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COFFEE CULTIVATION IN PAPUA AND NEW GUINEA

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Introductory Article.

(This article is the first of a series dealing with coffee growing in Papua and New Guinea.)

THIS short introduction on coffee cultivation in Papua and New Guinea is intended to meet, as far as possible, the immediate needs of Territory producers engaged in this important plantation industry.

All phases of coffee cultivation and production cannot be dealt with adequately in an article of this type. It is thus intended that this brief guide should precede a series of detailed articles, each of which will deal with one specific aspect of the subject in greater detail. These separate articles will later be combined to make a complete handbook on the cultivation, processing and marketing of coffee, with special reference to Territory conditions. Some of the important topics to be discussed are :—

1. Soil and climatic requirements.
2. High and medium altitude production.
3. Low altitude production.
4. Cultivation and clearing problems.
5. Nurseries, cover crops, temporary and permanent shade and planting technique.
6. Coffee varieties.
7. Improvement by selection and breeding. Propagation methods.
8. Insect and other pests.
9. Coffee diseases of pathological and physiological origin.
10. Processing.
11. Factory design, plant and management.
12. Economics, marketing and price trends.
13. Native production.
14. Mixed and mono-culture of coffee.

The Botany of the Coffee Plant.

All the species of coffee belong to the order *Rubiales* and the family *Rubiaceae*. There are two main subdivisions of the *Rubiaceae*; *Cinchona* is the type plant of one group and *Coffea* is the type representing the other main subdivision, the *Coffeoidae*. Several species in the *Coffeoidae* are of commercial importance, particularly *Coffea arabica* L. (Arabian or Arabica coffee), *C. robusta* L. (Robusta coffee); *C. liberica* Bull. (Schum.) (Liberian coffee); *C. stenophylla* G. Don.

All these species occur in the Territory as well as a number of others of minor importance and many hybrids.

The Robusta and Liberica types grow into shrubby trees up to twenty feet or thirty feet high if left unpruned. They are both considered to be low altitude species. Liberica has very large fruits which are of poor quality whereas the smaller Robusta beans are the main bulk coffee of commerce. Arabica is usually grown at higher altitudes and is somewhat smaller and less vigorous than Robusta; the leaves of the former are also more pointed and the fruits generally larger than those of the latter. *C. stenophylla* is a brown-fruited type producing small, high-quality beans.

There are a few trees of *C. stenophylla* at Popondetta and *C. liberica* can be seen in New Britain, but neither is of commercial importance in this Territory. Only varieties of *C. robusta* and *C. arabica* and possibly some hybrids are likely to be widely grown here. Robusta is of lower quality than Arabica but is generally considered to be a higher yielder although it has a lower ratio of bean to pulp (1 to 7) than the latter (1 to 5 or 1 to 6).

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A full botanical description of the coffee plant will not be given here as adequate literature on the subject is available. It should be mentioned, however, that coffee has white, tubular, hermaphrodite flowers borne in clusters at the nodes on new lateral wood only, which is of importance in pruning. Pollination may be effected by wind or insects but many types are said to be self-compatible and normally self-pollinated. Varieties vary in this respect but cross-pollination is usually essential for the maximum production by *C. robusta*.

The fruit is a two-seeded drupe resembling a cherry, with one seed in each locus. The sweet pulp is removed by a combination of mechanical and fermentative processes, and the hard parchment and underlying silverskin are also removed mechanically to give the coffee bean of commerce.

Most members of the *Rubiaceae* are noted for their drug secreting properties. The well-known stimulant "caffeine" is the main alkaloid in coffee and it can be extracted from waste whole and broken beans. Other alkaloids are present in lesser quantities.

The History of Coffee Growing in the Territory.

Both Arabica and Robusta coffee have been grown on a relatively small scale in the Territory for the past 50 years. However, prior to the 1939-1945 War, most interest was shown in Robusta coffee grown from sea-level to about 1,500 feet elevation.

Several European plantations of Robusta coffee of up to 500 or 600 acres were destroyed during the War and many Native plantings at Sangara were devastated by the Mount Lamington eruption in the post-war period. The rehabilitation of these latter plantings is in progress. Since 1945 there has been little European interest shown in this type of coffee although there is room for expansion in areas where the labour position is not too difficult. Native plantings of lowland coffee are on the increase in some areas, particularly Finschhafen, Samarai, Morobe and Popondetta.

An Arabica coffee plantation was established by the New Guinea Department of Agriculture at Wau in 1928, using the high quality Blue Mountain Jamaican variety of Arabica, which was specially

introduced by the Department for this purpose. The original small planting was later purchased privately and expanded to several hundred acres. This area is still in profitable production and a number of smaller plantations have been established in the same District using seed derived from the original plants. A small plot of coffee was also planted at Aiyura in 1937 using seed from the same source.

Since 1945 the main development by both Natives and Europeans has been in the growing of high-quality Arabica coffee at elevations ranging from 1,500 feet to 6,000 feet or more, particularly in the New Guinea Highlands. Expansion in these Districts is proceeding apace, although still in limited areas, and inquiries are received constantly from within the Territory, Australia and overseas regarding the economic prospects of this crop.

The Territory is still free of the devastating coffee rust caused by the fungus *Hemileia vastatrix* and plantings everywhere have thrived with a minimum of disease or insect damage. Rigid quarantine restrictions on the importation of coffee from other countries are designed to prevent the introduction of coffee rust as well as other diseases and insect pests.

Varieties of Coffee.

There are at present no well-defined varieties of Robusta coffee grown in the Territory, and the seed which is available gives rather a variable type of bush. The cross-pollination which is the rule in Robusta makes it difficult to achieve uniformity but the Department is working with improved introduced strains and it is hoped that seed will be available in a few years' time.

Almost all the Arabica coffee grown in the Highlands at present is derived from the seed introduced to Aiyura in 1937. However, several more recent introductions made at Aiyura show promise of approaching or even exceeding Blue Mountain Jamaican in yield or quality. These varieties are undergoing trials prior to a decision on their release to growers.

Plantation Practice.

A brief review only of some of the salient features of plantation practice will be given here. It is recommended that at this stage of development in the Territory, methods

employed on plantations should, as far as practicable, be on orthodox lines. Experimentation should be left until growers are more conversant with the crop.

Coffee is a true horticultural plant and must be treated as such. It requires as much attention as the average fruit tree in a commercial orchard. It is a shade-loving plant and in addition to the normal pruning, spraying and cultivation there are the needs of cover cropping and temporary and permanent shade. Nursery work and cultivation are at least as exacting as the requirements for ordinary temperate climate fruit trees.

(a) Choice of Site.—

Coffee is fairly tolerant to a wide range of soils and altitudes, but reaches its best development on a deep, well-drained soil with a high humus content and a slightly acid reaction. It does not tolerate very acid soils as well as tea and a pH value of 6-6.5 is optimal. Alkaline soils with high pH values are detrimental and cause stunted growth and chlorosis or yellowing.

A reasonably high and well-distributed rainfall is also important in the growth of the crop.

(b) Nursery Work.—

The young coffee bush develops slowly at first and must always be grown in a well-prepared nursery. The cleaned seed has a ventral groove which assumes importance in planting; correct planting requires that this groove be on the underside when the seed is sown. Unfortunately coffee seed retains its viability for only a short period; excessive drying is deleterious and the life of the seed is lengthened somewhat if it is stored in moist charcoal.

The seed normally takes six weeks to germinate and a further period of nursery growth for at least six to nine months is required before the young trees reach the usual planting-out height of twelve to eighteen inches.

(c) Use of Shade.—

Except under very unusual circumstances, notably at high altitudes and in deep, shaded gully formations, adequate shade is a physiological necessity and has a marked effect on the uptake of potash and the carbon/nitrogen ratios. Strong winds

are harmful to coffee and provision should be made for the establishment of wind-breaks in exposed areas.

The tendency when shade is eliminated, except under special conditions, is for the development of umbrella-shaped trees which shed the lower laterals and develop crown scalding and early over-bearing to the detriment of the plant. Shade removal is sometimes resorted to in Asiatic countries in order to produce heavy crops in times of financial stringency, but it leads to sharply increased liability to plant exhaustion and physiological diseases such as die-back (often also associated with the fungus *Botryodiplodia* spp.).

It was stated during a Rural Radio Talk on coffee over 9PA that under New Guinea conditions, coffee grown without shade will crop itself out. This talk has been reproduced in the *Papua and New Guinea Agricultural Gazette*, Vol. 8, No. 2, pp. 69-71, and should be referred to by the reader. This is considered to be generally true although there are probably some conditions here where, as in Kenya, the use of shade is not absolutely necessary. If a grower wishes to establish a permanent plantation it is essential that he control the cropping of his coffee and the only economical way to do this is by shade manipulation. Only experience will show what degree of cropping can be permitted on a particular plantation without damaging the trees. So that shade may be varied when necessary care should be taken to select permanent shade tree species which will stand lopping.

The Department strongly recommends the use of permanent shade for coffee wherever it is grown in Papua and New Guinea. When planning the initial shade density, the grower should bear in mind that it is much easier to remove shade than to establish it in an old coffee area. Hence at low levels, using *Leucaena glauca* as the permanent shade, an initial density of ten feet by ten feet is recommended and on the Highlands where larger permanent shade trees such as *Albizia* and *Grevillea* spp. are used, a minimum initial stand spaced twenty feet by twenty feet is considered suitable. The shade can be side-pruned to get the maximum height and diffusion and also thinned as may be necessary.

For temporary shade, *Crotalaria anagyroides* is generally accepted as the most useful species, especially in the Highlands, but *Tephrosia candida* and other quick-growing legumes may also be used.

(d) Cultivation.—

In discussing the question of cultivation it must be realized that coffee has two types of rooting systems. The main tap root goes deep to water and injury to this root can cause stunting or even death of the plant. The numerous fibrous feeding roots form in the surface layers of the soil and are most important in the nutrition of the coffee plant. Deep or excessive cultivation can cause serious damage to these roots and thus damage to the plant. It is important that coffee should be kept fairly clean and especially must the strong-rooted grasses be removed because of their heavy competitive effect. At the same time it is equally important that cultivation be shallow and disturb the coffee roots as little as possible.

The surface roots of coffee are capable of feeding on quite raw humus, a characteristic which is found much more frequently in tropical than in temperate climate plants. Just dead or browning leaves of the coffee plant itself as they fall are readily attacked by fibrous roots breaking through the surface of the soil.

For the scientifically minded, it may be stated that this power of the coffee plant to assimilate raw humus has been partly ascribed to the association of *mycorrhiza* (symbiotic fungi) with the feeding roots of the plant.

Maturity and Longevity of the Coffee Plant.

Generally speaking the first worthwhile fruiting is obtained from Arabica three to four years and Robusta two to three years after planting out, although light fruiting is often obtained earlier. The first trimming or pruning will be required during the second year of growth. Early bearing at, say, two years should not be encouraged as it may interfere with the development of a sturdy bush.

Profitable production per plant can be expected in five to six years. Profitable production at the plantation level will depend on the speed of planting up of the

original area and is thus usually a couple of years later. Maximum bearing can be expected in seven to eight years and should continue until the plants are twenty-five to thirty years old although plantings made under unfavourable conditions will die out early. With careful management good, sturdy plants may survive fifty years. Rejuvenation and grafting of old trees can considerably extend the life of the plantation under certain circumstances if carried out under favourable weather conditions; heavy losses may ensue if rejuvenation be attempted in dry weather.

The economic productive life of a plantation should be assessed at about twenty years when calculating costs, risks and depreciation in connection with coffee plantation work.

Further Information.

Comprehensive modern books on coffee culture are rare and difficult to obtain; this is especially true of those which deal with practical planting and production. For example the well-known text, *Coffee in Kenya*, by McDonald, printed by the Colony and Protectorate of Kenya Department of Agriculture in 1936, is out of print. This is an excellent publication on Arabica coffee although not all its recommendations apply to local conditions in the Territory where there are differences in soils, climate, labour, etc. Efforts by the Department to obtain extra copies for planters have been unsuccessful.

The Department of Agriculture, Stock and Fisheries employs a number of Specialist Officers in various spheres who will contribute more detailed articles on coffee in future issues of this *Journal*. The fields to be covered include Plant Pathology, Entomology, Soil Chemistry, Soil Surveying, Agronomy and Agricultural Economics. A number of Officers of the Department have been abroad studying coffee production in Hawaii, West Indies and Trinidad, Indonesia, Malaya, Africa and India. Many problems which arise can, however, be answered only by local experiment and trials are being laid down on Experiment Stations and growers' properties to provide answers to some of these problems. As well as Specialist Officers there are Extension Officers at main coffee-growing centres who will advise both on European plantation methods and Native coffee culture.

The Department has been fortunate also in obtaining advice on coffee growing from a number of overseas specialists, including Dr. Churchward of Anglo-Dutch Estates, Mr. J. Lincoln, Chief Adviser to Francis Peek Ltd., who are amongst the largest plantation companies in Indonesia and Malaya, Mr. G. K. Newton, a past president of the Planters' Association of Ceylon and a number of visiting Dutch experts. Australian processing firms give valuable assistance in assessing the quality of small samples from various regions and also from selected bushes. Their assistance in this way helps in advice on processing as well as in the selection of superior material. A representative of a leading Australian firm is expected to visit this country shortly.

Literature.

Several articles have been prepared on the subject of coffee growing at the request of the Department of Territories. The following brief list of publications, which will be repeated and added to at the end of this series, could also be consulted :—

- (1) *Coffee growing in Kenya*, by J. McDonald. Colony and Protectorate of Kenya, Department of Agriculture.
- (2) *Papua and New Guinea Agricultural Gazette*, Vol. 8, No. 2, October, 1953.
- (3) *The International Coffee Situation with special reference to Papua and New Guinea*; by Department of Commerce and Agriculture, Bureau of Agricultural Economics, December, 1947.
- (4) *The Production of Cacao, Coffee and Tea in the Territory of New Guinea*. Department of Post-War Reconstruction, Regional Planning Division. Halsey, Canberra, March, 1948.
- (5) *Tea, Coffee and Cacao Review*. 17/15 of 27.6.1947 F.A.O. and U.N.O.

The next article in this series will deal with some aspects of the establishment and cultivation of a coffee plantation.