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COCONUT EXPERIMENT WORK IN NEW IRELAND

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I. FIELD SURVEY AND INTRODUCTION.

A DESCRIPTION is given of a field survey of coconut plantations on the east coast of New Ireland, where extensive production decline has occurred in recent years. Palms were classified into four groups: healthy palms, old declining palms, heterogeneous palm stands, and stunted palms. These are related to soil types. Coral sands and red-brown clay-loams usually carry healthy palms, while yellow-brown clay-loams usually carry heterogeneous palms. It was concluded that the major factor causing decline probably was nutrient deficiency in the soil, therefore fertilizer trails should be laid down.

Introduction.

New Ireland is a long, narrow island lying between latitudes 2.5 and 5 degrees south. The south-eastern end of the island, which is wider and more mountainous than the remainder, is largely undeveloped, and the work to be described has been restricted to the north-western section. This consists of a strip of land about 150 miles long, and varying in width from 5 to 12 miles. The east coast, with a good motor road, is more fully developed than the west coast, and it is here that the survey was carried out.

There are about 50 coconut plantations along the east coast, with a total area of approximately 30,000 acres, all situated on the flat coastal strip. In addition, there are about a hundred native villages, all with groves of coconuts, which are used for food as well as for copra production. With the exception of four small villages in the hills, the whole native population in this section of the island lives right on the seafront.

About 80 per cent. of the plantations were planted wholly or very largely during the German administration of New Guinea, mainly between the years 1908 and 1918. Thus, the bulk of commercial plantings are now between 40 and 50 years old. However, the remaining 20 per cent. of plantations are mainly less than 30 years old. In the native groves there are palms of all ages, a few being probably as much as a hundred years old.

Nature of the Problem.

During and after the Japanese invasion of New Guinea, the coconut plantations were completely neglected for a period of from six to more than 10 years. Following their reopening, there was evident a most pronounced decline in productivity on many plantations. Accurate figures are unobtainable, but those given in Table I serve to illustrate the magnitude of the problem. It must be pointed out, however, that these figures are extremely approximate, and also that some of the pre-war figures may include a proportion of trade copra purchased from natives.

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TABLE I—*Copra Production in some New Ireland Plantations.*

Area in Acres	Pre-war Production (Tons/Annum)	Postwar Production (Tons/Annum)
400	130	100
400	140	50
890	280	120
1,300	300	220
375	215	100
750	230	200
975	350	120
350	85	50
675	240	160
550	275	200

Although this productivity decline has become more obvious since the war, it is not wholly a postwar development. Yellowing of fronds and decreasing productivity of palms had been noted on some plantations before 1940. The following comments, taken from inspectors' reports on what is a fairly typical example of the older plantations, are of interest. In 1940, there was noted the presence of "leaf droop, stunted yellow and tapered palms. Nuts small". In 1948, the loss was recorded of 2,109 palms (out of an original 37,799) due to war damage. By 1951, a further 12,000 palms had "died of wilt and soil deficiency".

On several plantations, too, there are very stunted palms which quite obviously have never made satisfactory growth. Dwyer (1939) reported what he described as a "maturation wilt" of coconuts just coming into bearing on a plantation near Namatanai. Thus, the problem is not only one of old palms declining, but also includes cases where palms have been poor through their whole life.

Evaluation of the factors involved in the general decline is complicated by war damage. Much direct damage was caused by bombing and strafing, particularly along the road, and one plantation near Kavieng lost at least half its palms from this cause, plus the cutting out of a large area for construction of an airstrip. Indirect damage is more difficult to assess. Overtopping of palms by secondary bush growth, and more especially their strangling by vines and creepers, may have led to the death of a number of palms, but it is doubtful whether many really healthy palms would be killed in this way. Bush growth certainly greatly reduced productivity of the palms, but within two or three years of clearing they appeared to recover completely. Indeed, it is not unlikely that a period of up to 10 years with nothing removed from the plantations may in some cases have had a beneficial effect.

Field Survey.

Between November, 1954, and June, 1955, a complete field survey of the problem was carried out. This included a soil survey, which has been described separately. The present report is concerned primarily with the condition of the coconut palms and an analysis of the probable cause of the declining productivity.

Clearing a New Ireland plantation of secondary bush growth resulting from wartime neglect.

A healthy New Ireland palm stand.

Palms encountered were classified into the four groups described below :

1. *Healthy Palms.*

Fortunately, almost all plantations have an appreciable proportion of normal, healthy palms. These are tall, with vigorous green fronds and carry, on the average, good crops of nuts. Except in the oldest plantations, these healthy palms may be expected to maintain their productivity for many years yet.

2. *Old Declining Palms.*

On a few plantations there are small areas of old palms which are quite tall and uniform, with fairly well developed green fronds, but a low average nut number. These would appear to be over-aged palms which have lived out their normal bearing life and are now in a declining phase. Such stands should be cut out and replanted, when a new stand of healthy young palms could be expected.

3. *Heterogeneous Palm Stands.*

Much more typical of the generally poor areas are very heterogeneous stands of palms. On young plantations, this is evident in very variable appearance of the palms. Some are well grown, with healthy, green foliage and good crops of nuts. At the other extreme are stunted palms, with yellow fronds, much reduced in number and size, and no nuts. All gradations between these extremes are found. In places, a single healthy palm may be surrounded by poor palms, and vice versa, but more usually patches of poor palms gradually grade into better palms, in an irregular pattern. Palm condition can sometimes be related to topography, there being a tendency for palms to be better in the depressions, but this is by no means universal.

In plantations more than 40 years old, the heterogeneity is not quite so marked, since many of the worst palms have died and most of those surviving are poor in appearance. However, there still remain patches where some of the palms are fairly healthy, contrasting with other patches where most palms have died. Heterogeneity is very evident in the height of palms, which may range from 25 feet up to more than 70 feet.

Stunted palms.

It is in this group that the worst production decline has occurred. On areas of this type, now about 25 years old, yield is estimated at 3 to 5 cwt./acre/annum, and it may be assumed that the older areas produced at least as well at the same age. These older areas now produce only 1 to 2 cwt./acre/annum, which is barely sufficient to cover maintenance costs. Furthermore, large areas, which had probably declined to a greater extent, have been completely abandoned.

About half the plantation palms would fall into this group, so that it constitutes the most urgent problem. It is most unlikely that replanting of such areas would be economic without some remedial treatment.

4. *Stunted Palms.*

Small localized areas of very stunted palms are found on many plantations. The worst of these, at 40 years old, have trunks only 15 feet tall, with yellow, stunted foliage and no fruit. Such palms are most commonly to be found where the area planted was originally grassland (*Themeda - Imperata* association) where constant burning of the grass has destroyed the fertility of the soil. There seems little possibility of any improvement of these palms.

Distribution of Palm Types.

A typical plantation has a strip of healthy palms along the sea frontage, about 200 yards deep. Beyond this depth palms are heterogeneous. Thus the proportion of good to poor palms on a plantation frequently depends on how far inland the plantation extends. The division between healthy and heterogeneous palms is sometimes quite sharp, but often there is a gradual merging of one type into another.

Such a description would fit an appreciable proportion of the plantations, but is not universal. There are a few plantations where palms on the seafront are poor, while further inland they improve. On one plantation there is a narrow strip of stunted palms, approximately parallel to the coast, with better palms on either side; another has a narrow strip of healthy palms along the shore, backed by a wide band of heterogeneous palms, but beyond this is a large block of quite healthy palms. There are also one or two plantations fairly uniform throughout.

The distribution was found to be related fairly closely to soil type, and may best be described under the major soil types encountered.

Leaning palms on coral sand, New Ireland.

1. *Coral Sands.*

These commonly support healthy and productive palms. However, there are many exceptions, including one plantation (the only one planted wholly on coral sand) which has been completely abandoned. It is likely that performance of palms on these soils depends largely on moving subsoil water, which may contain plant nutrients in solution. It is notable that some cases of poor palms are to be found where the ground is raised above the surrounding level. However, the soil type normally has a well-developed black, loamy surface horizon, 9 to 12 inches deep, overlying the sandy subsoil, and the palm roots undoubtedly draw heavily on this surface loam for both moisture and nutrients. Small areas are quite common on the coral sands where many palms are leaning, having been blown over at some period of their growth. These palms are usually only mediocre bearers and the condition is associated with poor development of the surface horizon.

The total area of coral sands on commercial plantations is not more than 2,000 to 3,000 acres, but the bulk of village groves also are on these sands. Hence, their place in coconut production in New Ireland is considerable.

2. *Clay Loams.*

The general pattern on these soils is that near the sea frontage they are shallow, red-brown in colour, and neutral to slightly acid in reaction. In most cases palms on such soils are healthy. Exceptions are on limited areas where it is probable that the topography allows excess drying of very shallow soils, and palms are heterogeneous or very stunted. In addition, on some of the oldest plantations many palms on this soil type are declining.

Further inland the soils are commonly deeper, lighter in colour (yellowish or red-yellow) and highly acid. Topography is usually uneven, with numerous depressions (sink-holes) where water disappears below the surface. There are occasional water courses, but they generally run no more than a few hundred yards before the water goes underground. Healthy palms are occasionally found on these soils, but more usually they are heterogeneous.

It is difficult to make an accurate assessment of the areas of these soil types, but there would be of the order of 14,000 acres each of the less acid and more acid clay loam soils. Of the latter, about half already has been abandoned.

Discussion.

In seeking a general cause of the decline, several possibilities were considered. Most of these were quickly eliminated, but, nevertheless, may be of some importance as contributing factors.

1. *Senility.*

The presence of both healthy and unhealthy palms of the same age on most plantations shows that senility is not the primary cause of decline. However, on many of the older plantations, replanting would be essential before any worthwhile improvement could be effected by any other means.

2. *Diseases and Pests.*

The distribution of unhealthy palms, often adjacent to fully-productive palms, excludes the possibility of these agents as primary causes. Nevertheless, insect pests may hasten the destruction of already debilitated palms, but there is no sign of any pathogenic condition of importance. Some plantations have been subject to occasional defoliation by coconut grasshopper, *Eumossula gracilis* Will. (formerly known at *Sexava*), which may shorten the life of the palms. It is surprising to note that, apart from one small area where several palms have been killed, damage by Asian rhinoceros beetle (*Oryctes rhinoceros*) and indigenous rhinoceros (*Dynastid*) beetles is negligible, despite the adundance of dead palms to provide breeding sites.

3. *Physiological Factors.*

(*a*) Water Relations.—Although rainfall in the area is 100 to 200 inches per annum, many planters said droughts are quite frequent and at times very severe. Several plantations have had grass fires through them in drought periods. However, although there may be small areas of shallow soil where drought is serious, drought is not likely to be a primary cause of the more widespread decline. The heavier clay soils would

contain large reserves of moisture in the subsoil even after the topsoil had dried out. These should prevent permanent damage to palms even after many months without rain, although temporary reduction in crop might result. In the lighter sandy soils, as has been suggested already, palms probably survive through drought because of a fairly shallow sub-surface water table.

Waterlogging also may be eliminated as a general factor, as the soils are mostly permeable (water is seldom seen lying on the surface even after heavy rains) and the underlying coral is porous, allowing rapid underground drainage.

(*b*) Soil Conditions.—

(i) *Texture.* Despite the high clay content shown by physical analysis, these coral-derived soils behave in the field as fairly friable loams. There are no marked differences in texture between soils from healthy and unhealthy areas of palms.

(ii) *Nutrient Status.* With the elimination of other possibilities, nutrient imbalance (deficiency or toxicity) remains as the most probable cause of decline. This is supported by the results of an analysis of a New Ireland soil reported by Dwyer (1939) which indicated a deficiency of potassium.

The range of conditions found in various palm stands could readily be explained on the basis of a deficiency. Stunted palms which have never grown well would indicate a soil initially very low in nutrient, while a gradual decline of originally fairly healthy palms would indicate a marginal content of nutrient in the soil, gradually becoming exhausted over the years.

The association on the clay soils between palm condition and soil type also supports the possibility of nutrient deficiency. The poorer palms are generally found on deeper and more acid soils, which, therefore, probably are older and more intensely leached.

Conclusions.

As a result of the survey, it was decided that field experiments with fertilizers and cultivation treatments should be laid down, supported by chemical analysis of soil and plant material. Because of the long delays if new plantings were to be used, tests should be made on existing plantations. The similarity of soil and palm conditions indicates that the problem is basically the same over the whole area, so that trials on any representative site should give results applicable to the whole.

Since it would be a matter of years before results of trials could be evaluated, it was considered that the original trials should be as comprehensive as possible, aiming to determine what elements were deficient rather than quantities of fertilizer required. Trials should be made on healthy stands, as well as on declining palms, to give a more comprehensive picture of soil conditions.

Concerning rejuvenation of the older stands, it was considered that replanting could not at present be recommended where the original stand shows severe decline. If premature senility is an indication of nutrient exhaustion in the soil, satisfactory growth could not be expected from replants. Most of the healthy stands should still have 20 years of productive life. However, planters would be well advised to commence replanting by stages so that new stands can be coming into bearing as the old ones cease to produce. Some planters have begun underplanting the old stands, a method of replacement which is being used in Ceylon. However, the practice in Ceylon is to thin the old palms to reduce competition with the replants, and it was considered desirable to carry out experiments to see what degree of thinning is necessary and to compare the economics with complete removal of the old stand.

(Part II of this article follows papers on the soil and chemical investigations.)

REFERENCE.

DWYER, R. E. P. 1939. Some investigations on coconut diseases associated with soil conditions in New Guinea. *New Guinea Agric. Gaz.* 5 : No. 1. 37-53 ; No. 2, 2-47.