OIL PALMS

THE AFRICAN OIL PALM.

LECTURE BY MR. T. D. MARSH.

At a meeting of the Central Perak P. A., held on Saturday, February 14, at No. 19, Hale Street, Ipoh, Mr. T. D. Marsh, of the Agricultural Department delivered an interesting lecture on the African Oil Palm and its cultivation in Malaya.

The paper he read was as follows:—

THE OIL PALM (*Elaeis guineensis.*)

This palm which is indigenous to West Africa is gradually coming into great favour in the East as a main crop, and is being planted instead of Rubber or Coconuts. It is undoubtedly the best crop known in lieu of the staple rubber and coconuts and promises to give excellent returns.

It was reported that the area under oil palm in the East Coast of Sumatra had risen to about 35,000 acres in the beginning of 1923.

The palm has during the past ten years received considerable attention, principally because the demand for oils and fats has greatly increased throughout the world. Estates in Sumatra and Malaya that are in bearing are nearly all planting larger areas and more estates are rapidly being opened up.

There is planted in Malaya more than 10,000 acres of which about 1,000 acres are in bearing. Enquiries for land and information about the crop are constantly being received by the Government, indicating a realization by the Planters of Malaya of its value.

The palm is valuable for the two oils, known to commerce as palm oil and palm kernel oil. Authorities in West Africa are getting nervous regarding its gain in popularity in the East as the Plantation oil is cheaper to produce, the yields being higher and is far better in quality than the native product.

VARIETIES.

Many varieties have been described and named, and several are being grown in the Kuala Lumpur, and Serdang Experimental Plantations. The Kuala Lumpur palms are in bearing, but the general impression throughout the East is that the Deli type which is being grown in the N. E. I. and Malaya is the best type to grow locally, it is *Elaeis guineensis* var. *dura.*

Lisomb type, *Elaeis guineensis* var *tenera* appears to be the ideal type, it having a very thin shell but its drawback is that it does not breed true to type, and probably requires years of selection to make it safe for plantations.

It is doubtful whether there are any distinct varieties and, may be, they are only types of the one variety, showing variation in composition and character of the fruits.

Numerous experiments are being conducted on the palms on an area planted on the Government Experimental Plantation, Serdang, and the

question of types and varieties and the production of more suitable strains will be investigated.

These variations consist principally in the percentage of the pericarp and its oil content, the percentage of kernel and its oil content and the thickness of the shell. What is required is a palm producing large crops of fruit with thick pericarp having a high percentage of oil together with a thin shell and high percentage of kernel of high oil content or in other words we want the strain of palm which will produce the maximum amount of oil of best quality with the lowest costs of collection and manufacture.

The Deli type produces the largest fruit of the types being tried in Sumatra and Malaya.

CULTIVATION.

From observations made, the palm prefers alluvial soils that are well drained and will probably give best returns on coastal areas in the vicinity of the big rivers.

Palms grow very well on most soils except peaty, sandy or swampy areas. They will grow inland on gently undulating land and are being grown at an elevation of over 1,000 feet above sea level in Sumatra and are yielding well at over 2,000 feet in the Cameroons. Shallow peats overlying clays are not so objectionable.

It is necessary to prevent the loss of top soil by erosion from the time of clearing the jungle, and especially on undulating land, the usual precautions must be taken such as planting on contour, weeding systematically to eventually form terraces, silt pitting from which the soil is thrown above the pit to also form terraces and the growth of leguminous cover crops.

It is not usually recommended to grow catch crops although coffee or other suitable catch crops may be grown between the palms to provide revenue until the palms are in bearing.

The oil palm is propagated from seed, the time taken for germination varies considerably and when undertaking a planting programme it is necessary to help germination as far as possible so that plants may be available when required. Fresh seed is desirable and after removal of the pericarp, the seed is sown in pure sand in the sun and kept moist by constant watering, in this way a fairly high percentage of germination can be obtained in 2 to 3 months. Immediately the young leaf sheaths appear the seedlings are removed and transplanted in well prepared nursery beds about 12 to 18" apart each way, where they are left for a period of about 8 to 12 months until they are planted in the field. Many estates plant the seeds in well prepared nursery beds, rich in humus consisting of leaf mould and cowdung and without shade, the beds should always be kept moist, for convenience the beds should be close to water. Young seedlings without shade grow hardy and stocky whereas under shade the palms are inclined to get more leggy but make a faster growth. The plants may be put out in the field as small seedlings or up to 2 or 3 years old, but experience shows that 8 to 12 months old is best. Old seed is very slow in germinating and may take 12 months. All kinds of experiments are being conducted to find a method of quick germination. Hot fermentation, etc.

The distance apart of planting recommended is 30 ft. by 30 ft. on the equilateral triangular system which gives about 55 palms per acre. Sumatra 9 to 10 meters which is 28 to 32 feet. Holes are dug deeper than necessary for the plant and partly filled in by surface soil and the seedlings planted with the base of the leaves just above ground—it is essential that the leaves of the plants be kept above the level of the ground and deep planting must be avoided. The young palms withstand transplanting fairly well if the operation is carried out when the land is moist and during rainy weather—if dry weather sets in, then it is advisable to shade the plants with a few leaves until they are established.

The after-treatment consists of preventing erosion of surface soil, growing cover crops, and I would say that during the first few years *Calapogonium mucunoides* is likely to give good results at least until the palms throw too much shade. Giant mimosa kept away from the young palms is very popular in Sumatra. Sarawak bean is a very fine cover and will continue to grow under shade, and *Centrosema plumieri* and *C. pubescens* are to be recommended. Any of these covers will give good results for a few years on soils suitable for the growth of oil palm if they are established immediately after clearing the jungle. At the same time when choosing a cover I would pay due attention to the class of soil suitable to each one.

On the coastal areas it is advisable to cut "rantas" through the virgin jungle before clearing, and cut main drains to lower the water table before felling and burning, afterwards it is essential that the subsidiary drains be cut as the palms will not thrive in stagnant water, and on such land weeding costs are much higher and covers do badly. On land with a high water table scupper drains may be cut between the rows of palms and the soil thrown towards the palms, and in the monthly round of weeding the soil should be gradually worked towards the palms forming a wide ridge and shallow furrow.

Very little has been done in the way of manuring, but in mature palms the soil could with advantage be enriched by the ploughing in of green manures, or the growth of such plants as the *Tephrosias* or *Crotalarias* which are periodically pruned and the leaves and stems allowed to cover the ground forming a green nitrogenous manure and mulch.

The palms come into bearing about the third or fourth year after planting in the field.

PRUNING.

It is customary to prune the leaves at the base of the crown of the palms, but the leaves below the bunches of fruit should not be cut until the fruit is ripe, and as this pruning, if excessive, is liable to limit the producing capacity of the palms, the leaves being the manufactories of the plant, very mild pruning is necessary. In the past it has been observed that severe pruning has resulted in smaller fruit and reduced crops. Pruning has the effect of stimulating production of fruit for a time, after which the yield falls off, also the trunk of the palm grows thinner during a period of severe pruning and the palm grows taller than usual. Various degrees of pruning are being tried at the Government Plantation, Serdang.

POLLINATION.

In Sumatra it was observed that many palms produce female flowers but little fruit and it was thought that the flowers were not fertilized by the pollen of the male flower. This has since been proved by experiments in Malaya and Sumatra to be the case. In Kuala Lumpur by artificial pollination the palm has been made to produce bunches containing over 50% by weight of fruit whereas under natural pollination the percentage of fruit on the bunches dropped to below 20%. It has become a recognised estate practice to artificially pollinate female flowers at least on young palms and regular patrols are organised to carry out this work, and it is usual to patrol the estate once every three days; a cooly can pollinate about 20 acres a day or 60 acres in the three days. The operation is as follows:—The male flowers are sought for and cut when ripe, that is when they emit a strong smell of aniseed and are shaken in a large funnel which is placed over a bottle or other receptacle. The pollen if kept dry will germinate for some time after collection but it is advisable to use it as fresh as possible. The female flowers also emit the same scent when in a receptive condition, they only remain in this condition for about three days The pollen is dusted over the bunch of female flowers by a simple duster made from a tin with the lid perforated, the leaf stalk above the flower is marked with paint to record the operation, a different mark for each month is advisable; it facilitates harvesting. It is recommended in this way to breed from the best selected palms on the plantation for seed purposes by protecting the female flowers for a few days before and after fertilization. It is impossible to fertilise the flowers a day earlier or later than the receptive condition. Experiments and pollination are at present being conducted on young plants at the Government Plantation, Serdang.

THE BUNCHES ARE RIPE ABOUT 6 MONTHS AFTER POLLINATION.

Experiments have shown that artificial pollination can be carried to excess, resulting in reduced size of fruits and a thinner pericarp; the extent to which this operation may be carried on will depend on the quality of the land, cultural methods, etc. It is a question that will have to be determined on each Estate.

The crop is not evenly distributed throughout the year, and it is reported that the maximum crop is obtained during the dry season so that when installing machinery for dealing with the crop it is necessary to have a plant that can deal with more than the average yield.

As the palms get older and taller the costs of harvesting become higher. The bunches are systematically cut when ripe, and placed in long collecting sheds, in which they are stored on open racks of bamboo or wood—the fruit falls into a sloping catchment shelf placed below. Many of the fruits ripen in a day or so and fall on to the shelves below, and the remainder is removed fairly easily by hand. The separated fruits are then taken to the factory and treated as soon as possible—the oil from fruit that is stored too long, especially in heaps, or damaged by careless handling, deteriorates and free fatty acids are rapidly produced by a fat splitting enzyme present in the pericarp.

This is a very important point and the smaller the percentage of free fatty acid in the oil the greater its value. It must be the object of every estate to extract the oil from the fruit in the shortest space of time after it is ripe.

YIELDS.

Individual palms may yield from 6 to 10 bunches per annum and the weight of picked fruit per palm may vary from 45 to 145 lbs. per annum according to age.

The following table gives conservative estimates based on palms planted 55 per acre and calculated on the average percentage of pericarp, palm oil and kernel.

Reference Bunting and Georgi—Malayan Agricultural Bulletin, June and July, 1924.

Age of Palm	Fruits per palm per annum	Fruit per acre	Pericarp per acre	Palm Oil per acre	Palm Oil Output per acre (85% of total)	kernels per acre
4th Year	45	2,475	1,436	767	652	173
5th to 7th	90	4,950	2,872	1,534	1,304	346
8th to 10th	100	5,500	3,190	1,705	1,449	385
11th to 15th	125	6,875	3,988	2,131	1,811	481
16th to 30th	145	7,975	4,626	2,472	2,101	558

The Composition of Oil Palm Fruit of Malaya.

			per cent.
Fruit	Pericarp 58 per Cent.	Moisture	33
		Palm Oil	53
		Residue	14
			per cent.
	Nut 42 per cent. — Shell 85 per cent.	Palm Kernel Oil	43
		Moisture	15
		Residue	42
	Nut 42 per cent. — Kernel 15 ,,	Palm Kernel Oil	43
		Moisture	15
		Residue	42

Proportion of Palm Oil on whole fruit=31 per cent.

Proportion of Kernel on whole fruit=7 per cent.

Over the whole fruit there is about 3 % of Kernel Oil.

It will be seen that palms in full bearing will produce in round figures about 1 ton of oil, and about $\frac{1}{4}$ ton of kernels per acre per annum and as the oil content of the pericarp is about 31 % roughly 3 tons of fruit must be treated per acre per annum.

On a 1,000 acre Estate about 3,000 tons of fruit would have to be treated. On a basis of 350 working days per annum, about 8 tons per day, or 1 ton per working hour would have to be treated, but as the crop varies monthly, some months producing twice as much as others, it would be necessary to instal a plant having the capacity for a larger output, and during some seasons it may be necessary to work overtime.

Experiments in Medan, Sumatra, were carried out with a mechanical threshing machine for separation of the fruits from the bunches. It was found that the bruising of the fruits produced a very high free fatty acid

content of the oil, but by immersing of the bunches in boiling water before threshing the enzyme was destroyed and the chemical change was stopped and an oil with a low percentage of free fatty acid was produced.

Comparing the usual method with the threshing machine the disadvantages of the threshing machine method are that about twice the amount of material must be transported to the factory (about half of the bunches being waste) and that larger heating vessels are required.

The advantages are that no collecting sheds are necessary in the field and less labour is required. Reports state that the threshing machine method is the most economical.

In Sumatra I understand Estates have been satisfied with a percentage of free fatty acid not higher than 7% but the West African product is sold on a basis of 18% Free Fatty Acid, a premium is paid by the buyers for oil with a free fatty acid content below this amount at 1*s.* 9*d.* per cent. per ton. Free Fatty Acid in West African oil goes up to 50% — it should be brought down to 3 or 4% in the plantation product.

Up to recently the great problem with this crop has been machinery, which has been very expensive and inefficient, but Mr. B. J. Eaton describes two different makes of machinery in detail in the Agricultural Bulletin of December, 1924, one of which he has had the opportunity of observing at work at Wembley Exhibition and he states that the one he saw is a great improvement over earlier machinery, is almost automatic in action, is very efficient and simple in operation with prices comparatively moderate and can be supplied in any capacity even down to hand power. Tennamaram Estate in Salangor has one of these plants installed and in daily use. The one at Wembley having a capacity of 2 tons per hour had only two attendants.

The plant in question is being made by Messrs Manlove Alliot & Co. of Nottingham—for Nigerian Products, Ltd., the other plant is made by Culley Expressors, Ltd. This can also be supplied to treat 10 cwt. per hour down to hand power.

I would recommend any one interested to obtain the Malayan Agricultural Journal of December, 1924, and read Mr. Eaton's article. He describes both these makes of machinery in detail, giving the process in each case and comments on them.

The price of the Nigerian Products, Ltd., machine made by Messrs. Manlove Alliot & Co. Nottingham including engines, boilers, shafting and supports, packing and delivering to English port F.O.B. is about £6,500 for a plant having a capacity of about 2 tons per hour.

Culley Expressors, Ltd. supply a plant with a capacity of about 10 cwt. per hour packed and delivered F.O.B. English port £2,500, this does not include boilers, engines and shafting, etc.

Briefly the extraction of the oil and treatment of the fruit is as follows:—In the Manlove Alliot process the fruit is placed in a digestor and treated direct with steam to destroy the ferment, then it is placed in a centrifuge and the pericarp oil is expelled from the whole fruit—this operation also partly separates the pericarp from the nut, this is completed by a rotary separator. The oil is pumped to settling tanks heated by steam

coils to coagulate the suspended matter and afterwards run off into storage tanks from which casks are filled for shipment. It might be advisable to pass the oil through a filter press. The nuts are cracked by machines and the shells are separated from the kernels by immersion in brine, clay suspended in water acts equally as well as lime but is not so clean though it is cheaper, the shells sink and the kernels float. Tennamaram Estate have found it necessary to sterilize the fruit before using the M.A. & Co. Machinery.

In the Culley Expressors, Ltd., process, the fruit is placed in a steam jacket digester, and the steam does not come in contact with the fruit. It is afterwards depericarped in a patented machine without water, for which it is claimed the objections to former machines have been overcome. The oil is separated from the pericarp by a centrifugal extractor. It is then pumped into settling tanks and from this it is filtered into storage tanks, or casks for export. The nuts are cracked, and the kernels separated from the shells much the same as the former process.

The Culley people state that the water or steam direct on the fruits cause a development of Free Fatty Acid and glycerine which is lost in the water. Mr.B.J. Eaton is of opinion that this is of no consequence.

The kernels are exported in sacks and in view of the demand for them in the Home market it is unlikely that the oil will be extracted in this country. The kernel residue after the extraction of the oil is used as a food for stock.

One or more Sumatran estates are extracting the oil from the residue with a solvent instead of final pressing or centifugal machinery. The solvent which is benzine is recovered, and used over and over again; I would say that if a solvent is used then the whole oil should be extracted in this way, and eliminate all the other machinery. The solvent extraction will remove all the oil from the pericarp.

BARRELS.

At present Californian fir and English oak casks are used costing about $ 8 per cask. Experiments are being conducted in the Forests Departments of Malaya and Sumatra to endeavour to find suitable local woods. Metal containers have been used in the past with little success, they being more expensive than casks.

Palm oil is used in the manufacture of soaps, candles, lubricating greases, and in the manufacture of tin plate; high grade oil (that is pericarp oil) is used for edible fats. In view of the larger supplies of plantation produced palm oil which is as mentioned previously of higher quality than the native product—this market is likely to expand and palm oil will compete with coconut and palm kernel oil in the preparation of substitute bu ter and cooking fats.

Experiments in 1917 were being conducted in Belgium in running a crude oil engine on low grade oil with reported success.

Palm kernel oil is principally used for edible purposes. I might here mention that the F.M.S. Railways have reclassified palm oil freights from rates at 4/5 of a cent per picul per mile which is the ordinary freight on oils to 2/5 of a cent per picul per mile.

PESTS.

The pests so far have not been very serious, but, when large areas are planted we must expect more damage, and consequently greater costs will be involved in keeping them in check.

The pests so far noticed are the same as attack the coconut palm and, the principal ones are the coconut beetle (*Oryctes rhinoceros*) and Red striped weevil (*Rhynchophorus schach*).

There is a disease which affects young palms and is known as "Crown disease." This causes the leaves to fall down and the crown gets a twisted appearance. As a rule after some time the palm recovers and assumes the normal growth. This disease has not been investigated as far as I know, but it probably has a physiological origin and may be due to the overgrowth of the leaves in comparison with the roots.

Rats, pigs and porcupines have been observed to damage the bunches of fruit on young palms, and to pick out the seeds from the nurseries. Unripe fruits damaged by pigs may be harvested when ripe without fear of giving a high percentage of Free Fatty Acid.

Experience in Malaya has proved that this crop is well worth cultivating.

Tennamaram Estate expect to pay a dividend in 1925.

A comparison of coconuts and African oil palms at 10 years old will be of interest.

The yields of the oil palm are based on estimates only, as per the table mentioned earlier.

Coconuts, say yielding 60 nuts per palm per annum and 55 per acre gives 3,300 nuts per annum or about 16 cwt. of copra.

16 cwt. of copra at £29 10*s*. per ton=£23 12*s*. which is a very high yield and much above the average.

OIL PALM RETURNS.

Say 10 year oil palms produce 16 cwt. of oil at 85% extraction and 4 cwt. of nuts.

London prices September, 24th	Sumatra oil	£36 2*s*. 6*d*. per ton
	Palm kernels	£20 15*s*.
	16 cwt. oil	£28. 18*s*
	4 „ kernels	£4 3*s*.
		£33 1*s*.

The oil below 18% Free Fatty Acid would obtain a premium of 1*s*. 9*d*. per cent. per ton, for each per cent. below 18% as granted by the buyers, and with improved machinery this should be brought down to 3 or 4 %. The yield of oil palms will increase probably for several years after the 10th.

The cost of depreciation and running machinery must be charged against the oil palm as no machinery is necessary in the preparation of copra.

The above estimates of oil palm returns are probably on the conservative side under good cultural methods.

I might here mention a few main points in the acquisition of State land for the cultivation of the African oil palms. Premium of $3 per acre or such smaller sum as is approved by the Resident.

Rent 50 cents per acre for 6 years and thereafter $2 per acre. Export duty 2½% *ad valorem* or such other rate as is from time to time published in the *Government Gazette*.

Land shall be used solely for the growth of an oil palm or such catch crops as are approved of by the District Officers.

On areas over 200 acres 10% of the area must be reserved for food production.

There are also rates of planting per year and labour conditions.

For further information on African oil palm please refer to :—

Malayan Agricultural Journal, June and July, 1924, "The Oil Palm in Malaya" (Bunting and Georgi).

Malayan Agricultural Journal, December, 1924, "Recent development in Oil Palm Machinery" (B. J. Eaton).

Malayan Agricultural Journal, April-June, 1921, "The Oil Palm in Sumatra," (J. N. Milsum).

—The Malayan Tin and Rubber Journal, Vol. XIV. No. 5.