particular interest. It has already been shown that there is a close relationship between the response of the two species to levels of phosphorus and potassium (Santhirasegaram 1964). This would indicate that *P. commersonii*, though still useful as an indicator of magnesium deficiency in soils in relation to coconuts, it is less sensitive to this nutrient.

The calcium and magnesium requirements may be met by the application of dolomite from a long-term point of view.

SUMMARY

Three experiments were carried out to determine the optimum requirements of the deficient major nutrients in the lateritic gravel at Mattegoda. Highest yields were obtained with the application of 4 cwt./ac. $\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$ (P),



4 cwt./ac. $K_2SO_4(K)$, $\frac{1}{2}$ cwt./ac. $MgSO_4 \cdot 7H_2O(Mg)$ and 5 cwt./ac. $CaCO_3(Ca)$. Potassium entered into interaction with phosphorus and magnesium, where the yields increased with increase in the levels of the nutrients.

A C K N O W L E D G M E N T S

The authors wish to record appreciation of the help given by the members of the C. R. I. Division of Agrostology in maintaining and recording the experiments. The figures were drawn by Mr. R. M. Dayaratne and the typescript was prepared by Miss H. Jayasinghe.

R E F E R E N C E S

- (1) NETHSINGHE, D.A. (1962) Rept. Soil Chemist, C.R.I., *C.C.Q.* XIII.
- (2) PALTRIDGE, T. B., and SANTHIRASEGARAM, K. (1957) *C.R.I. Bull.* II.
- (3) SANTHIRASEGARAM, K. (1964) 2nd F.A.O. Conf. Coconut Prod. Proct. Process, Colombo, December, 1964. *ct. 16/64.*
- (4) SANTHIRASEGARAM, K., FERDINANDEZ, D. E. F., and RAJARATNAM, D. T. (1965) *Tropical Agriculturist* 121 : 43-54.

NUTRIENT STATUS OF SOME COCONUT SOILS IN CEYLON

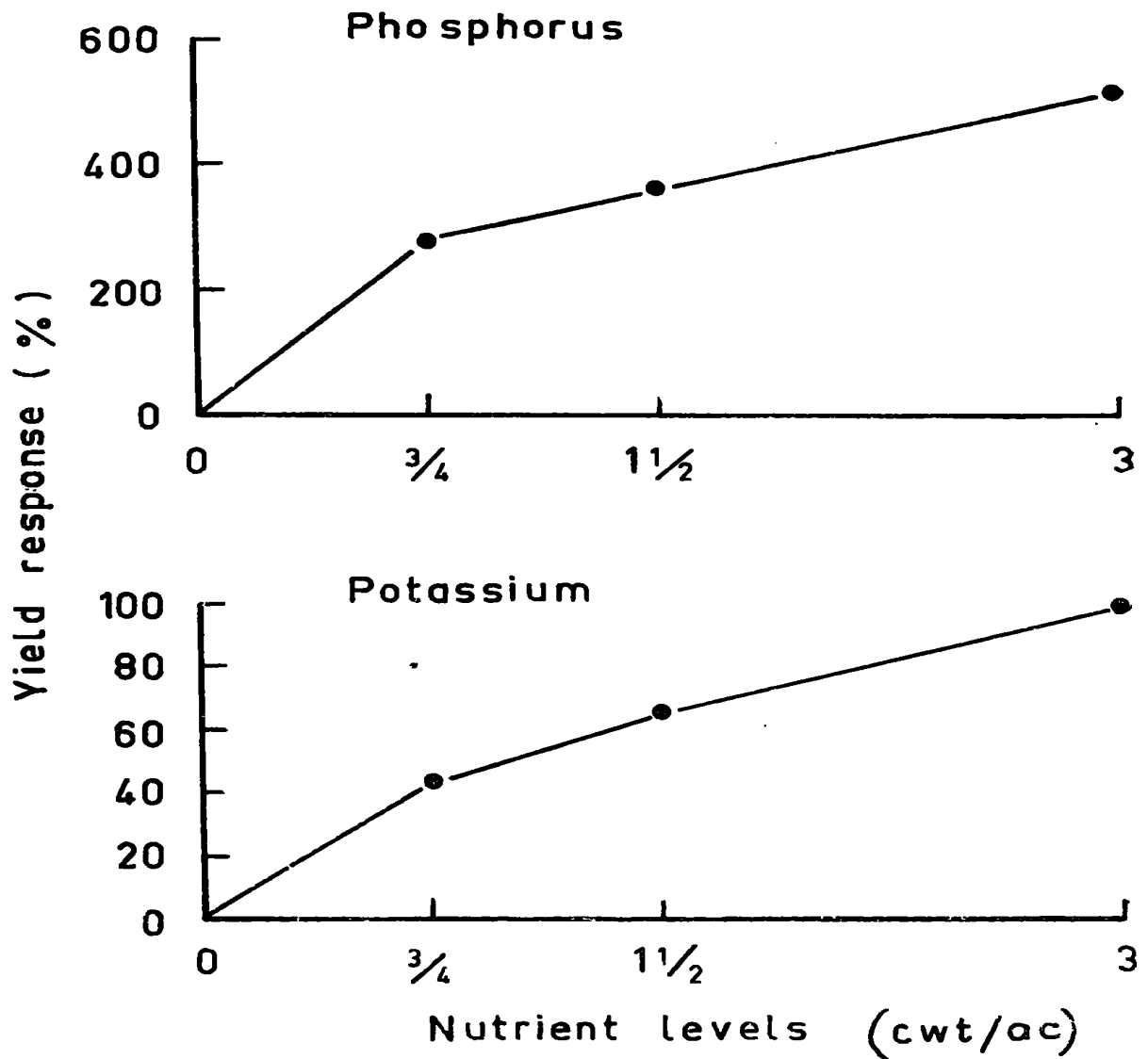
TABLE 1.—Dry matter yield (g/plant) of *P. Commersonii* to levels of phosphorus and potassium

Nutrient levels (Cwt./ac.)	P	K
0	0.71	1.90
3/4	2.69	2.72
1½	3.27	3.16
3	4.40	3.79
L.s.d. 5%	1.27	

TABLE 2.—Summary of statistical analysis of Experiment 2

Treatment	d.f.	M.S.	V.R.	Level of Sig. (%)
P	3	134.40	243.88	0.1
K	3	20.56	37.50	0.1
Mg	3	0.45	0.81	N.S.
Har. 1 PK	9	3.56	6.46	0.1
PMg	9	0.64	1.17	N.S.
KMg	9	0.48	0.86	N.S.
PKMg	27	0.25	0.45	N.S.
P	3	55.82	146.89	0.1
K	3	53.09	139.71	0.1
Mg	3	2.57	6.76	0.1
Har. 2 PK	9	6.36	16.74	0.1
PMg	9	0.48	1.26	N.S.
KMg	9	0.82	2.16	5.0
PKMg	27	0.30	0.79	N.S.

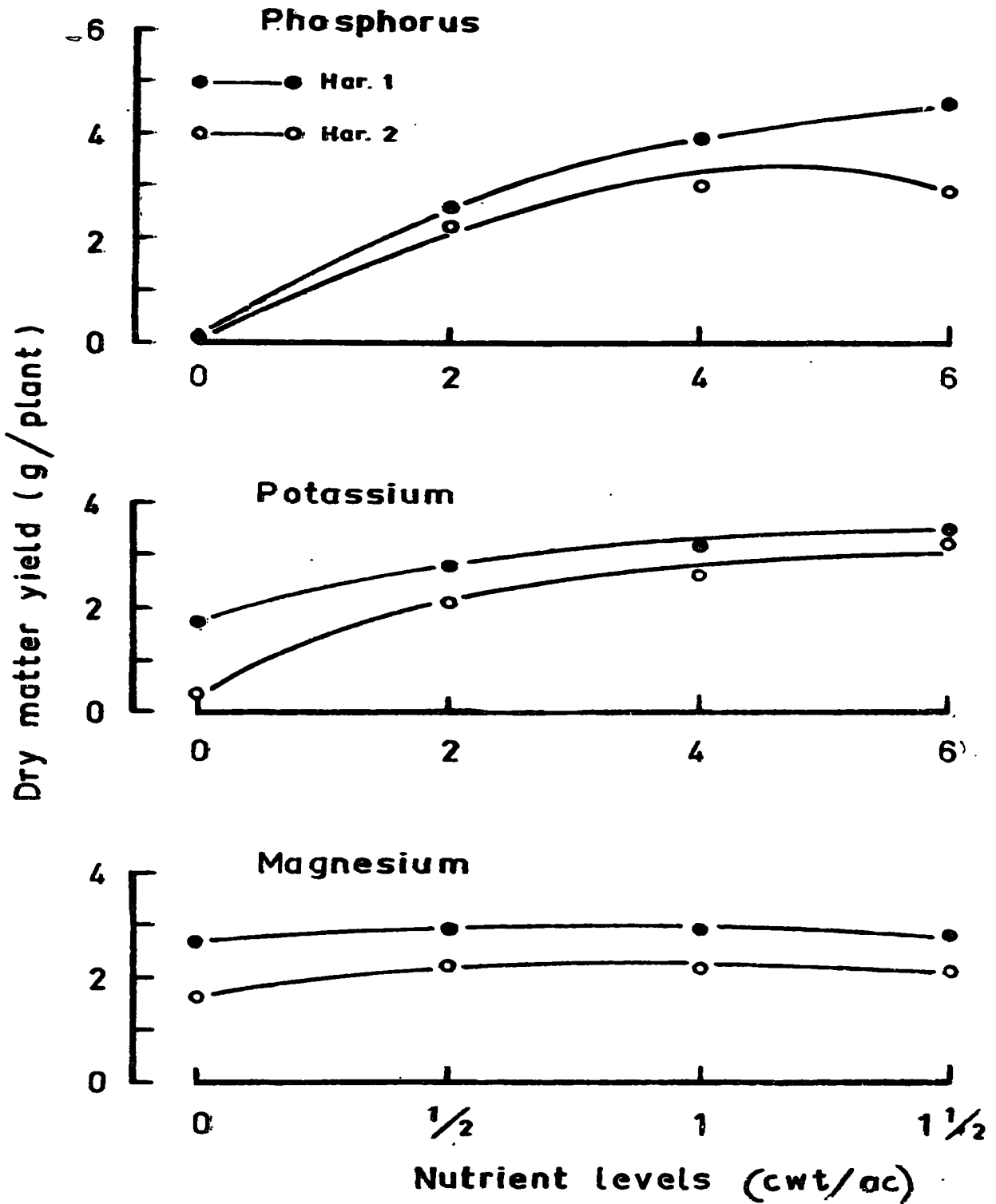
Fig. 1



Yield response (%) of *P. commersonii* to levels of phosphorus and potassium in *Experiment 1*.

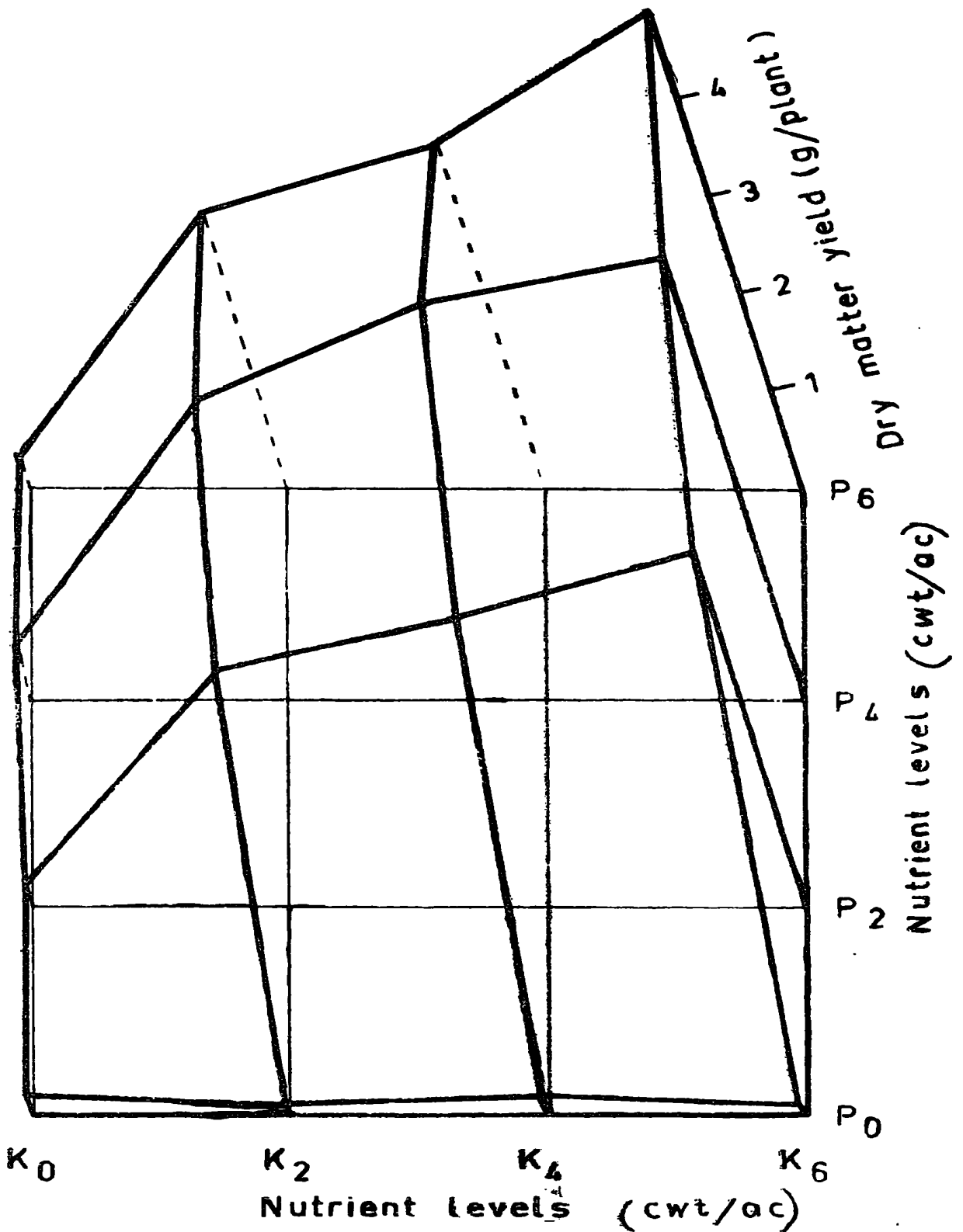
NUTRIENT STATUS OF SOME COCONUT SOILS IN CEYLON

Fig. 2



Dry matter yield of *P. commersonii* to levels of phosphorus, potassium and magnesium at the two harvests of *Experiment 2*.

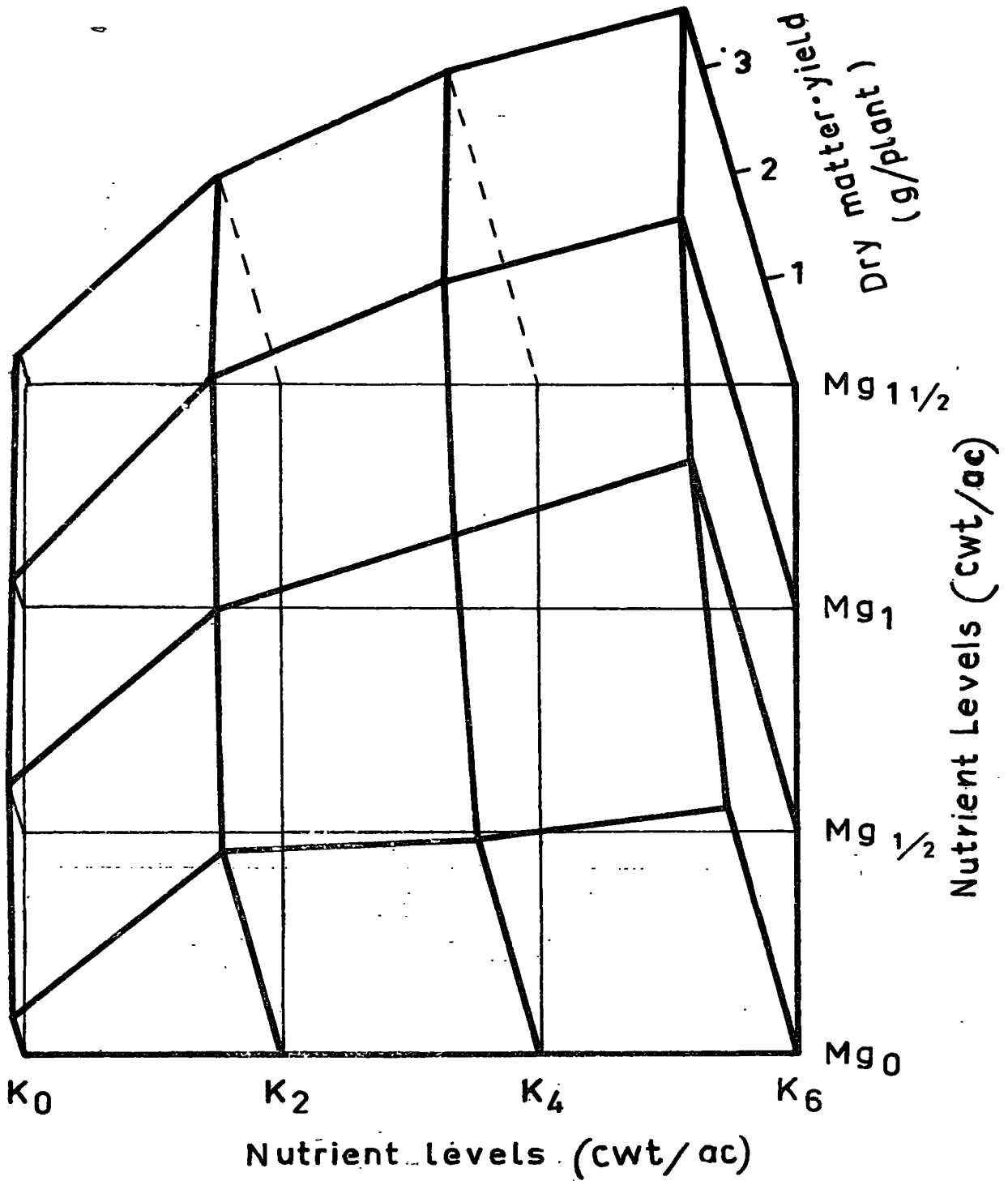
Fig. 3



Dry matter yield of *P. commersonii* at all combinations of levels of potassium and phosphorus at the second harvest of *Experiment 2*.

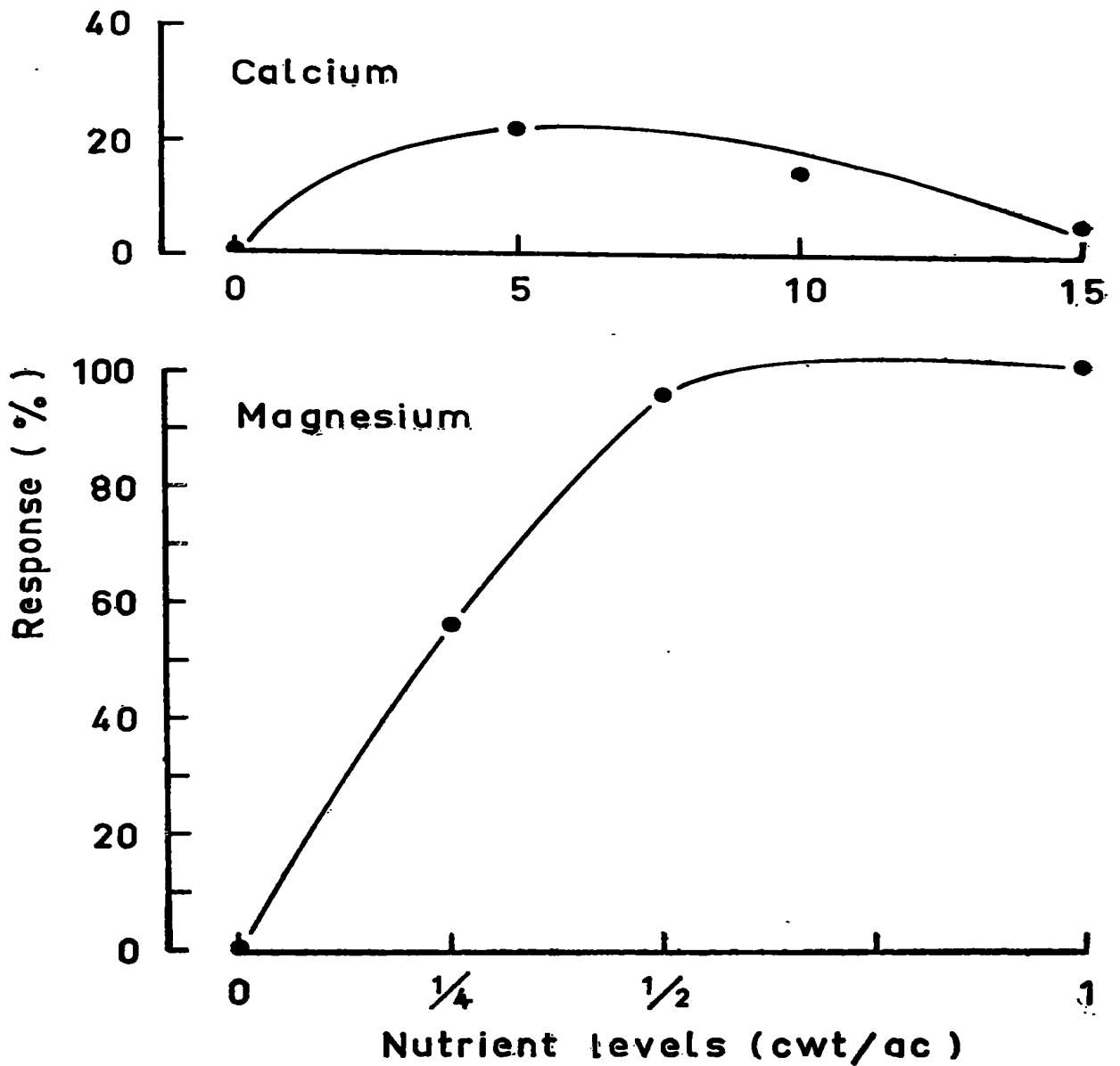
NUTRIENT STATUS OF SOME COCONUT SOILS IN CEYLON

Fig. 4



Dry matter yield of *P. commersonii* at all combinations of levels of potassium and magnesium at the second harvest of Experiment 2.

Fig. 5



Yield response (%) of *P. commersonii* to levels of calcium and magnesium in Experiment 3.