

COCONUT EXPERIMENT WORK IN NEW IRELAND.

II. PROGRESS REPORT ON FIELD TRIALS.

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COMPREHENSIVE fertilizer trials, involving all plant nutrient elements, were laid down on plantation coconuts in November, 1955. Up to June, 1958, a trial on red-brown clay-loam had given no response to any element. A trial on yellow-brown clay loam gave a response to potassium only, but not at an economic level. Further trials, with different rates and methods of application of potassium, are being commenced.

A cultivation trial (disc harrowing and strip ploughing), on an intermediate soil type, gave no response, and it is concluded that generally cultivation is impracticable on these soils.

The rates quoted are for a dressing to be repeated every two years. Sulphate of ammonia, however, was not applied in a single dressing, but in six-monthly applications each of 1 cwt./acre.

The design is a factorial, a half replicate of 2⁷ on plots with and without lime. The individual plots are of a single palm. Thus, 128 palms are included in the trial. With all fertilizers except lime the mixture is spread within a circle extending about four feet out from the base of the palm. This close placement aims at preventing "poaching" of fertilizer by the roots of neighbouring

Fertilizer	Nutrient Element	Rate
Lime	(pH control)	2 tons/acre
Sulphate of ammonia	Nitrogen (N)	4 cwt./acre
Muriate of potash	Potassium (K)	2 cwt./acre
Disodium phosphate	Phosphorus (P)	2 cwt./acre
Magnesium sulphate	Magnesium (Mg)	2 cwt./acre
Copper sulphate	Copper (Cu)	14 lb./acre
Sodium molybdate	Molybdenum (Mo)	1 lb./acre
Trace element mixture (Sh):		
Sulphate of iron	Iron (Fe)	56 lb./acre
Zinc sulphate	Zinc (Zn)	14 lb./acre
Manganese sulphate	Manganese (Mn)	28 lb./acre
Cobalt sulphate	Cobalt (Co)	2 lb./acre
Borax	Boron (B)	28 lb./acre

Introduction.

As a result of the preliminary field survey, it was decided that exploratory fertilizer trials should be laid down on the two main divisions of the clay-loam soils. A cultivation trial also was to be carried out on a typical example of these soils.

*A. Fertilizer Trials.**Design of Experiments*

The fertilizer trials are comprehensive in nature, involving the materials in the above table.

palms. The lime, which is used primarily to reduce acidity, has to be spread over the whole surface of the soil to be effective, hence it is broadcast on larger plots (or sub-blocks) of eight palms each (4 x 2), and these plots are separated by a guard row of untreated palms.

The effect of each fertilizer treatment is assessed in each case by a comparison of the yields of 64 palms which have received the treatment, with 64 not treated with that particular fertilizer. The design of the trial also permits accurate assessment of the effects of two or three fertilizers in combination.

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Yield Recording.

In New Guinea, nuts are harvested after they have fallen to the ground. Hence, with the use of single palm plots, it is not possible to record yield as the actual quantity of copra harvested, since it is impossible to determine with certainty where a fallen nut has come from. In any case, accurate recording of fallen nuts is difficult on a commercial plantation.

The method adopted, therefore, has been the counting of immature nuts on the palms. Only nuts above about three inches in diameter are counted. Losses of crop due to nuts which have reached this size failing to reach maturity are very low under our conditions, and may be ignored. On a healthy palm usually seven to eight bunches of nuts are counted, and these represent the yield over a period of about eight months. Counts are made every six months.

Initially, counting was carried out by native assistants who climbed the palms. However, it was found that the recording could be done more quickly and easily, and with equal or greater accuracy, by counting from the ground with the aid of binoculars. This technique has, therefore, been used for all recording after the first two counts.

Records also were made of the weight of meat in nuts from each palm, where possible. Three nuts were sampled if they could be found, but there were always a number of palms with no nuts under them, so that the data collected were incomplete.

Notes also were made on the appearance of the palms—leaf colour and density and shape of the crown.

Selection of Sites.

The results of the soil survey indicated that the soil types were fairly uniform throughout the whole area, so that fertilizer responses from any typical stand of palms should show what could be expected throughout. The sites selected, therefore, were a typical example of the acid, yellow-brown clay-loam soil and a typical example of the red-brown clay-loam.

In both cases, fairly young plantations (about 25 years old) were selected, for two reasons :—

(a) Younger palms are more likely to be in a condition to respond than are older palms.

(b) A fairly compact block of palms is needed for a reliable experiment. On the poorer soils, particularly, it would be impossible to find a suitable block on the older plantations, where many palms have died.

Experiments and Results.

(a) Yellow-Brown Clay-Loam.

Palms on the site selected are typically heterogeneous, varying from rather stunted palms with poorly developed, yellow crowns and few nuts, to quite well grown, green and productive palms. There are very many palms missing, and the trial is therefore spread out rather irregularly over four to five acres. Because of the proportion of palms missing, it is difficult to make a precise estimate of the yield per acre, but at the beginning of the experiment it was about five to six cwt. per annum. Subsequently it fell, as shown in Figure 1. Copra out-turn is about 6,800 nuts per ton.

The first nut counts were made in November, 1955, and the first fertilizer dressing was applied at the same time. Thus, the first set of nut counts is a measure of yield prior to fertilizer application and provides a base with which later yields can be compared by covariance analysis. Nut counts have been repeated at six-monthly intervals and are still being continued.

Results of the nut counts up to the time of writing are shown in Table I. Records of meat weights have not shown any indication of response. The only promising result shown by the nut numbers is to potassium (Figure 2) where the response was shown by analysis of covariance to be significant at the 1 per cent. level on the May, 1957, counts. At that time, also, there was observed an appreciable improvement in appearance of potash-treated palms relative to those which had not received potash, and this evidence of potash deficiency has been amply confirmed by chemical analysis of soils and plant materials.

(b) Red-Brown Clay-Loam.

This trial is situated on raised coral a few hundred yards inland from the sea. Palms are mostly well grown, healthy in appearance,

TABLE I.

Nut Numbers : Fertilizer Trial on Yellow-Brown Clay-Loam.

—	Nov. 1955	May 1956	Nov. 1956	May 1957	Nov. 1957	May 1958
K ₀	3,138	2,626	1,937	1,184	2,058	2,296
K ₁	3,174	2,581	2,110	1,731	2,608	2,602
P ₀	3,125	2,540	1,912	1,494	2,284	2,348
P ₁	3,187	2,667	2,135	1,421	2,382	2,550
N ₀	3,217	2,704	2,089	1,474	2,311	2,394
N ₁	3,095	2,503	1,958	1,441	2,355	2,504
Cu ₀	2,906	2,304	1,869	1,307	2,060	2,266
Cu ₁	3,406	2,903	2,178	1,608	2,606	2,632
Mo ₀	3,211	2,717	2,111	1,555	2,386	2,482
Mo ₁	3,101	2,490	1,936	1,360	2,280	2,416
Mg ₀	3,036	2,499	1,892	1,483	2,349	2,332
Mg ₁	3,276	2,708	2,155	1,432	2,317	2,566
Sh ₀	2,971	2,533	1,959	1,480	2,295	2,470
Sh ₁	3,341	2,674	2,088	1,435	2,371	2,428
Lime ₀	3,739	3,016	2,225	1,523	2,656	2,792
Lime ₁	2,573	2,191	1,822	1,392	2,010	2,106
TOTALS	6,312	5,207	4,047	2,915	4,666	4,898

and carry a good crop of nuts. Several, however, show slight to moderate yellowing of the foliage and rather poor crop. The number of missing palms is not so great as in the yellow-brown soil area, and so it was possible to lay down this trial in a fairly compact block.

Yield of palms at the commencement of the experiment was estimated at 12 to 13 cwt./acre/annum, with a copra out-turn of about 5,800 nuts/ton. It is, therefore, a better than average block of palms on Papua and New Guinea standards.

The first nut counts were made in November, 1955, and fertilizer was applied in May, 1956. In this case, therefore, the first two sets of records are measures of pre-treatment yield. Details of nut counts to date of writing are shown in Table II. No significant response has been shown to any fertilizer treatment.

Discussion.

The results of these trials up to date have been somewhat disappointing. They have confirmed that there is potassium deficiency

in the poorer soils, and indicate that other nutrients probably are fairly adequately supplied. However, the application of potassium fertilizer at a moderate rate did not give a very great increase in yield. Although the appearance of treated palms was improved, they were not brought to what could be called a healthy condition. It is quite possible, considering the very slow cycle of growth of the coconut palm, that the full effect of the fertilizer has not yet become apparent. However, this is not supported by the yield records, as shown in Table II. The graph shows a slight response to potassium evident 12 months after the first application of fertilizer, and this response reached a peak after 18 months, being maintained for a further six months. However, by 30 months after the initial dressing, this response had declined to half, and apparently the second dressing, made six months earlier, had not yet taken effect.

There are two possible conclusions :—

- (i) There may be some other factor, in addition to nutrient deficiency, affecting the palms on the poorer soils.

TABLE II.

Nut Numbers : Fertilizer Trial on Red-Brown Clay-Loam Soil.

—	Combined November 1955 and May 1956	November 1956	May 1957	November 1957	May 1958
K ₀	9,521	3,902	3,770	4,417	3,383
K ₁	9,287	4,109	3,830	4,780	3,360
P ₀	9,275	3,894	3,888	4,728	3,298
P ₁	9,533	4,117	3,712	4,469	3,445
N ₀	9,781	3,900	3,789	4,552	3,324
N ₁	9,027	4,111	3,811	4,645	3,419
Cu ₀	9,452	3,993	3,711	4,583	3,349
Cu ₁	9,356	4,018	3,889	4,614	3,394
Mo ₀	10,281	4,169	4,018	4,719	3,503
Mo ₁	8,527	3,842	3,582	4,478	3,240
Mg ₀	9,450	3,950	3,704	4,417	3,451
Mg ₁	9,358	4,061	3,896	4,780	3,292
Sh ₀	9,220	3,827	3,684	4,641	3,409
Sh ₁	9,588	4,184	3,916	4,556	3,334
Lime ₀	9,237	3,908	3,770	4,492	3,352
Lime ₁	9,571	4,103	3,830	4,705	3,391
TOTALS	10,560 8,248	8,011	7,600	9,197	6,743

(ii) The rate of application of potassium fertilizer may have been too low or the method of application inefficient, so that the maximum response was not obtained.

Observations over the past three years have not indicated any other factor as likely to be of primary importance. Hence, our current programme is based on the second possibility and two new trials are being commenced, involving different rates and methods of application of potash fertilizer. These will include dressings at the rate of 1 cwt., 2 cwt. and 4 cwt. per acre per annum, comparison of annual and biennial dressings and comparison of close placement (as used in the original trial), with broadcasting over a larger area. In addition, the effect of potash on young seedlings is to be tested in an experiment on underplanting. The main aim of this last experiment (commenced in June, 1958) is to compare the economics of underplanting (i.e., replacement of senile palms by planting new seedlings underneath them, the old palms to be cut out when the new come into bearing) with different levels of thinning of the old stand.

From the practical viewpoint, no firm

recommendation can yet be made. The gross return obtained from 2 cwt./acre of muriate of potash has been only about 3 cwt./acre of copra, with indications of little residual effect. This return would not be economic.

The above discussion applies to the heterogeneous palm stands on yellow-brown clay-loam soils. Concerning the red-brown clay-loam soils, it may be stated fairly confidently that, where palms are healthy and bearing well, little or no response could be expected from fertilizing and that it would certainly not be economic.

B. Cultivation Trial.

This is a simple experiment, involving two treatments (ploughing and disc-harrowing) and untreated control.

Since, in these soils, the bulk of the palm's roots are to be found close to the surface, there can be little doubt that over-intensive cultivation, whatever the long term effects, would severely damage the palm initially by cutting a large proportion of its roots. Strip ploughing, therefore, was used, a strip of about 15 feet width being ploughed down alternate rows in alternate years (i.e., treat-

ment to be carried out at yearly intervals). This should effect "root pruning", while treatment of alternate rows only would prevent damage to the palms. The harrowing was repeated at six-monthly intervals and aimed to break up any surface crust on the soil and to turn in the cover crop as a green manure.

The design is a randomized block with four replications. Plots are nominally of 25 trees (5 x 5), separated by a single untreated guard row.

Yield Recording.

The same method of nut counting was used as for the fertilizer trials.

Selection of Site.

The siting of this trial was difficult. On the red-brown clay-loams nearer the shore there is usually so much outcropping coral that cultivation (at least with standard implements) is impossible. On the deeper yellow-brown soils further inland topography is frequently too uneven. A compromise site finally was chosen on an intermediate soil type. The palm stand is fairly old (about

tear on machinery, therefore, was very high. The area carried a dense creeping legume cover crop, and it was found impossible to cultivate satisfactorily without first removing this completely. This was especially true in the case of disc harrowing, as even with heavy weights attached the machinery merely rode over the surface and scarcely scratched the soil. For the first cultivation treatments, carried out in March, 1956, the ground, therefore, was thoroughly cleared. However, this adds greatly to the cost of the operation and also is undesirable since it removes organic matter from the soil. For later treatments the cover crop was left as it stood. Ploughing was moderately effective, penetrating three to four inches, and would certainly have effected some root pruning.

Yield records for this trial are shown in Table III. There was no sign of any response at all from either treatment.

Discussion.

The main conclusion from this trial is that cultivation with standard implements is not satisfactory on the bulk of New Ireland soils. Even where cultivation may be practicable, the lack of response in this trial is sufficient

TABLE III.
Nut Numbers : Cultivation Trial.

	Nov. 1955	May 1956	Nov. 1956	May 1957	Nov. 1957	May 1958
Control	2,536	1,872	1,573	1,413	1,585	1,700
Harrow	2,845	2,156	1,847	1,444	1,622	1,739
Plough	2,569	1,888	1,802	1,356	1,573	1,688
TOTALS	7,950	5,916	5,222	4,213	4,780	5,127

40 years) and shows marked decline, with many palms missing. The number of palms per plot varies from 18 to 23. Yield was estimated at about 4 cwt./acre at the outset, with a copra out-turn of 6,600 nuts/ton.

Experiment and Results.

Although the site had been chosen for its apparent freedom from outcropping rock, the soil proved to be very stony. Wear and

to indicate that little benefit could be expected from cultivation of these New Ireland soils.

This experiment has now been abandoned and the site is being used for one of the new fertilizer trials.

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