PREFACE

to

First Draft

Catalogue Of Agronomic Practices Of MALAYA

Ref. WRS 3.81
30.3.64

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Catalogue of agronomic practices of Malaya

Introduction

The science of agronomy has been given various definitions, but whether taken in its broadest or its narrowest sense it is essentially a synthesis of the agricultural sciences, bringing together to the improvement of plant culture - to higher levels of productivity - the disciplines of agricultural biology and economics. The process of synthesis brings to light the weaknesses in our knowledge of the component disciplines which together contribute to agronomy, and the idea of a catalogue arose from the thoughts of the author of this project on the problem of presenting a clear unequivocal picture of how to grow crops in Malaya by advanced agronomic methods. To illustrate the false conceptions of agronomy which can arise, it is appropriate to quote the words of one student who, in a report on an estate, stated that "this estate does not adopt modern agronomic practices because it is essentially a business concerned with profit." In the philosophical sense of "Freedom from Hunger", this student's statement is acceptable in that one must push the level of production beyond that which we regard as strictly economic at the present time, but in the short term sense, indicated by the context, the statement arose as a misconception of the idea of agronomy. The need to exercise students minds in the art of bringing together the divers items of fact and principle is very real.

The function of the catalogue

The main divisions of agronomy are:-

(a) The knowledge of the fundamental principles of crop culture.

(b) The application of that knowledge to individual crops and local agricultural systems.

The fundamentals of agronomic practice are not strictly Malaysian in character, but the range of conditions from cold-temperate to equatorial cannot be taught satisfactorily at the opposite end of the range of conditions to that in which the student will ultimately work. The culture of specific crops is absolutely dependent on a knowledge of local conditions. Methods of improved crop culture are dictated by those local conditions. There is at the present time a revolution being conducted in tropical crop agronomy especially in such subjects as the approach to the problem of variability of the tropical environment, the questions of soil and soil surface management, the use of herbicides and agricultural chemicals, mechanisation, logical land use, etc. Reviewing these general topics lies outside the brief of this catalogue. The author has indicated, at appropriate points in the text, where improvements in present agronomic practice might be effected by taking into account the advances of knowledge of the principles of agronomy. The form of the catalogue recognises that changes in agronomy are taking place rapidly and this first draft is designed to bring the data in the catalogue under scrutiny before it is committed to printed form. The present form allows for the insertion of supplementary data, the replacement of sections and the addition of pages to sections. In spite of attempt to standardize the catalogue, owing to differences in treatment of the subjects by the participants some variation in the aptness and quality of the text occurs and a considerable improvement and extension of the bibliography is indicated.

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The format of the catalogue

It is doubtful whether a text-book of agronomy is ever read as literature and it is even more doubtful if a text-book, in semi-literary form, is the most appropriate means of imparting information to the student. On the other hand, it is perhaps moving too far in pursuit of the analogy between the human brain and a computor to adopt a FORTRANS syntax, but the author considers that the catalogue does not suffer by having its information laid out in the form of a series of statements preceeded by an address, i.e. each crop is given a numerical code-position and the information for each crop is supplied in the same sequence of sub-headings, similar information for different crops occurring under the same numerical sub-head. This means that, against the sub-head numbers for different crops, there may be large differences in the quantity of information available and that further divisions have had to be included to allow for the specialized treatment of information on particular crops. The decimal points after the sub-heading and the alphabetical sub-paragraphing are not standard for all crops but follow from this change in quantity of specific information from crop to crop.

Use of diagrams

It is hoped that, in the final version of this catalogue, further diagrams and illustrations will be included where these are efficient means of conveying information. In particular, these will be concerned with distribution, developmental pattern and ideograms of varietal differences.

The crop coding

Information cataloguing and retrieving has now become a major science and it is difficult to draw a line between too little and too much attention to the ordering of the extension to personal memory. After careful consideration of the coding method used in Biological Abstracts, the Library of Congress, the Universal Decimal System and the various divisions of the Commonwealth Bureau dealing with crops i.e. Herbage Abstracts, Field Crop Abstracts, Horticulture and Plantation on Crop Abstracts and the Commonwealth Bureau of Plant Breeding and Genetics, it appeared to be desirable to create a separate "humid-tropics" specific catalogue. This was done to avoid the very uneven distribution of information within divisions which occurs using a code-system based on world agriculture or temperate-zone agriculture, particularly as the majority of reported research is still on the crops of the temperate zone. By contrast, therefore, the major plantation crops have been assigned major divisions in the catalogue.

Comment

This cyclostyled information is being made available in advance so that the project may be subjected to thorough scrutiny and an interim stage. The compiler would therefore appreciate comments not only on the data presented, but also on such features as the coverage of crops, format, literary style, information view-point, possible changes and additions to the text, etc. (It will be noted that rubber and rice are omitted from this first draft. These crops present major problems of condensation and editing of data. Their husbandry is also well documented, the research problems are known and are being tackled. There is therefore not the urgency to collect information as occurs with other crops.)

W. R. STANTON
30.3.64

PLANT SCIENCE 111 (Agronomy)
Course Notes Section No.3
(Prepared by W.R. Stanton 17.5.1963)

Subject: WHAT A STUDENT SHOULD KNOW ABOUT EACH OF THE CROPS COVERED BY THE COURSE

The following notes are designed to assist in the systematic collection of data to obtain comprehensive notes on the culture of individual crops. The detail into which the student should probe depends on the relative importance of the crops in Malayan husbandry. It is intended to use this system of a standardized format to compile a catalogue of the methods of culture of the principle crops in Malaya, which will then be available to students for reference after leaving the course and for subsequent students on the course. The details will be subject to revision from time to time.

Some of the information about aspects of culture of particular crops is not yet available, because the data has not yet been collected or the necessary research has not yet been done. However, the headings will in such cases be of value in indicating the aspects of the culture of crops on which research is still required. It is possible that the information required under one of the headings below cannot be represented as a simple statement of figure, in which case the information should be set out in tabular from by varieties, states, ethnic groups or other classifications. In answering the questions about each particular item of crop culture, it should be remembered that the data is desired for Malayan conditions. Where the information is only available from other regions or territories, this should be clearly stated.

ITEMS REQUIRED

1) Botanical name of the crop and family, its various local names, (stating the language in brackets after the name). It may be necessary to divide this statement into the names adopted in different states of the Federation.

2) The use or uses of various parts of the crop.

3) The geographical distribution and the diversity of forms to be found in different parts of Malaya. If the number of varieties is extensive, it may be necessary to refer to bibliographies on the subject of to create an appendix of names.

4) When the crop was introduced into cultivation generally and how.

5) When the crop was introduced into Malaya.

6) How the crop spread through Malaya.

7) The acceptability of the crop in Malaya by different ethnic groups, different social groups and in different parts of the country; its position in the agricultural system and the comparison between its position in the agricultural system in Malaya and that of other tropical countries.

8) The general cultural requirements of the crop in the field under the subheadings: rainfall and water, aerial humidity, soil type, shade requirements, nutrient status, wind protection etc.

9) Method of sowing seed, transplanting seedlings and other nursery operations.

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Draft* Malayan Agricultural Practice, Catalogue Section 82.65
(Project supervisor: W.R.Stanton)

THE RAMBUTAN

1. Family: Sapindaceae.
Botanical Name: Nephelium lappaceum, L
Local Name: Rambutan (Malay). Throughout Malaya
'Rambut' = hair.

2. Use: Tree fruit: widespread popularity in Malaya, Indonesia, Philippines.

3. Geographical Distribution and Diversity of Forms.

3.1 Cultivated throughout Malaya. 25% of fruit grown as sole crop = 6,000 acres. Total acreage: 24,000 acres (1958) - 61% mixed kampong cultivation; 8% as main or dominantcrop.

3.2 Indigenous tree medium size: 30' - 50' in height. Leaves: petivolate, alternate, pinnate. 2 - 4 leaflets in pairs, leather. Inflorescence: widely branched, axillary and terminal. Greenish - white flowers covered with very fine, soft, short hairs. Perfect, or male, or female. Usually monoecious. Fruits produced in clusters of 10 - 30. Fruit: oval or round; vary in size. 7 cm long. 50 gm. in weight. Colour: red, yellow orange. Edible portion is translucent, pearly white pulp. Juicy and sweet. Flavour varies - very sweet to acid. Aril thick or thin, adheres to seed coat or parting easily. Fruiting life: 10 - 20 years.

3.3 Varieties ( )+
Ochse : 7 district varieties.
( )+
Popenoe: 15 varieties.
( )+
Whitehead: 35 varieties. 11 important in Malaya:

Ref.	Name	SERONG COLLECTION	origin year
R1	Choo Ang	Penang,	1932
R3	Peng Th'ng Bee	Penang,	1933
R4	Ya Tow	Penang,	1933
R6	Ayer Mas	Penang,	1933
R7	Kepala Besar	Penang,	1933
R9	Tau Poh Cheng	Penang,	1933
R10	Azimat	Selangor,	1933
R11	Bara	"	1933
R12	Kelip-2	"	1933
R86	Singapura	Singapore,	1939
R99	Triang	Pahang	1939

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10) Preparation of site for the growing crop and its pre-treatment.

11) Planting and sowing giving fertilizer requirements etc.

12) Husbandry during development under the following subheadings: weed and weed control, thinning and transplanting, pruning and shaping, pests and diseases and their control, fertilizer requirements (others than the fertilizer used prior to planting), cover crop management.

13) The developmental pattern of the plant. That is, information on the duration of the different stages in development.

14) Methods of harvesting the crop.

15) Methods of processing and storage. Here reference may be made to the bibliography where the methods are complex.

16) Current experimentation on:

a) Improved varieties.
b) Improved nursery technique.
c) Developments in management of the growing crop.
d) Developments in harvesting methods.
e) Developments in storage and processing.

17) Brief discussion on the problems which the crop still present in culture and harvesting and a discussion on its future prospects as an important crop in Malaya.

18) A general bibliography on the crop.

Compiled by W.R. Stanton
29/8/1963

3.4 Quality assessment based on public demand and price offered in open market.

Quality Assessment

Quality	Varieties
Good	R3, R4, R7, R12
Fair	R6, R10, R84, R99, R86
Poor	R11, R61, R68, R81

* liked by Europeans only

Average Retail Price (Selangor)

good..... $2/- per 100
average.... $1.50 per 100
poor..... $1 per 100

3.5 Fig. 1 Distribution of Rambutans.

* Seminar material. Not to be quoted this stage.

+ (Correct the format - WRS)

3.6 Fig. 2 Histogram showing total acreage of rambutans, from 1951-55.

4,5,6. Indigenous. Used from time immerial.

7. Position of Rambutan in Malayan Agriculture

Fruit cultivation in Malaya not developed. Found village orchards, with spices planted at random. Surplus over home consumption is sold. Important trend towards planned orchard in which one species is grown as a main or sole crop. Rambutan, citrus and durian most important home grown fruit trees.

8. General Cultural Requirements

Rambutan strictly tropical tree. Humid, hot, well distributed rainfall. Also in region of not more than 4 months dry seasons.
Soil: various. Best - deep, well drained, loamy soil.
Reponds to good cultivation.

10,11. Planting and Propagation

11.1 Vegetative propagation used to ensure good quality fruits (Lambourne, yr.)

* 1. marcotting
* 2. the etiolation method.
* 3. budding.
* 4. grafting

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11.2 Seed propagation: seeds viable for short period; percentage of germination low after two weeks. Will not germinate after one month. Pulp removed, seed planted horizontal with a small portion exposed. Will germinate 9 - 19 days. Use containers or germination beds. Shade.

11.3 Transplanting: greatest loss as rambutan intolerant to root disturbance. Sever taproots when seedling stocks are 6 months old. Budded plants at 1 month. Lifting best done between flushes of new growth. Liberal watering important and shade for transplanted plants.

11.4 Planting: Various planting distance suggested. 35 feet apart recommended. Large enough planting hole. Mix top soil with 50 - 100 gm of commercial fertilizer or shovelful of well rotted compost. Crown of roots not deeper than they were in nursery or container. Soil firmly packed and liberal watering.

12 Husbandry

12.1 Weed control: Usual procedure, according to degree of infestation.

12.2 Thinning: Necessary if planting distance was close initially.

12.3 Pruning: to fill spaces available. Carried out when necessary.

12.4 Pest & Diseases: reports of disease rare. Fomes lignosus can kill the tree. Leaf eating insects. Control: Range of proprietary. Insecticides - as for citrus. Fruit eating bats and flying foxes - worst pests. No effective control known yet.

12.5 Fertilizing: No specific direction due to lack of experimentation. Mixture of N, P and K fertilizer amount proportionate to tree size. (Citrus as a guide - WRS). Magnesium limestone convenient form used. Cattle manure desirable additive especially during early years and applied at 4 or 5 times at interval of 12 months. RRI mixture C2 suitable for early growth on all but sandy soils. RRI mixture Y used for trees sufficiently matured to bear fruits.

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Application of 3 dressings each year. 1st application is heaviest and done immediately after harvest and subsequent prunning, the second after flowering and the third during early fruit development. Fertilizer application made away from the trunk. Broadest on the soil in a ring around the young trees extending from a little away within the canopy to a distance of up to 2½ times the radius of the canopy measured from the trunk.

(Contouring, terracing, sod, cover-crop or clean culture - no data - WRS)

13 Developmental Pattern

Flowering period varies with seasons and districts. General rule April/May and September/October. Fruits ripen in July/August and December/January. Two crops not usually obtained from each tree each year, though this may happen occasionally and if so, one crop small.

Variation in flowering date not necessarily associated with lattitude. Evidence that almiate variations influence, flowering and thus harvesting. Evidence inadequate but rainfall distribution and possibly temperature difference may account for the variations. More work to be done on other developmental aspects. (See Fig.III).
(Possibility of phenomenon being analagous to biennial boaring - WRS).

14 Harvesting

Seedling takes 5 to 6 years to grow into bearing. Grafted will bear fruits in 4th year. Picking of fruit involves the whole of the panicle or cluster from tree. Picking done on tree itself by climbers or using ladder. Hand picking or using special cutting knives attached to poles. Improved grafted trees lower in height and thus easier for picking: Harvesting date vary with seasons and places. (Fig. 3 Harvesting date of rambutans.)

15 Rambutan seasonal and perishable crop. During harvesting season in one area may bring glut of fruit for a period. Distribution of fruit is very poor. Possibility of preserving rambutan for consumption outside glut seasons important. Investigation shows that a product of acceptable quality can be obtained by canning certain varieties of rambutan. Canned rambutan produced by RIDA. Work still going on.

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16 Current Experimentation:

Rambutan Variety Trial

Planted - 1948 at F.E.S. Serdang. Designed to provide information on relative fruit quality, flowering and harvesting dates, age at bearing and relative profitability of 15 varieties. Soil Serdang sandy loam. Budgrafted plant used. 1948 at Degong Agric. Station, Lower Perak. To determine relative yield and vigour of 6 varieties. Alluvial clay soil, budgrafted trees used. To date variety trials are still being carried out at the FES and result and findings* are yet to be published.

* Available at Serdang? - WRS

Developments in Storage and Processing.

Under investigation with a view of developing the cottage industry of the country.

17 Discussion

The cultivation of tree fruit crops in Malaya has not yet developed to an extent comparable with that of their temperate and sub-tropical equivalents. A large number of village orchards consists of a mixture of various fruits species planted at random. Fruits from these orchards is sold when it is a surplus to home requirements but income from such source is often looked upon as windfall and is not considered as a planned feature of the domestic economy. There is however an important and increasing trend towards the cultivation of planned orchard in which one species of fruit is grown as the sole crop. This trend is occurring with durian and rambutan and in particular with citrus. If the rambutan is to be cultivated and developed into a main fruit crop for home and export, then a more research is required on variety improvement, mursery techniques, orchard management, harvesting, storage and processing, and improved marketing and distribution.

18 General bibliography (Revise - WRS)

Valmayor, R.V. et al, (1961) Rambutan - varieties, and culture.
Popenoe, W.(1927) Manual of tropical and sub-tropical fruits. MacMillan & Co. New York.

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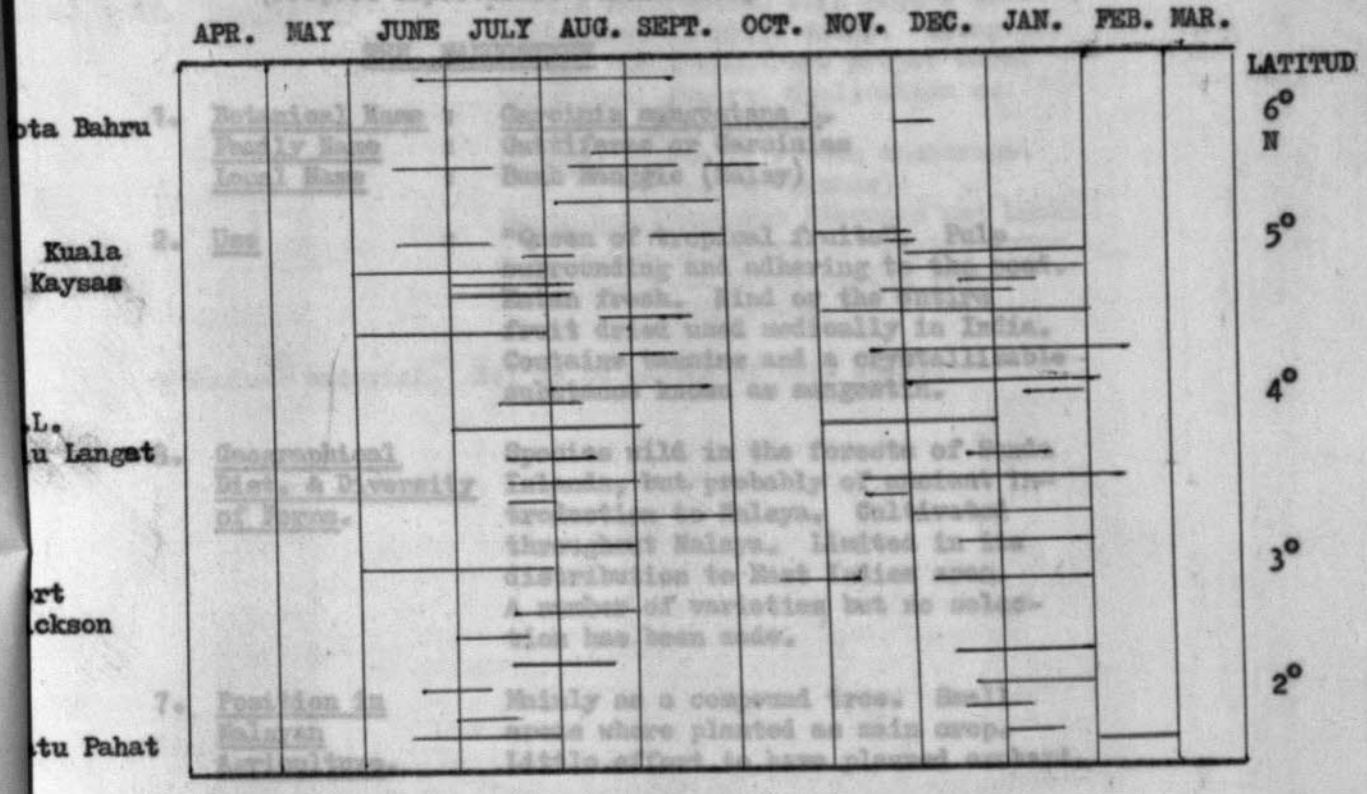
FIG. III

HARVESTING DATES OF RAMBUTAN



- (SOURCE: M.A.J. Oct.42) -

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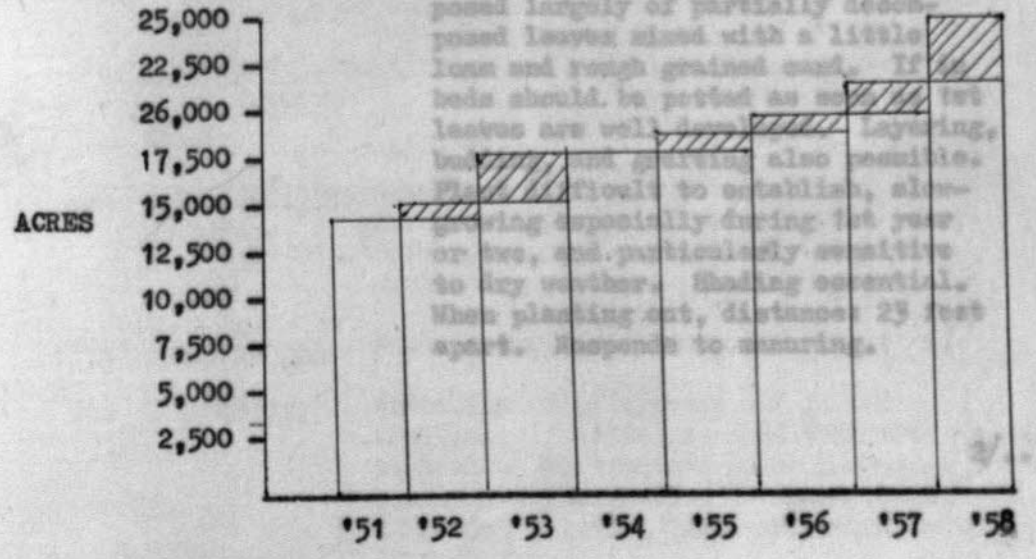
FIG.2

HISTORARY SHOWING TOTAL ACREAGE OF RAMBUTAN FROM 1951-1958



Draft* Malayan Agricultural Practice Catalogue Section 82.63
(Project Superviser: W.R.Stanton) Date 31.3.64

THE MANGOSTEEN

1.	Botanical Name	:	Garcinia mangostana L.
	Family Name	:	Guttiferae or Garciniae
	Local Name	:	Buah Manggis (Malay)
2.	Use	:	"Queen of tropical fruits". Pulp surrounding and adhering to the seed. Eaten fresh. Rind or the entire fruit dried used medically in India. Contains tannins and a crystallizable substance known as mangostin.
3.	Geographical Dist. & Diversity of Forms.		Species wild in the forests of Sunda Islands, but probably of ancient introduction to Malaya. Cultivated throughout Malaya. Limited in its distribution to East Indies area. A number of varieties but no selection has been made.
7.	Position in Malayan Agriculture.		Mainly as a compound tree. Small areas where planted as main crop. Little effort to have planned orchard.
8.	General Cultural Requirements		Strictly tropical in its climate requirements. Soils: (specific) high clay content (alluvial); water table about 6 ft. below surface. Well drained with plenty of decayed vegetable matter. Shade required as provided by rubber trees. Responds well to manuring and thrives up to 2,000.
10.	Planting and Propagation:		Propagation usually by seed. Seeds sown in pots or boxes under cover.
11.			Fresh seed essential. Use soil composed largely of partially decomposed leaves mixed with a little loam and rough grained sand. If in beds should be potted as soon as 1st leaves are well developed. Layering, budding, and grafting also possible. Plant difficult to establish, slow-growing especially during 1st year or two, and particularly sensitive to dry weather. Shading essential. When planting out, distance: 25 feet apart. Responds to manuring.

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12. Husbandry: Little information with regard to management of fruit trees. Young plants needs shade and proper care.
Manuring: general application as Rambutan.
Covers: Use of covers encouraged (as for Rubber)
Pests and Diseases: Diseases not known or reported. Flying foxes and fruit eating bats - main pests.

* Seminar material. Not to be quoted at this stage.

1. Family : Bombacaceae.
   Botanical Name: Durio zibethinun Linn
   Local Name: Durian (Malay)
   Lowleen (Cantonese)
   Lewlean (Hokkien)

2. Use: White custard like pulp surrounding the seed is highly relished. Pulp usually eaten raw. "Tempoyak" - fermented pulp. Pulp also made into "durian cake". Pulp made into "sugar", and also eaten raw with rice. Added to a number of food preparations. Skin of fruit used as mulch and fuel when dried. It has been claimed that the fruit has great rejuvenating power.

3. Geographical Distribution and Diversity of Forms: Now seldom found in the wild state. Considerable variation in size, quality of fruit. Some have stronger odour than others. Very large kind (Durian kepala gajah) weighs from 10 - 15 lbs. Certain localities reputed for special flavour of fruit.

4. When introduced into cultivation: Indigenous to sporadically until recent times, but more frequently wild trees conserved and widely distributed in Malaya.

5. Introduction: Indigenous.

6. Crop spread in Malaya: Presumably by tridal movement.

7. Position in Malayan Agriculture: Though at the moment more of a door yard fruit cultivated randomly and mixed with other fruits, increasing trend towards planned orchard cultivation. Great popularity of fruit provides incentive for improved cultivation. Selection of varieties needed.

8. General Cultural Requirements: Soil : deep, alluvial or loammy. Hot, humid conditions best. Thrives up to 2,000 feet.

9. Acceptability of Crop: Human reaction to durian varies. European find the odour extremely offensive. Local people relish the fruit.

10. Planting and

11. Propagation: Readily raised from seed if sown fresh. Viability of seed short and germination poor if seeds are more than one week old. Germination takes 8 days. Planting distance: Due to large spread of roots, planting distance should be 50 feet apart.

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12.	Husbandry:	Once established needs little care. No detailed information on optimum cultural conditions.
13.	Developmental Pattern	Germination: 8 days. Tree fruits about 8 years after planting. Flowering: March or April. Fruiting: July or August with subsidiary fruiting at end of year. Flowering and fruiting period may change due to abnormal season. (c.f. rambutan)
14.	Harvesting:	Ripening fruit drops naturally. Small hut erected under or near orchard and wait for 'sound' of fruit dropping. Usually a number is collected in the early morning.
15.	Processing and Storage	Due to seasonal glut, need for preservation. Fermented pulp or 'tempoyak' is an old method. Hygienic method can improve cleanliness. Durian cake wrapped with paper or canned.
16.	Current Experimentation.	Variety trials carried out at Serdang but no records available.
17.	Discussion	Considered as 'royal' fruit'. Investigation required on all aspects of culture and marketing of this fruit.
18.	General Bibliography	Popenoe, W(1927) Manual of tropical and sub-tropical fruit. M.A.J., (1935) Malayan Fruits - MAJ Vol. 23, No.3 p.129 Macmillan H.F. (1956) Tropical Planting and Gardening. Wilson, ( ) Marketing of Durian fruits, MAJ Vol.XXXVII No.4 p. 215. Burkill? Allen, (Mrs.) B.M. in press

Draft* Catalogue of Malayan Agricultural Practice Section 43 ..
(Project supervisor: W.R.Stanton)

SORGHUM (GRAIN)

1. Botanical Name : Sorghum vulgare, Pers
Family : Gramineae
Malay : Jagong
Tamil : Cholam

2. Uses

Sorghum is used as human food in parts of Africe, India, Indonesia, arid and semi-arid parts of the tropics generally. In USA, Australia and parts of South America the grains are principally used for animal feed. The grains may be used for the manufacture of fermented (alcoholic) drinks, whilst the vegetative parts of the plant can be used for fodder or silage.

3. Geography - (General and diversity of forms - (Sweden 1935 - WRS)

3.2 Geographical Distribution in Malaya

In Malaya this grain crop is not widely grown on account of the difficulties confronting harvesting and storage. Prompt harvesting is a necessity in moist environments. In 1886 Cantley, after trying it at Singapore, reported that he had difficulty in consequence of insect attacks so that it became difficult to save enough grain for the next season. During the rice scarcity of 1917 - 18 it was advocated and, though in 1919-20 a small plot in Singapore yielded fairly, in 1920-21 it failed. The earlier successes were attributed to suitable weather condition. Better successes were reported from Selangor (Bunting and Milsum, (1931). Sorghum has never been a regularly accepted crop in Malaya and this is the reason for absence of literature on it in this country.

4. Introduction into Cultivation - General *

Sorghum is apparently indigenous to tropical Africa.+ It was grown in Assyria before 700 B.C. The first 'sorgo' or sweet sorghum was introduced into the USA from France in 1853. The most important shipment of sorgo was that of 16 varieties from Natal, in South Africa in 1857. These were the progenitors, and probably the identical types, of several of the varieties grown widely today in America.

* Seminar material not to be quoted at this stage.

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At least two varieties of sorghum called chicken corn and Guinea kafir were introduced by slaves from Africa into America.

Sorghum was unknown to the Greeks. After the time of Christ Persia acquired it. It has no Sanskrit names and it is thus believed that India can only have received it during the Christian era. In India it is called Jowar or Jowari.

5. From India it was most probably introduced into Malaysia. The period of introduction is not known.

6. Spread in Malaya

Although the crop is quite important in the neighbouring countries like Java, it never became sufficiently important to be cultivated widely in Malaya. It is quite impossible to trace its distribution pattern in Malaya as it is not a regular crop. About the only time when the crop was grown in appreciable quantities was during the Japanese occupation when it became a favourite substitute for rice, especially amongst Indians.

7.1 Acceptability by the ethnic groups in Malaya.

The Malays and Chinese do not like this grain and the Indians are about the only people to welcome it, even during the period when rice was scare (Japanese occupation). It may be assumed that sorghum production in Malaya is insignificant when compared to that of other countries like Indonesia where it is mostly grown in Java in order to cope with the shortage of rice to feed the island's densely packed population.

7.2 World production (1955) (revise to 1964 - WRS)

In 1955 world production of sorghum amounted to 34,560,000 metric tons of which 25,420,000 tons were grown in the Far East; 6,160,000 tons in USA; 1,750,000 tons in the Near East; 750,000 tons in Africa;* 120,000 tons in Australia; and 40,000 tons in Europe. China and India are the predominant centres in the Far East with the former accounting for nearly 50% and the latter 25% of sorghum produced in Asia F.A.O. Statistics (1956).

8. Cultural Requirements+

8.1 Climate: (might be better under 3 - general geography. Bennett Food-crop climates 1960)

Like maize, the sorghums were originally tropical plants, but are now cultivated in nearly every part of the tropic and the temperate zones. Most of the acreages lies between 40° - 45° N Lat. and 40° - 45° S Lat. They are well adapted to aris and semi-arid regions too dry to produce maize.

The most favourable mean temperature for growth of sorghum is 80°F. It cannot tolerate frost.

Sorghums are well adapted to regions of limited rainfall where average annual precipitation is only 17-25". However, sorghum is highly productive on irrigated land (and under higher rainfalls - WRS)

* Statistic questionable - Probably larger - WRS.
+ quote authors.

The plant remains practically dormant during periods of drought, but resume growth as soon as there is sufficient rain to wet the soil.

8.2 Soil

Sorghum is grown successfully in almost all types of soils. In moist seasons the highest yields are obtained on heavy soils but in dry seasons it does best on sandy soils. Sorghum will tolerate considerable quantities of alkali or salts.
(Might be important in some coastal areas of Malaya.)

10. Preparation of site

Warm mellow seed bed is essential to good seed germination. This may be achieved by manual labour or by machinery. The land is ploughed, harrowed to get a suitable tilth. A rotovator may also be used for pulverising the soil. In America it is claimed that yield may be increased by 25% through proper and thorough seed bed preparation. (But consider trash farming methods - WRS)

11. Planting

Sorghum is planted in rows 36" - 44" apart whilst the distance along the row can be 14" - 21" apart (6" - 21" - This is for 'dwaf' sorghum - WRS). This spacing along and between rows depends on tillering habits of the variety. It is advantageous if sowing is done at a time when there is enough rain. Planting is preferred under conditions so that soil moisture (rain or irrigation) is not limiting during the earlier stages of growth. (But note sorghums tolerance of an erratic rainy season - WRS). A shower in every 4 or 5 days is sufficient until tillering time. IN Malaya sowing can commence in October or early April.

Fertilizer requirement is similar to that of maize (already described), but for sorghum application may be less liberal. Details for Malaya not known.

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12.1 Weed control

For maximum yield efficient weed control is very important, especially during the early stages of its growth when the foliage is not yet able to suppress effectively the growth of weeds. After tillering if proper weeding had been done earlier no further weeding is necessary as by then the leaves should be dense enough to prevent weed growth. For smaller areas hand weeding is sufficient but for larger areas mechanical weeding or use of selective weed killers. (hoeing, ridging?)

12.2 Pests

Insects: The most destructive insect pests of sorghum are the cinch bug, sorghum midge and aphids.

12.21 Cinch bug (Blussus lencopterus)

This is a sucking insect that feeds varaciously on the leaves and sheaths of the sorghum plant. Spraying with insecticides e.g. chlordain, bensene hexachloride will kill the bugs quite effectively.

12.22 Sorghum midge is abundant in the southern states of USA. The midge is small with a red body and it lays its eggs inside the flower at anthesis. The larva absorbs juices from the ovary and thus prevents seed development. Effective preventive measures are best in controlling this pest. In the southern states of America this is done by planting early in the season so that the plants flower before the midge is plentiful. Matthee and Oberholzer (1959).

Recommended measures for control of sorghum midge are:

(a) Use of varieties with uniform and brief flowering stage.
(b) Cultivation to ensure uniform stand.
(c) Spacing to allow as few side shoots as possible to form.
(d) Early planting so that flowering is complete early.
(e) Eradication of wild sorghum spp. flowering near the crop (sp. occurring in Malaya?)
(f) Removal of ears which flower before main crop.
(g) Burning any remaining chaff in spring to destroy dormant and resting larvae.

Spraying with DDT on full grown crop will help control the pest to some extent.

12.23 Aphids (Aphis maidis)

This insect is a serious pest of sorghum when occuring in large numbers. Malathion sprays are effective. In addition preventive measures as for sorghum midge are also recommended.

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12.3 Diseases:

Leaf spots

Bacterial leaf spot diseases include stripe caused by Psendomonas andropogoni, spots caused by P. syringae and leaf blight caused by Helminthosporium turcicum.

14. Harvesting

In America, Australia, and the other advanced countries which grow sorghum extensively, harvesting is usually done with a combine. The crop is ready to be harvested when the grain contains 13% moisture or less, unless provision is made for drying the grain. The cheapest method of drying is to dump the threshed grains in long low tiers or piles on a clean dry sodded area. Artificial drying is also frequently carried out.

The chief contribution that can be made in producing hybrid sorghum would be to release disease resistant varieties with seedling vigor and resistance to lodging.

16.2 On Management of Developing crop

In Queensland Passlow carried out (1960) field trob during 1951-56, in which the effectiveness of eight insecticides was investigated. The results indicated that spraying of a well grown crop, with 1.1 kg. DDT/ha. in not less than 170 litres of water, would be economically sound.

At Tozi (Sudan) kernel smut (caused by Sphacelotheca sorghi) is completely controlled by seed dressing with organo mercurials. (Clinton, 1961).

On Storage

"Research on Farm Drying and Storage of Sorghum Grain". The maximum moisture content for the safe storage for one season of sorghum grain in S. Texas was found to be 12% where grains were not turned or aerated. Storage for more than one year required a moisture content of 11%. Sorghum grain containing 12-14% moisture which was aerated or turned during storage was stored safely for 9 months. Grain with a moisture content high than 14% could not be stored satisfactorily. The drying of grain containing 18% moisture with heated air required an air flow or 25 C fm/hushel with a maximum grain depth of 8 ft. It was essential to reduce moisture content of all grain to 15% within 8 days in order to prevent growth of moulds. (Sorensen, 1957).

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17. Sorghum's main competitor as a grain crop, for a niche in an agricultural system is maize, over which it has advantages: drought or irregular rainfall resistance, low soil nutrient requirement, ease of full mechanization, and nutritional value of the grain. As a fodder/silage crop its competitors are other tropical grown species.

Selected sorghums, suitable for mechanized agriculture, can be grown under Malayan conditions, the main requirement being resistance to the rusts, leaf spots, head diseases, and insects prevalent under such conditions. Harvested as a fodder, these pathogens are not so important.

The disadvantages of sorghum over maize are: it is not bird-proof; it is not acceptable for human consumption, its fodder may be less paletable and of lower digestibility than maize, it may be posionous.

Nevertheless, Malayan rainfall is very irregular. Malaya has large areas of very poor soil. These two conditions make a general advocacy of maize culture inadvisable and with the increased demand for home-grown livestock foods, it appears unjustified to discuss sorghum as a crop which could constitute to a diversified local agriculture.

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Snowden J.D.?

Garber, E?

THE SUGAR CANE

Cultivated species - Saccharum officinarum, Linn.
Species used in hydridisation because of their disease resistance are: S. sinense, S. barberi, S. spontaneum (Jeswiet classification - based primarily on floral characteristics, also vegetative characteristics, includes S. officinarum)
S. robustum (Brandes - Jeswiet expedition - group of canes found in New Guinea)

1.2 Varieties

Numerous varieties are being cultivated, and derived from mutation or through hybridisation of the above species. For convenience, sugarcane varieties are differentiated broadly into two groups:-

(a) The Old Varieties - known by common names in the various countries of cultivation.
(b) The New Varieties - designated by symbols and numbers, and obtained by hybridisation and growing the true seed under controlled conditions.

There is no real difference in the origin of the varieties of these two groups.

The two varieties once commercially grown in Malaya were the "Red Ribbon", and the "Large Yellow" or "Bourbon" cane.

2. The Uses of Sugarcane

2.1 Sugar in three forms:-

(a) crude brown sugar - called by the Indian names Jaggery or Gur; for direct consumption.
(b) raw sugar - called "cargo" or "muscovado"; a less pure form.
(c) white sugar - termed "plantation white" or "direct consumption" sugar.

Sugar is used principally as a sweetening agent; a foodstuff for direct consumption; in food manufactures; and for many industrial and other purposes.

2.2 Forage; from some varieties, mainly for feeding cattle.

* Seminar material - not to be quoted at this stage.

2.3 Uses of the by-product of sugar production

(a) Trash (tops and leaves) for direct feeding to livestocks; ensiled for use as a silage feed.

(b) Bagasse (or Megasse) is the fibrous residue left after crushing the cane. It is used in the manufacture of various forms of compressed fibre boards, asbestos cement board, coarse paper and artificial silk.

The pithy fragments of the bagasse screened out, or the entire dried bagasse ground, and then mixed with cane molasses (with or without the addition of other feeds) may be used for feeding horses, mules or cattle.

Bagasse is also used as a fuel in the sugar factory or as a domestic fuel in the form of briquettes (a mixture of bagasse and molasses subjected to carbonization).

(c) Filter mud or Press cake is the residue left after filtration. May be used as a fertiliser being rich in lime and with a fair amount of phosphate and nitrogen.

(d) Crude wax may be extracted from the dried filter mud with the appropriate solvent and purified to yield a pure cane wax. The wax obtained could be used for various industrial purposes e.g. manufacture of polishes and electrical insulating material.

(e) The press cake can be used as a manure or for stock feeding.

2.4 Molasses is the brownish-black, highly viscous liquid residue remaining after separation of the sugar crystal by centrifugation. It is used for various industrial purposes:-

(a) the production of alcohol with the residue as a dried cake for feeding stock.

(b) as a fertiliser - rich in potash (37.5%).

(c) the production of chemicals like motor spirit, glycerine, acetone, acetic acid, citric acid and lactic acid.

(d) for producing rum; treacle or golden syrup; and food yeast.

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4. See Burkill, pp. 1925 - 1929, 1931 - 1936.

5. The introduction of sugarcane into Malaya (Burkill, pp. 1929 - 1930, 1936 - 1940)

6. <u>The spread of sugarcane in Malaya</u>

The Chinese cultivated sugar cane in the Province Wellesley long before Penang was colonized. Sugar was reported to have been exported from Penang as far back as 1805. The principal areas where the crop was grown were Province Wellesley and Krian and by 1901 it extended to Lower Perak. However, by 1905 sugar cane was being replaced by rubber. In 1911 it was grown only as a catch crop under rubber, and by 1913 it ceased to be an estate crop altogether.

A large number of varieties were reported to have been grown formerly in Malaya. Some of them e.g. the "Selangor" cane and the "Red Purple" cane of Singapore formed the nucleus from which a number of new varieties were developed. The two varieties formerly widely grown on a commercial scale were the "Red Ribbon" and the "Large Yellow" or "Bourbon" cane.

7. <u>The acceptability of the crop in Malaya and its past and present importance</u>

Sugar cane is acceptable to all the different ethnic groups in Malaya. There are no taboos or prejudices against its cultivation or its use in any form.

Its present position in the local agriculture system is insignificant. It does not form an integral part of the agriculture system. It is grown mainly by villagers in their kebuns for their own consumption.

The position of the sugar cane industry in Malaya in the late 19th century was comparable to that in other tropical countries where the plant was then grown as an estate crop. Malaya was at that time one of the foremost sugar producing countries, with sugar being one of its principal export crops. However, since 1913 sugar cane has ceased to be an estate crop or even one of any commercial importance. In 1960, the acreage under sugar cane was reported as 3,000 acres, which is 0.05% of the total cultivated area. The importation of sugar and sugar preparations for the same period was 67.5 million dollars, and ranked second only to rice imports. Thus, Malaya is at present entirely dependent on other tropical countries for its sugar supplies, (The status of the sugar cane in Malaya is insignificant and more so when compared with other eastern countries like India, Pakistan, Java, Japan, Formosa and the Philippines which are important sugar producing countries.)

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8. The General cultural requirements

(a) Rainfall and water - suited to wetter parts of tropics. Requires plenty of water almost throughout the year. Annual rainfall should at least be 60" and uniformly distributed throughout the year. Where rainfall is not adequate or unevenly distributed throughout the year irrigation is essential.

(b) Temperature - at least 75 to 80°F over most of the year. Minimum temperature 54°F.

(c) Light - sugar cane - a sun-loving plant. Full light intensity essential for normal growth.

(d) Wind and storms - will damage the crop mechanically. Indirect effect of wind is its influence on transpiration, soil moisture, air, humidity, etc.

(e) Lodging - has a harmful effect in promoting production of sucker.

(f) Soil types - best on medium textured soil overlying a porous subsoil e.g. fine sandy loam, silt loam or silty clay loam. Sugar cane will not tolerate water logging therefore free drainage important. Where the water table is less than one meter from the surface, artificial drainage required. Optimum soil pH - 6.0 to 7.5. Moderately salt tolerant (details?)

9.1 Selection of planting material

Planting materials are selected from well grown cane of 10 - 12 months old free from pests and diseases. In large scale planting, the establishment of a cane nursery may be necessary for the supply of good planting material.

9.2 Method of propagation

Vegetative propagation by means of stalk cuttings of 2 kinds:-

(a) top cuttings consisting of the upper portion of the stalks; also called top seed or top seed pieces.

(b) stalk cuttings are cuttings from the remaining part of the stalk; also termed body seeds or body pieces.

(c) Cane used for propagation is ordinarily called seed cane to differentiate it from cane seed - the true seed of the cane plant.

Generally, the former practice in Malaya was to use top cuttings 8" to 10" in length with 2 to 3 buds for planting. Top cuttings are still often used because they contain less sugar; sprout better, and more rapidly then do buds from the basal joints.

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9.3 (a) Pre-treatment of the seed cane is recommended if the quality of cuttings or external germinating conditions are sub-optimal. In general pre-planting treatment aims at controlling pests or diseases rather than to stimulate germination of the buds. Pre-planting treatment may be one of:-

(b) soaking in water e.g. soaking cane cuttings in hot water (52°C) for 20 minutes for the control of chlorotic streak and pineapple diseases. This treatment also stimulates germination of the cutting.

(c) treatment with fungicides and insecticides e.g. the use of disinfectants such as 0.5% - 1% Aretan solution (1 oz. Aretan to 1 gal. of water at 1 lb. of Aretan/acre.) Or benzene hexachloride (as chlordane) mixed with the fertilizers and applied to the furrows will check disease and pest respectively.

(d) soaking in aqeous solutions of chemical compounds.

(e) treatment with growth regulating substances.

The latter two are more of academic interest rather than in field applications at present.

10.1 (a) Preparation of the site involves clean cultivation to a depth of 6 - 7 inches to get rid of the weed, and to develop a fine tilth. Can be done manually or by tractor involving ploughing and harrowing the land. The land may be left to weather for a week or so, and ridges are then built up spaced 4 - 5 feet apart with intervening furrows of 2' deep by 2' wide.

(b) Cross section showing ridge and furrow

The ridging is done manually or by mechanical means.

10.2 Preparing for the Ratoon Crop is done after harvesting the plant cane. The trashes are removed from the root zone and left as a mulch in the inter-rows. Only supplementary fertilization required. From the stubbles, new shoots give rise to the next cane crop.

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10.3 Preparing for the next plant crop. After harvesting the last ratoon crop or the plant crop, the land is prepared for the next plant crop. The trash may be ploughed into the soil, leaves to rot for a week or so, and again ridges and furrows built for the new planting. If planting is to be delayed a leguminous crop or a natural cover should be maintained, and ploughed in later when preparation for planting is carried out.

11.1 Planting of the seed cane is done manually by dibbling.

(a) A hole is made by an implement at an oblique angle along the furrow, and into it the seed cane is pushed with the bud upwards. The soil around the sett is consolidated by the toes. The seed cane is planted with the upper end just protruding above the surface. The spacing of the seed cane in the furrows is 2' to 3', each planting point may be planted with a single cutting or a pair.

(b) The density of planting is determined by the distance between row centres, and the spacing of seed cane in the rows. With the rows spaced 4½' apart, 8000 cuttings per acre is suitable. In general, the planting density can vary from 2,000 to 10,000 cuttings per acre. For, within limits, variations in planting distances will not greatly affect the cane yields.

11.2 Fertilizer requirement (Possibly condense this section - WRS)

(a) The crop showed good response to high dressings of nitrogen, and a sufficient supply of phosphorus and potassium.

In Mauritius the optimum leaf composition on a dry basis was found to be:-

N	- 1.66	- 1.85%
P205	- 0.45	- 0.55%
K20	- 1.26	- 1.75%

Fertilization may be met in part by the by-products of sugar production vis the trashes can be ploughed in and allowed to rot, and the filter mud may also be used. However, the bulk of it has to come from fertilizers.

(b) Nitrogen fertilisers. Sulphate of ammonia is the most common fertiliser used. It may be incorporated into the furrow at the time of planting all in one dose, or split into one, two or three applications. Studies have shown that nitrogen uptake by the crop is most rapid in the early phase of the plant development, hence it is best to apply the total amount of nitrogen within two months or so after planting. No Malayan information is available, hence some examples of tropical areas are given to show relative rates used.

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In Natal (S. Africa) ammonium sulphate is applied at 400 lbs. to 800 lbs/acre. In the Philippines, on alluvial soils and the volcanic, red and yellow soils, nitrogen dressings of ammonium sulphate vary from 80 lbs to 240 lbs/acre.

(c) Phosphorus

Phosphatic fertilizers are generally applied into furrows at the time of planting to promote root development. In India, the rate of application is 30 lbs. to 80 lbs. P 05 per acre. In Natal (S. Africa) on brown ferruginous lateritic and podzolic soils, super phosphate is supplied at planting at 480 lbs/acre; and 240 lbs/acre for ratoon crop. The applications to ratoon is made in furrows at one side of and near to the cane row as soon as possible after reaping of the previous crop.

(d) Potassium - Potassic fertiliser is applied together with phosphatic fertiliser at planting time; and for ratoon crop immediately after the previous harvest. The rate of application in:-

India - 60 - 120 lbs. K_2O/acre

Natal - 120 - 240 lbs. potassium chloride/acre

The principal commercial potash fertilisers commonly used are muriate of potash (60% K_2O), and sulphate of potash (48.6% K20).

(e) The Trace Elements

Not much is known about the role and need for trace elements in sugar cane growing and production.

Manganese requirement for normal cane growth is 0.25 p.p.m. equivalent to about 0.75 lbs per acre.

Iron is needed in very small amounts, and its deficiency corrected by spraying the leaves with 2% solution of iron sulphate.

Boron is needed up to 0.1 p.p.m.

Copper is essential in raw peat soils up to 75 lbs to 100 lbs. of CuSO4/acre (e.g. Florida) applied into the furrow before planting. Deficiency could be checked by injecting weak solution of CuSO4 or a small amount of precipitated Cu as Bordeaux mixture into the stems.

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12.1 Thinning Excessive tiller formation to be avoided as the ultimate number of stalks a crop can produce is limited. However, a margin of reserve shoot not exceeding 100% should be allowed for losses. Superfluous tillers can be suppressed by early earthing up of the cane plant in the furrow using the soil from the ridges. This earthing up will also help to prevent lodging.

12.2 Weed and Weed Control

Weeds are a serious menace of the sugar cane by:-

(a) directly reducing yield of both cane and sugar.

(b) assisting infestations by pests and diseases resulting in increased damage and loss.

(c) making harvest more difficult by impeding the reaping process.

Therefore, the field is to be kept free of weeds as far as possible from planting time till the cane plants develop a canopy covering the space between the rows. Then no further inter-row weeding is necessary nor is it practicable. This stage may be reached in about 3 - 4 months from planting. During the early period, weeding may be one of cultivation using hoes, or mechanised with animal or tractor hauled implements. Another method is by spraying with herbicides. In mechanical weeding and spraying with herbicides, hand weeding in the cane rows may be necessary.

12.3 Pests and Diseases

The more important and wide spread pests and diseases of the sugar cane are:-

	Type of Disease	Name of Disease	Pathogen
(a)	Fungus Diseases	Red Rot (plant)	Physalospora tucumenensis
		Sugar cane Smut (plant)	Ustilago scitaminea Sydow
		Eye spot (leaf)	Helminthosporium sacchari
		Yellow spot (leaf)	Cercospora kopkei
		Downy mildew (leaf)	Selerospora sacchari
(b)	Bacterial Diseases	Gumming Disease (stalks & leaves)	Xanthomonas vasculorum
		Leaf Scald (leaf)	Xanthomonas albilineans
(c)	Virus diseases	Mosaic (leaf)	Virus (Vector- Aphis maidis)
		Fiji Disease (plant)	Virus

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Control Measures
(i) use of resistant varieties.
(ii) sugar cane debris should be destroyed.
(iii) use only healthy cane setts for planting.
(iv) promote rapid germination of buds, and rapid development of young shoots to reduce period of susceptibility.
(v) rotation of crop.
(vi) eradicate possible alternative hosts.
(vii) by quarantine restrictions.
(viii) by eradication.

(e) Diseases caused by Nematodes

Root knot caused by Meloidogyne sp. giving rise to root galls. Root injury due to Rotylenchus similis causing blackening and decay of root tissues, and intercellular cavities. Severe cases, plants die. May lead to secondary infection by root-rotting organism.

Control: (i) use of soil fumigants.
(ii) application of nematocides e.g. D.D. methyl bromide.
(iii) crop rotation.
(iv) use of resistant varieties.

(f) Pests

(i) Rat damage by (a) direct destruction of stalk, followed by death and rotting.

(b) indirectly by predisposing the plant to diseases by infection through damaged parts.

Control: use poison baits with warfarin or zinc phosphide.

(ii) Insect
Diatraea saccharalis - a moth

Female lays eggs on young cane; hatched larvae, bore into the cane and feed on the tissue. Tunnels developed predispose the cane to secondary diseases.

Control: (a) biological control through Trichogramma minutum.
(b) use of disease - free planting material.

13. The Developmental Pattern (clarify further - WRS)

The growth pattern is a sigmoid curve, and according to Sachs, the grand period of growth, in terms of growth increments, is as follows:- *

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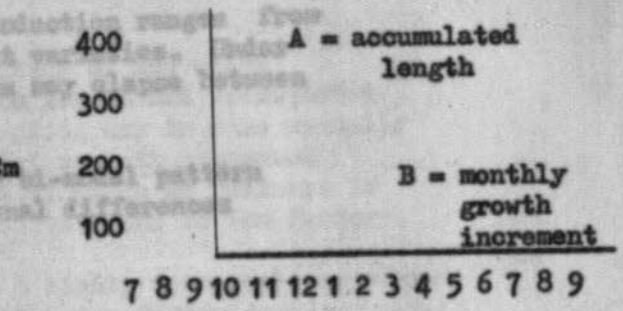
* checked - WRS

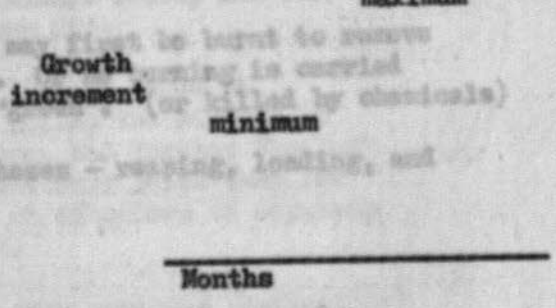
13.1 Grand period of growth of POJ 2878, calculated from growth measurements in West Java



13.2 Growth of Complete Stool

Under normal conditions (e.g. Java) where the growing period is 14 months, growth of the complete stool shows a symmetrical grand period of growth. In countries with seasonal fluctuations in temperature and rainfall, and the growing period exceeds one year, the curve, becomes bimodal, the two maxima being separated by a minimum corresponding to the season of adverse growing conditions.

13.3 Bimodal Growth curve



13.4 (a) Differential growth rates of organs

Early germination - leaf development is far ahead of stem growth. As plants grow older, this disparity gradually diminishes, as the unfolding of each leaf is associated with the completion of one joint.

(b) Leaf Growth

Longevity of a leaf differs with variety and external conditions. Hawaii - the leaf blade remains green for 60 - 75 days from the time of full expansion. In Formosa, the F108 variety - lowest two leaves of stalk live for 30 - 40 days, the 5th to 16th blade for 60 - 150 days, and above 20th leaf blade for 60 - 90 days.

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The rate of new leaf production ranges from 5.0 to 7.2 days for the different varieties. Under unfavourable conditions two weeks may elapse between formation of successive leaves.

(c) Stem Growth may be uni- or bi-modal pattern under normal conditions or seasonal differences respectively.

(d) Root development

Set root to shoot root. Buttress roots from basal nodes help in anchoring the plant. The superificial absorbing roots are located in the surface soil. In Hawaii, irrigated cane showed 50% of its roots occur in topmost 8" of the soil. The percentage decreases markedly in deeper layers. Root system of ratoon crop is shallow than first crop.*

* plant-crop

14.1 Harvesting

Generally in the tropics, plant cane is grown for a maximum of 18 months, and a minimum of 12 months. The age at harvesting is normally between 12 to 16 months from planting.

At harvesting, the field may first be burnt to remove the trashes (e.g. Australia). Or no burning is carried out, and the cane harvested "green". (or killed by chemicals)

The harvest involves 3 phases - reaping, loading, and transport.

14.2 Reaping

Only ripe canes are harvested. Ripeness may be determined by experience, visual observation, or testing samples of the canes 4 to 6 weeks before milling time at 2 weeks interval for its purity and sucrose content. The maturity of cane is favoured by bright sunshine, low humidity, cool nights and dry weather. In irrigated fields, water is withheld about 6 weeks prior to period of reaping.

In reaping, the cane is cut as close as possible to the ground by hand using a cutlass. The tops and leaves are then striped. By hand, a man can cut and strip the tops and leaves of 2 to 3 tons of cane a day. Or the whole process is mechanised e.g. Queenland, the Fairymead cane harvester cuts one row at a time at 200 tons or more per day, and bundles the cane into 400 lb-loads along the row to be loaded by grab loaders.

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14.3 Loading and transport

After cutting, the sugar content of the canes deteriorates rapidly, and must be loaded and transported to the mill within 48 hours. Loading may be done manually and then transported mechanically, or both processes mechanised. An efficient layout of roads or railways is important for rapid conveyance of cut cane to the factory.

15.1 Processing of the Sugar Cane is a highly technical procedure. Two kinds of sugar are produced by cane factories:-

(a) raw sugar of 96% to 98% sugar content.
(b) white sugar of 99.8% sugar content.

Therefore the difference is in the extent to which non sugar impurities are removed, and is tied up with the degree of purification.

15.2 The whole manufacturing process is summarised:-

(a) the "stripped cane" is cut into short lengths.

(b) the cane is milled in rollers to express the juice from it. Residue left is the bagasse.

(c) the extracted juice is subjected to clarification or purification lime is always added, and the standard method may be one of:-

(i) Defecation - where lime is added to neutralize the raw juice; the mixture is heated under pressure, and further "boiled" in open pans (defecators); juice then led into setting tanks or subsiders to separate off the dirty juice.

(ii) Sulphitation - the same process (defecation) followed, except double the amount of lime is added, and treating the mixture with sulphurous acid gas.

(iii) Carbonatation - very much more lime is added with treatment with carbonic acid gas and also a small quantity of sulphurous acid gas.

The suphitation and carbonatation is better than defecation. And though technically carbonatation is advantageous over sulphitation, economically it is not so;

(d) The clarification is to remove colloidal impurities in the raw juice. This is essential as colloids will affect the ultimate sugar colour, impede filtration, retard boiling, and also generally lower the efficiency of the various other operations.

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(e) Filtration of the purified juice to remove the remaining impurities by filter press or other machinery. Residue is the filter mud or press cake.

(f) Purified juice is concentrated by the tripple or quadruple-effect vacuum evaporators.

(g) Concentrated juice subjected to graining in the vacuum pan.

(h) Sugar is crystallised out in coolers or crystallizers.

(i) Crystals are separated from the viscous liquid by centrifugation. Resulting brownish black, highly viscous liquid residue is the molasses.

(j) Sugar crystals are dried and then cooled.

(k) The sugar product is graded, and then bagged for distribution. Recovery with good factory practice is 1 ton of sugar per 9½ to 11 tons of cane according to cane quality.

16 Information required.

17 <u>The Problems and Future Prospects of the Crop in Malaya</u>

17.1 From the meagre information available on the former cultivation of the sugar cane in Malaya, it appears that the crop ceased to be of commercial importance due to:-

(a) the introduction of rubber and the high price received for it in the 1900's.

(b) the price of sugar did not give, except to the most enterprising and efficient planter, adequate profit.

(c) it was easier to convert sugar cane land to rubber than to open up new jungle area, when rubber superseded sugar cane in importance.

It is therefore evident that in Malaya, it is not the physical or technical limitations of sugar cane cultivation and manufacture but rather consideration of the economics of production and manufacture which has prevented it from remaining a commercial crop of importance. Parts of Malaya are eminently suited to sugar cane growing. Agricultural diversification is being considered as rubber prices are falling rapidly in an uncertain market. With a world wide shortage of sugar, sugar cane growing and the production of sugar may, therefore, be considered as one of the possible alternative crops. The seriousness of the situation is further realised by considering the fact that comparing the 1st four months of 1962 to the corresponding period in 1963, the imports of sugar

increased from 60,589 tons to 67,118 tons. In terms of money value, this represents a rise of $15.4 million to $26.8 million which is an increase of $11.4 million, the chief suppliers in order of importance being India, China, United Kingdom, Hong Kong and Formosa. Hence, Malaya is very much dependent on outside sources for her supplies. In view of a high internal demand for sugar and the world wide shortage of sugar with its consequent high price, the future of sugar is a promising one.

In order to revitalise the sugar cane industry, there is a need to revaluate the situation as a whole. It is necessary to determine what planting materials are still available and their potentiality. Research will have to be undertaken to study the general behaviour of sugar cane cultivars and their cultural requirement; agronomic practices essential for good cane growth under local conditions will also require study. The economics of sugar cane growing, and sugar production in relation to other alternative crops must be ascertained, including the possible trends of markets and prices. It is only by a systematic study and local experimentation that this crop can be established on sound lines. The results of experimentations obtained in other tropical countries may be used as a guide, but should be repeated under local conditions. The future appears bright, but it will be a major undertaking to establish the sugar cane industry in Malaya on a firm basis.

18 Bibliography in preparation.

ARENGA

1. Botanical name: Arenga pinnata, Merr., or A. saccharifera, Labill.
Family: Palmae
Common name: Sugar palm.
Local names: Enau, (Malay and in Mantera). In Malaya also called Kabong - (Semang).
Kawung - Sudanese
Mergat - in Sumatra.

1.2 (Other species of Arenga)

(a) Arenga westerhoutii, Griff

Langkap, Lengkap - Malay
Ta, Taha, Taak - in Semang
Rangkap, Rangkai - in Siamese.
Found on slopes of hills in forests from Penang to Malacca.
Pith is sweetish and eaten in curries by Malays, and in various ways by jungle tribes of Southern half of Malaya.
Skai of Perak eat it, and also the cabbage.
Leaves - used for thatch.
Kuantan Jakuns make arrows from the midribs of the leaves.

Fruits - poisonous due to irritant needle - crystals in its tissues. Malays may give the juice, criminally, in coffee.

(b) A. undulatifolia, Becc. - source of sago in Borneo.

(c) A. ambong, Becc. - sago in Philippine
- pith used by people of Palawan for plugs of blowpipe darts.

(d) A. tremula, Becc - cabbage apt to cause a sort of intoxication. Sometimes tapped for sugar. Pith used for plugs of darts by people of Palawan.

2. Uses (Mainly for sugar production).

2.1 Uses of the sugar and juice of Arenga - palm

(a) Fresh juice converted into toddy for drinking. Fresh juice is called 'NIRA' or 'LACHANG' in Javanese or 'TUAK' in Sundanese.

(b) Few hours after fermentation a refreshing drink is produced. Further fermentation results in acetic acid being formed.

* Seminar materials, not to be quoted at this stage.

(c) If cut after 3 days it contains too much acetic acid to be any longer drinkable, being almost 4% vinegar.

(d) Fermentation is hastened by throwing the bark of a tree called "lamud" into the juice, or retarded by throwing in a handful of chillies.

(e) Drinking toddy is forbidden to Malays. In Borneo the palm is the chief source of toddy, also much tapped in the Philippine Islands. Toddy from this palm is a regular source of yeast in Borneo and elsewhere.

(f) Over a large part of Malaysia the fresh toddy is drunk as the French drink wine, and it can be very intoxicating.

Use of other parts of palm.

2.2 (a) Cabbage - eaten by the Benua, reported by Logan (Journ. I 1847, pg. 255)
Known to be eaten in Borneo, Jave and the Molucaas. It is sweetish. Ochse says that removal of the cabbage does not kill the palm and the top may even be renewed!

(b) In times of scarcity the palms may be cut down and sago made of the starch, but eating too much of the sago produces bowel complaints.

(c) In Java, a syrup called "Chendol" is made from it.

(d) Wood - used for making water condiut when a halved stem is hollowed out. Walking sticks.

(e) Fruit-wall - contains needle-crystals. Used as a poison.

(f) Roots - In Java, used to make a medicine for stone in bladder.

2.3 Fibre - called "Ijoj" - fibres obtained from bases of petioles.
Fibre has been a very important product in Malaysia and is still widely used. It hangs on the tree ready made.

(a) Stout bristles use as pens. Formerly, in Malay schools, the boys were supplied with a pip-clayed board on which they scratched their letters with one of these pens.

(b) May be used for thatching but very inflamable.

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(c) Pagan tribes in Malaya make thread and cords of it for use in various ways. Sakai women make belts of it.

(d) Jakuns use a bunch of the fibres as a signal to passers by not to approach a place where a women is in labour.
Cords of 'ijok' fibres are found in the market generally. They are very durable but too stiff for any purposes. Medium fibres serve as brush material.

2.3 (a) Immature leaves may be used as a cigarette wrapping. In birth ceremonies, a Malay midwife chews a betel-quid containing usual substances and a bit of the leaf-stalk of Arenga palm is included. This quid is spit on to the navel of the new born infant and is supposed to be protective.

(b) The leaf stalk is also protective when tied to the mast of a boat to prevent the water-spirit from setting on it. The leaf stalk can be made into a walking stick.

3. Geographical Distribution

Occur wild throughout Malaysia. Indonesia.

Extends - north westwards to Annam and Eastern Himalaya.
North eastwards to Liu - Kui - Islands.
Introduced to Pacific Islands and taken to Africa.

4. Origin of cultivation - n. record.

5. Introduction into Malaya.

Not recorded probably indigenous.
Chinese records of 1416 mention it as found in Malacca. (Quote). When Penang passed into the hands of the East India Company the palm apparently was rare or absent, but large quantities were imported from Moluccas later along with cloves and nutmegs.
At the same time Singapore had few palms and use to procure supplies from Malacca where the palm was plentiful and there were sugar and rope industries. Industries extinct.

6. Wild state spread by excrete civet-cats, which eat the fruits and excrete the seeds. No record indicating spread by human groups in Malaya.

8. The palm is not cultivated on the large scale and no records have been made of its husbandry and cultural requirements.

9. It is seed propagated.

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13. Development pattern

Flowers at 7-10 years of age whence the stem becomes filled with starch.
Inflorescences - called 'Mayang', first appear at the top and flowering proceeds downwards.
Female members, of 2 to 5, are not tapped due to low yield, only male inflorescences are tapped. The tapping of the sugary juice from the inflorescence exhausts the palm of its starch and 2 years after flowering begins the palm dies.

15. Extraction of sugar.

15.1 (a) 7 - 10 years palm commences flowering, stem becomes filled with starch.

(b) The male inflorescence is tapped, but not the female one.

(c) Peduncle of male inflorescence is beaten with a wooden mallet for about 3 - 7 days.

(d) Flower spikes cut off and the sugary juice collected in a suspended receptacle.

(e) The tapper visits the palm twice daily, removes the fresh juice, cuts a thin slice off to let it bleed afresh and new receptacle suspended.

15.2 In Malacca, when the industry was thriving, it was customary to leave a few days between the cutting of the flower-spikes and the first drawing of the juice, during which the cut end was bandaged in a poultice of rice and pulp of tuber of Discorea hispida. The great abundance of Dioscorea in parts of Malacca is that time was a result of cultivation by tappers for this purpose.

15.3 The juice - called "NIRA" is carried away to be boiled into sugar, the evaporator vessel having undergone sterilization by smoke or lime before being used.

The tapper's success lies on how sterile he keeps his vessels otherwise; if yeast and bacteria get into the juice, fermentation is set up. Use of bamboo containers is unhygienic.

15.4 Boiling of juice is done in open pans; to prevent boiling-over various objects are put into the syrup - Aleurites seeds, lumps of coconut endosperm, or resin (laru). Sugar ready to set, it is poured into moulds.

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15.5 Arenga Sugar

Dark coloured, contains a lot of impurities which impair keeping. Characteristic taste; thought to be slightly purgative. Sugar content in fresh juice about 5 - 15%.

15.6 Composition

16.5% sucrose - much albuminous matter associated with the sucrose; these albuminous matter makes sugar soft, hygroscopic and easy to ferment.

Short preliminary boiling of juice coagulates the proteids which are removed; but there are unremovable pectins and gums and these give the sugar its characteristic dark colour.

15.7 When alcohol is made, the elimination of the albuminous matter is a natural consequence, but the rapidity with which acetic acid forms is important. The fresh juice is scarcely acid at all.

16. There is no experimentation on the palm at all, as it does not prove to be an important crop commercially.

PALMS OTHER THAN COCONUT OR OIL PALM

Family: Palmae

Palms, other than coconut and oil palm, which are of interest as crops:-

1. Areca catechu, Linn. - Betel nut palm
2. Arenga pinnata, Merr. - Sugar palm
3. Metroxylon sagus, Rottb. - Sago palm
4. Nipa fruticans, Wurmh.- Nipah palm
5. Phoenix dactylifera, Linn. - Date palm

1.1 Areca catechu, Linn.

Common name: Betel nut palm
Local names: Bluk, Bloku, Bluku, Blocku (Sakai).
Lakun (Benua),
Chongoi (Besisi),
Pinang (in Sumatra).
Jambe Wohan (in Java).
Jambe (in Sudanese).
Vlak (Siamese).

The common Malay name is 'pinang' and the Chinese call it "pun-long" (Cantonese). The Malays have a number of names for different processing stages. (See processing)

1.2 Other species of Areca

The seeds of these other species may be substituted for that of A. Catechu.

A - pumila, Blume. - found in Sumatra, Java and Malaya (from Langkawi to Seremban)

A. triandra, Roxb. - found in Sumatra, Andaman Islands (off West coast of Sumatra) and islands off the Kedah coast. The cabbage is eaten.

A. furcata, Becc. - found in Johore, called 'pinang kaki pelandok' (or mousedeer's - foot - Areca)

A. Borneensis, Becc.-found in Borneo where the cabbage is eaten.

A. hutchinsoniana, Becc. - found in Philippines where the cabbage is used as a vermifuge.

A. caliso - the sap is used as a drink in the Philippine Islands.

A. Whitfordii - found in Philippines.

A. valiso, Becc. - " " "

A. ipot, Becc. - " " "

* Seminar material, not to be quoted at this stage.

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A. glandiformis, Lam. - found in the Moluccas (palms cultivated in Singapore Botanic gardens)

A. nagensis, Giff.

A. Concinna, Thavartes- found in Ceylon

A. macrocalyx, Zippel - found in New Guinea.

2. The uses of various parts of the palm.

2.1 Seeds (Nuts)

The palm is grown chiefly for its nuts, which are used as a masticatory - chewed in both the ripe and unripe state. This is a customary hairs with the Indians. The nuts are cut into thin slices, which are chewed with a piece of betel vine (Piper betle) leaf, a pinch of slaked lime and some other minor ingredients. It is chewed mainly for its taste which is astringent and the quid is spit out. The Malay woman chews the betel nut during certain ceremonial practices.

2.1 (a) Medicinal uses:

Its medicinal uses are due mainly to the alkaloids (arecoline, arecolidine) and tannin content in the seed.

(b) In India the nuts are given in milk or ghee as a vermifuge. Tannin causes astringency and this makes the nut used widely as a vermifuge.

(c) Malays

Use a decoction of betel nut to cure diarrhoea; a decoction with roots of Capsicum, Scleria and a Pandanus - for gonorrhoea;

(d) Pulp of young nut given for stomach pains of infants; a docoction of old rip nut is used for chronic colonic obstruction with diarrhoea;

(e) The pulp of 'pinang mengkelan' with various substances in a decoction is used for herpes on the stomach.

(f) In Borneo unripe nut is chewed and the juice swallowed for blood in the urine.

2.2 External uses:

(a) The juice of young nut is recommended for use in the eye for several complaints like specks on the cornea, dimness of vision;

(b) Applied on the body for fever, hysteria, dysentry in children, and a peculiar complaint called "pirai";

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(c) Malays apply the betel nut juice on the head for headache; and the Malays use the unripe fruit with benzoin and a decoction of leaves of Garcinia mangostana to apply to wound of circumcision.

2.3 Other uses:

(a) The kris is rubbed with a young betel nut to produce a dark colour on the edges.

(b) The bows of Malay fishing boats are farlanded with a string of betel nuts at a launching ceremony. The nuts are used for tanning purposes and making toys for children. The Indians maintain that betel-chewing keeps the gums healthy and in India a tincture of the nuts is used for bleeding gums. But continuous betel-chewing ultimately destroys the teeth.

In the Dutch East Indies the ashes of burnt nuts and husk are used as a tooth-powder as it is believed that it makes the teeth white and strong.

2.4 Uses of other parts of the palm.

(a) Husks - use as fuel especially that from 'pinang salai'. The smoke of burning husks is believed to be able to drive devils away. The Chinese use the half rotted husks to make a decoction used for curing dysentery.

(b) The Cabbage

The Juice of the cabbage, with juices of Euphorbia hirta, and a Loranthus, is given for 3 days after childbirth as a protective medicine. The Malay woman uses the shoot, boiled with the roots of Croton caudatum and Plumbago to procure abortion. (At present the belief is that the Plumbago is the active substance and not Areca)

(c) Roots:

When boiled along with various herbs the decoction is used for dysentry.
The roots are reputed to be diuretic in the Dutch Indies. The pulp of the stem and roots with pepper-vine leaf and an oil comprises a hot application for pushing into the ear for a discharge of blood from the ear.

(d) Leaves

When powdered with Atalantia leaves and Citrus are swallowed for stomachache. A cigar made by rolling together with leaves of Mimusops elengi is smoked for ulceration of the nose.

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(d) Trunk:

In the gardens used for fencing.
Juice of the Areca - stump with black rice and egg of a black fowl forms an antedote taken internally for all kinds of poison - a magic treatment. The whole trunk may be used as fishing stake as the outerwood is hard. (check this - WRS).
Not suitable for house post as it can last for a year only.

(e) Spathes:

The spathe is tough and can be woven into baskets called 'upis' or 'upeh' and also woven into wrappings for lining carrying baskets. Made into a bucket used as a bath in the colouring of kris. In Borneo the Dyaks lay their new born babes in to such a bucket.

The Malay midwife chews a little of the spathe with a betel-quid and spits on to the abdomen of new-born babe during a ceremony called 'sembor-sireh'.
In the Philippines it is used for making hats.
In India, it is tied over inflorescences to protect it from rain.
In Kelantan, a bundle of sprouting stems of young Areca, which in the hands of a magician who holds a divining rod, help him to locate stolen property.

(f) Flowers

As ornaments in Malay weddings and in Borneo. Used in 'conjurations for purpose of healing the sick'.
Used in the bathing water for a mother after labour; and with a micellany of other things for bathing the child.
"Beras bunga pinang", which is the male flowers are used at a rajah's funeral.

(NB - This section requires further editing - WRS)

3.1 Geographical distribution in Tropics

The palm can be grown everywhere in Malaya except at the highest elevations Malaysia is said to be the home of the betel-nut palm. It has been established in cultivation northwards as far as Canton, Amoy and Formosa; westwards as far as Madagascar and East Africa, and eastwards towards Central Pacific. (It has taken hold in Fiji quite recently). The hub of its cultivation seems to be in those lands where gamblier is grown most extensively - viz. Sumatra, Malaya, Western Java and Borneo. The great variety of local names indicates, that it has been grown and for a long time in the Malay archipelago.

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3.2 Races

There are many races of A.catechu ill-defined, as the trees are cross-pollinated by insects. It may be roughly classified into (a) those with round nuts and (b) those with long nuts.

Some races are unexceptable in that the nuts give an unpleasant sensation of tightness in the throat and cause profuse secretion of mucous - when chewed.

The nuts of such races are called by the Malays as 'pinang mengkalan' (i.e. pinang which chokes)

7. Given below are some statistical data for 1934, 1937 and 1938. From it, it appears that these areas, formerly of areca, must be planted with rubber, coconut or oil palm at its present time.

Area cultivated - 1934: 53,062 acres
1937: 61,709 "
1938: 61,922 "

	Imports		Exports		Net Exports	
1937	tons	value	tons	value	tons	value
	53,071	$6,242,993	83,155	$10,577,512	30,084	$4,333,519
1938						
	55,420	$5,607,979	89,189	$10,445,751	33,769	$4,837,772

		Best	Medium	Mixed
Prices:	1939	$7.71	$7.19	$6.63
(per picul)	1938	$7.64	$7.16	$6.55

(From Dept. of Agric. FMS & SS Bulletins Economic Series Nos 6-10) (correct reference)

8. Cultural requirements:

The palm requires abundant water and establishes well on virgin soil.

It is grown from seed; begins to bear at 5 - 6 years of age; bearing period is about 20 years and then it continues to persist sterile until it is 60 - 80 years of age.

Crop planted mainly by the Indians and Malays. Also found growing wild throughout the country. No large scale cultivation. Details of cultural requirements, fertiliser requirements, husbandry are not known.

15.1 Processing of betel-nut - Two methods are adopted generally:-

(a) By peeling off the husk with a knife and then boiling the nut. In India: fruit boiled till the tissues have softened and the nut is extracted. The nut is removed, sliced or split or left whole and dried. (check - WRS)

(b) By drying the fruit until the husk shrivels the seed can be extracted.

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15.2 There are different Malay names for different processed stages.

(a) The unripe fruit is called 'pinang muda', 'jerkat', or 'pinang kachat'.

(b) Unripe fruit when split into two, dried and marketed as 'pinang bunga'; full size, unripe as 'pinang kasar'; ripe - called 'pinang lechak' or sometimes 'buah pinchang'.

(c) In Malaya the first process after plucking is to split into two along the median grove by a slasher, halves are dried with split side uppermost, as such it is called 'pinang belah'.

(d) Sometimes the fruits are dried without splitting, this takes about 3 months before the nuts can be picked out - this is an inferior product called 'pinang kusi'.

(e) When heat is used - drying over an oven - the product is superior and marketed as 'pinang salai'.

(f) Another way of drying is : first slice off the ends, split into 4 and then dry in the sun, the product is 'pinang awak'; when perfumed by smoke of benzoin it is called 'pinang ukup.'

(g) A special article made from immature nuts stored in salt in sacks for 2 or 3 months is called 'pinang asin'.

(h) <u>Other names</u>

'pinang belah')	all equally called
'pinang kusi')	'pinang kotai' or 'tokeh'
'pinang salai')	(dried nuts).
'pinang kusi')	are 'pinang bulat' or round
and Pinang salai)	pinang.

16. There are no experimentation carried out on this crop.

1. Nipa fruticans, Wurumb
Palmae
Malay Nipah
Siamese: Chak
Chinese: Ar-tup (Attap)

Grows on tidal mud from mouth of Ganges to Australia. In Malaya - occurs round the coast, chiefly along estuaries for fresh water is necessary for its growth.

2.1 Uses:

(a) Leaves:

Used mainly for thatching. Malays plant the palm for its leaves to add to the limited supply from wild plants. Palms not affected by over cutting. When leaves are cut and used for partitioning without further preparation it is called 'samit' in Malay.

(b) Attap

The chief use made is for making attap. Leaves dried, pinna folded at two-thirds of its length over a rod of hard wood or bamboo and then stitched into place. This attap forms a good roofing material, also used for walls in fishing villages.

Durability depends on pitch of roof; at high pitch - can last 5 or more years, at low pitch - can last 2 or less years.
Leaves also used for making umbrellas, sun-hats called "selacots", raincoats, coarse baskets, mats and bags called in the Philippine Islands. Young leaves made into a cigarette wrapper by natives from Siam to Singapore. This wrapping gives a sharp taste to the cigarette. Petioles made into arrows in the Mentawai Islands off West Sumatra.

(c) Toddy

Toddy is tapped from the inflorescence at 5 years of age when the palm has had its second flowering. The fresh juice is called 'Nira', which is sweet and ferments rapidly. Flowering extends throughout the year and it usually carries two inflorescences at a time. It has been accepted that tapping for over 50 years is possible. Sap contains 18% solid, 17% of which is sucrose, and 1% is ash. Fermentation takes place as soon as the sap exudes from the inflorescence stalk, and the sucrose is converted to alcohol and other substances. Toddy when left alone for a fortnight becomes vinegar.

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(d) Yield of Nipa-sugar

Nipa-sugar might be extracted at the rate of 115 lbs per 100 gallon of the juice, or equivalent to about 2 hundred weights per acre.

Nipa-sugar is not made much in Malaya because it contains too much treacly substance which is difficult to eliminate.

2.2 Other uses of palm

(a) Young seeds are edible. In 1779 Koenig found the Chinese in Kedah making a sweet meat from them by coating them with sugar. If the boiling of the fruit is prolonged is hardened. The Malays call the fruit 'tembatu'. Food from the seed is mainly starch. Mature seeds are hard enough to be considered as suitable for making buttons.

(b) The bud of the stem is also edible.

(c) Juice from young shoots when drunk with coconut milk is used for treating herpes, whilst the pulp from which the juice is expressed is applied.

(d) In Borneo by burning the leaves or roots and lixivating the ash, a salt may be obtained; 'garam nipah' (Nipa-salt) used medicinally toothaches and headaches.

Dalton 1926 narrated how fishermen submerge Nipa leaves in the sea when fishing to attract fish. It may be that Nipa is chosen because it is easily procured for this purpose.

12. The palm is not widely cultivated and supply of its leaves comes mainly from wild growing palms. For this reason little is known of its cultural requirements.

Journ. Roy. Ass. Mal. Branch, 4, 1926, pg.104)

DATE PALM

Phoenix dactylifera, Linn.

Palmae

Local name: Khurma - Arabic

Palm found chiefly in relatively dry or saline places in Asia and Africa.

(a) From prehistoric time it has been a cultivated tree of the dry belt from Senegal to the Indus. It is said that it will not fruit when rain falls upon it between flowering and ripening, a period of 5 months. This is a good indication of the dry condition which it needs.

The use among the Malays of the fruit as an indication of its being brought eastwards to Malaya.

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In the time of the Tang dynasty, the Chinese knew the fruit sufficiently well to call it the Persian jujube. Probably in Malaysia, through all the centuries since Arabs first visited the shores, there have been trees here and there, often well grown but sterile. The sexes are almost always separated so that the isolated female trees should not be expected to fruit. Propagation is by suckers.

1.2 Other species

Phoenix farinifera, Roxb. - sago is extracted from the pith.
P. rupicola, T. Anders - Pith is eaten.
P. paludosa, Roxb. - Pith is eaten. Called Dangsar or Khurma locally. In Malaya it seems to be most common on the Kedah and Perak coasts. The leaves are sometimes used for temporary fencing in Province Wellesley and Krian.
P. humilis, Royle - var roebelinii - and some other spp. are grown as ornaments.

Uses

2.1 (a) The date fruit is eaten in most date-producing countries.

(b) The juice of the fruit is used for sweetening food.

(c) Leaves made into matting, screens and twisted ropes.

(d) A small amount of oil can be expressed from the seeds and there is a volatile oil in the flower sheath.

(e) There is coumarin in the leaves, and atrace of it, in the fruit. Presence coumerin possible reason for sheaths being used for scent in some parts of tropical Africa.

This palm is not cultivated in this country because the climate is not suitable for fruit production. It may be grown as an ornamental palm.

18. Bibilography: (Section 24 - -)

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Areca catechu pg. 222 - 230

Arenga pinnata pg. 230 - 237

Metroxylon sagus pg. 1460 - 1463

Nipa fruticans pg. 1557 - 1561

Phoenix dactilylifera pg. 1712 - 1714

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2. Cobley, L.S.(1962) An introduction to the Botany of Tropical Crops. Longmans.

Areca catechu pg. 252 - 253

Arenga pinnata pg. 189 - 190

Metroxylon sagus pg. 189 - 190

Phoenix dactylifera pg. 269 - 272

Draft* Catalogue of Agricultural Practice — Section 24.
(Project supervisor: W.R.Stanton) — Date 5.4.64

SAGO PALM

1.1 Botanical name: Metroxylon sagus, Rottb.
Palmae

1.2 Local names: Sagu - Malay
Ambulung, Bulu, Kersula, Rajang, Rembulang, Resula, Tembulu - in Java
Kirai in Sundanese.
Rambia, Rontan, Rumbai, Rembi in Sumatra.

1.3 Other species of Metroxylon

Metroxylon rumphii, Mart

This is the spiny-sheathed species, predominates in Eastern Malaysia.
Slightly smaller than M. sagus which is the smooth-sheathed sago palm.
Both species are equally economically important; both are present in Malaya in cultivation in a half-wild state.
In Borneo this species is preferred because of abundance of wild pigs which will attack the smooth type. M. rumphii is shorter and yield less than M. sagus.

2. Uses of Sago

As a substitute for rice when supply of latter is low. Some of the sago flour is used in Europe to prepare glucose and in textile industries.

Other parts of palm

2.2 (a) Leaves make good attap - cultivated in North Malaya and lower Siam. These attaps are admitted to be the best obtainable in Malaya.
(b) Leaves often used in padi nurseries to shade the young seedlings.
(c) Leaf-stalk can be plaited into matting for use as a rough filter in the extraction of sago.
(d) Leaf-stalk also used as a substitute for bottle corks and its inner parts provide lining for insect-boxes.

2.3 Cabbage - can be eaten but a bad food, called "umbut robin" in Borneo.

2.4 Fruits - may be eaten and in Malacca it was a custom to preserve it.

2.5 Stem - serves as animal food; sometimes poultry (even horses) feed on pith of stem. Sago is recommended as an exipent in making poultice for shingles.

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2.6 Sap - from trunk when mixed with Datura forms a poison. Alcohol may be made from the sap, and also from the starch.

3. Distribution:

Found in Malaysia throughout.

Present in Malaya in cultivation in a half-wild state.

Indigenous to Malaya? - Not certain.
Spread in Malaya - Not certain.
Found usually in low swampy land (padi areas).

8. Soil

The palm likes swampy soil; failed to grow in old mined land even though it is wet.

9. Propagation - by suckers. As seeds are commonly infertile in Malaya and Borneo.

13. Life Span - 15 years

Reaches maturity between 9 to 15 years. Whence spical bud begins to form flowers, inner parts of trunk (Serampin) are filled with starch. Signs of maturity - change in colour of leaf-stalks and shortening of leaves. The palm is cultivated for sago. Where it is not profitable to grow for sago, it is grown for its leaves - in North Malaya.

15.1 Extraction of sago

Palm felled at maturity, one inch or more of outer hard surface removed, rasp the rest into a coarse meal, or sawdust, and the starch is washed out of this meal and made pure by several washings. Further purification is done in the factory. It was said that about 1815 the making of pearl sago was started by Chinese. At that time the sago from Siak in Sumatra was the best; but the Chinese were able to bring to the fore what they produced in Malacca by a lustre which they gave to it and were able to sell, at an advantage, this improved pearl sago in London in 1818.

15.2 Composition of Sago

80% starch; 16% water; 2½ of nitrogenous substances; very little ash.

15.3 Yield of Sago - 250 - 660 lbs per palm trunk.

16. No experimentation on its husbandry and cultural requirements has been carried out. Much can be done with regard to the cultivation of this crop.

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TEA

1. Family: Theaceae (240 spp)
   Genus: Camellia or Thea (15 spp.)
   Local Names: (a) thei (in Malay and Tamil).
   (b) te, cha, and chia (in Chinese dialects.)
   (c) chai in Malayalam.

2. Uses:

   Leaf - beverage.
   Caffeine in tea - medicinal - nerve stimulant.

3.1 Geographical distribution and diversity of forms found in Malaya:

   Highland variety: Cameron Highlands.
   Lowland Tea: Selangor (Central Experimental Station, Serdang) and palins of Malaya i.e. Perak, Malacca, Kedah and Johore.

3.2 Varieties:

3.21 Lowland tea: (a) Dangri
   (b) Rajghur
   (c) Betjan
   (d) Dhonjan
   (e) Chinese

   Origin: (Ceylon or S. Indian gnats-tea seed gardens)

3.22 Highland tea: (Varieties of the same)
   Thea (or Camellia) sinensis and Camellia assamica.

4. When introduced into cultivation:

   variously attributed to:
   (a) Emperor Shim Nong - 3rd Millineum B.C.
   (b) Dharuma a Buddhist Monk - 5th Century A.D.
   (c) 1st account of tea - by Lo Yu - AD 780.
   (d) Introduced into India and Ceylon by British East India Company.
   (e) India - Brahmaputra Valley - 1840.
   (f) Ceylon - 1860's - 1875 - 1000 acres.
   (g) Java, Indonesia, - by Dutch - 1690 - by Camphys (Governor General)
   (h) Home of tea plant - Upper Burma, S.E. China and Annam in Indo China.

5. Introduction in Malaya: - 1874 - in Province Wellesley and Singapore.

* Seminar material. Not to be quoted at this stage.

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6. How crop spread through Malaya

(a) Tea would have spread if not for Rubber.
(b) Chinese Tea on Chinese smallholdings of early introduction. 1940 - Acre 533. At present negligible.
(c) 1925 - Tea Expt. carried out at Serdang - later in Cameron Highlands.
(d) 1932 - Ac. 2400 acres, 1942 - 9000 acres.
(e) At present about 10,000 acres - more than half in Camerons, and less than half lowland tea in the plains.

7. Acceptability of crop in Malaya.

This crop has been accepted as a commercial crop and is grown extensively in Cameron Highlands, up to an elevation of 5000'.

Lowland tea is only grown as a small-holders crop in the plains of Malaya (details not available) although it compares favourably economically with other tea producing countries. An attempt was made by Guthries Plantations Ltd. to grow Lowland Tea in Mantin Estate Negeri Sembilan on a large scale. The estate did not survive due to a high incidence of pests and diseases and probably due to improper management. The area has been planted with rubber. This makes it rather difficult for the other large companies to decide to grow tea on a large scale in the plains. However, tea can be grown with success in Malaya under good management in the lowlands and should be considered in the Government Agricultural Diversification Programme.

8. Cultural requirements:

8.1 Rainfall:

Lowland tea: Malayan climate well suited for growing tea.
Grows well - from 70" to 200" of rain. (No optimum rainfall conditions recorded).
Highland Tea:
Rainfall - no optimum condition. Same as for lowland tea.
Temp: Low temperature in highlands lowers yield, but improves quality.

8.2 Aerial humidity: No records available on optimum conditions in Malaya.

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8.3 Soil type:

In Ceylon- medium friable loam overlying quartzite rock.
In India - same as Ceylon S. India, some acres contain large quantities of humus - These "flats" yield - 2000 lbs/acre per year.

In Malaya - thrives well on:-
Light sands to clays. Well drained peats. Will not grow on: alkaline soils. Does well on: Acid soils pH 5.4 to 6. Can grow at pHs 6 to 7.

8.4 Shade requirements:

Highland Tea: No shade used in Malaya.

Lowland Tea: According to experiments carried out at Serdang:

(a) Albizzia falcata - spreads a 60' high shade- planted at 60' x 60' not advised.
(b) A. odoratissima - spread 30' - plant at 32' x 32' recommended.
(c) A. stipulata - not advised - 32' x 32'.
(d) Gliricidia maculata - planting distance 20' x 25' recommended.

Ideal shade
Aodoratissima - 20' x 25' planting distance and Gliricidia maculata planted under 16' apart. (details: refer: The cultivation of Lowland Tea, Central Expt. Station Serdang by Greig ( ).

8.5 Nutrient Status

No information available for Malaya.

9. Propagation.

9.1 Good seeds picked. Immersed in water. Floaters discarded.

9.2 Germination beds:
Clean sand. Shaded by palm leaves 5' above bed.
(a) Seeds, 1" apart, lightly pressed into sand.
(b) Watered daily.
(c) Germinates in 25 to 30 days - continues up to 70 to 80 days.

9.3 Germinated seeds transferred to - deeply cultivated nursery beds - planted 9" x 9" square. Left in nursery for 18 months to 2 years stem. diam.:3/8" to 1/2".

9.5 Main stem severed at 4" to 5" above ground. Roots trimmed. Stumps tied in bundles - ready for planting. Covered with wet sacking awaiting transport to field.

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10. Preparation of field:
(a) Plant during the wet season (April, or from October to December.)

10.2 Clearing land prior to planting:
(a) Depends on site and on vegetation.
(b) Wind breaks needed: Jungle belts from 1 to 3 chains ideal.

10.3 Drains: Constructed where required in lowlands. Highlands no drains required.

10.4 Lining and holing:
(a) 4' x 4' recommended. In hills - following the general contours of land.
(b) Holes: Inverted cone - Depth: 18" to 20"
Top diam: 12"
Bottom diam: 4"
(c) Holes filled with good surface soil.

11. Planting material:
(a) seed or germinated seed.
(b) seedlings in baskets.
(c) stumps - seem to be best suited for Malayan conditions.

12. Husbandry: during development:

12.1 Supplying: A nursery sufficiently large to supply 10% to 15% of the area planted.

12.2 Weeding
(a) Minimum soil disturbed during weeding. A scraper or pointed stick most suitable. Wees dug out placed in a sack. Heaps left to dry and burnt. Herbrcides used.
(b) Many estates maintain clean weeding. Necessitates use of changkol and fork esp. for removing lallang.
(c) Some estates practice selective weeding - covers established to control erosion.

12.3 Cover Crops.
(a) Indigofera endecaphylla - best cover under Malayan conditions - established from cuttings planted 2' to 3' apart.
Crotalaria anagyroides
C. usaramoensis and Tephrosia candida also grown.

12.4 Manuring.

Acidity of soil must be considered.
(a) Pruning mixture at the rate of 430 lbs/acre applied at the time of pruning.
Composition: 30 lbs of N
60 lbs of P
40 lbs of K

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(b) 6 to 8 months later general mixture applied at 600 lbs/acre.
Contains: 40 lbs N
25 lbs P
30 lbs K

(c) In field which are allowed to run for 3 years after pruning - general mixture (as b) applied a year later.

(d) Normally pre-pruning mixture 300 lbs/acre 4 to 5 months before pruning is applied. In fields when a second application offertilizer is given only 250 lbs of pre-pruning mix is applied.

(e) This supplies per annum: 50 lbs N, 50 lbs P, 43 lbs K, in fields pruned every two years. 43 lbs N, 42 lbs P, 40 lbs K, in fields pruned once in 3 years. (This policy is practiced in Ceylon and is being applied in Malaya until manurial experiment at Serdang give results.)

12.5 Forming bush.

(a) Young bushes allowed to grow up to 30 to 36" about 5 to 6' tall. That cut back to 20".

(b) Numerous side shoots develop and when suitable frames are formed they are tipped and brought into plucking rounds 3 months later.

12.6 Pests and Diseases

12.61 Diseases

(a) Blister blight - causal organism Exobosidium veraus - control, copper fungicide.

(b) (2) Tea yellows - sulphur deficiency, black rot.

(c) (3) Corticum invisum

12.62 Pests

(a) Metatetranychus bioculatus. Control: lime-sulphur spray.

(b) Helopeltis theivora - DDT spraying.

13. Developmental pattern of the plant: (Depends on the type)

13.1 Roots

(a) 1st appears as white thread - a year later in nursery about 1' long - then laterals grow.

(b) In mature bushes - Tap root 3' to 5' deep - lateral roots limited in spread.

(c) Most of feeding roots in top soil.

13.2 Growth of tea leaf:

(a) Spiral phyllotaxis 2 - 5 system.

(b) Top pruned bush - about 5 flashes in a season.

(c) Leading shoot rising from frame after pruning gives maximum yields when tipped at top.

13.3 Flowers

(a) Open in the 3rd flush - seeds produced about a year later.

(b) Tea flowers self sterile. Only 2% produce seed. Fruit set about 40%. (Duration of various periods

in growth about tea in Malaya - No information available).

14. Plucking

14.1 Only 1st 3 leaves plucked from a shoot by breaking them off with the thumb and forefinger.

14.2 Plucked once in every 7 or 8 days.

14.3 First few rounds of plucking in a newly opened area - are called tipping rounds, done by experienced pluckers.

14.4 Stem below the 2nd leaf i.e. lower part of 3rd leaf and stem are discarded.

14.5 Plucked leaves - carried in baskets to factories weighed.

15. Methods of processing and storage

15.1 Withering pd - 16 to 24 hours - on lofts - on hessian/ nylonnet racks - 1 lb - 9 sq' space - temp not less than 80°F.

15.2 Rolling: 4 half hour rolls in Malaya (Boh Tea plantation) in Ceylon same. In Assam (two ½ hr. rollings).

15.3 (a) Fermenting: spread - 1½" thick to ferment. 2½ to 3½ hrs. Temp. not more than 80°F.
(b) For quality twmp. 70°F or lower.

15.4 Firing: in a dryer: Blast of hot air used - temp. 180° to 220°F. Fired in one or two operations according to the extent of withering.

15.5 Storing: packed in packets and stored for some time before selling. This is done to season the tea. (For details: see Harler ( ) Cutter ( )

(N.B. above temp. and times a general guide only. Packet storage to 'season' of doubtful value - WRS)

16. Current Experimentation

16.1 Work is being carried out in Ceylon Tea Research Institute on: improved varieties, b.c.d. and e as given in the schedule 3.21. (Ref: Tea quarterly Journals of Tea Research Inst. Ceylon.)

16.2 In Malaya at Serdang.
(a) Some Manurial experiments have been laid out.
(b) Intensity of planting.
(c) Shade (Ref: Dept. of Ag. Journals)

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17. Growing of tea in Malaya does not seem to be as profitable as Oil Palm or Rubber. Tea grown in Camerons is good quality tea (compares favourably with tea produced in Ceylon or India). Important in Camerons. Malayan climate ideally suited for growing tea and should prove a useful crop if Oil Palm or Rubber fails. Worth of consideration in her diversification programme.

18. Binliography (require revision)

(1) Harler - Culture and Marketing of Tea.
(2) Dept. of Agr. Fed. of Malaya - publications.
E.A. Cutler - Cultivation of Lowland tea in Malaya.
J.L. Greig - Culture of tea in Ceylon and India.
(3) The Tea Quarterly Journals of the Tea Research Inst., Ceylon (Vol. 33 pts: I, III and IV, Vol: 34, Pt.I)

COFFEE IN MALAYA

1. Taxonomy

Family: Rubiaceae.
Genus : Coffea, L.
Spp: Coffea arabica, L
Coffea robusta, Linden.
Coffea liberica, Bull and several others.

Local Names:

Copi, Kopi (in Malay, Cantonese and Tamil)
Karwa (Punjabi)

2. Uses & Various Parts of Crop

(a) Berries - drink
(b) Leaves - drink in ancient times.
(c) Drug - Caffeine - from berry - nerve stimulant.

3. Geographical distribution and diversity and forms

S. Perak, Central Perak, Camerons, Selangor - (Ulu Langat), Kuala Selangor, Muhar (Johore).

Varieties:

Coffea arabica - Cameron Highlands.
Coffea robusta - Interplanting (lowland) - under coconuts or rubber.
Coffea liberica - From sea level up to 1,000'.

4. When introduced into Cultivation (its History)

(a) Spoken of in Arabic Literature A.D.900.
(b) Probably 1st used by aborigines of Africa (Linnaeus)
(c) Initially used for chewing and as medicine in Arabia, Europe and America - supposed to help digestion and rarify blood.
(d) A ration to his army by Caleb Negus - crusade - when he went to punish Yurif Yaruh in Yemen.
(e) Used in coffee bars. 18 Century - Europe.

Coffee as a drink:

1470 to 1500 - Reached Medina and Mecca.
1503 - Introduced into Ceylon by Dutch.
1591 - Introduced into Turkey, Egypt & Arabia.
1598 - Introduced into the Far East.
1696 - To Java from Malabar Coast - Dutch
1727 - Brazil from Ceylon by a Brizilian envoy.
1730 - Jamaica - British.
1750 - Celebes - Dutch.

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* Seminar material, not to be quoted at this stage.

5. Introduced into Malaya in 1875.

6. How crops spread through Malaya:

6.1 Coffea liberica introduced - 1875 - spread rapidly throughout Malaya.
6.2 1894 - export of coffee from Selangor and Perak - 4,000 pikuls/mth.
6.3 1905 - 107,218 pikuls/mth from Selangor. Due to introduction of Rubber after this period production of coffee fell.
6.4 Smallholder crop - up to 1938.
6.5 1948 - Practically went out of the market - competition from outside sources.
6.6 Still grown on a few estates and by smallholders in Selangor and Perak.

(N.B. A more accurate 'current' statement desirable - WRS)

7. Acceptability of crop in Malaya

7.1 Is less profitable than rubber or oil palm at present.
7.2 Competition - outside sources - Brazil more than ⅓ world's production. Production in Brazil - considerably affects prices.
7.3 Coffea liberica - grows well in Malaya - no foreign market - taste not generally acceptable.
7.4 May develop as a useful subsidiary crop - under oil palms, rubber or coconuts.

8. Cultural requirements

8.1 Rainfall:
75" ideal.
30" to 40" evenly distributed - can grow - e.g. certain parts of Brazil.
Therefore requirements of rainfall - no hard and fast rule.
Temperature:
60°F to 80°F. more than 80°F as in Malaya - shade necessary (but Cf - Cocoa)
8.2 Aerial Humidity - No information readily available.
8.3 Soil Type:
(a) Sensitive to acidity - does not flourish on coastal clays (Robusta coffee)
(b) Grows well on virgin land of granitic origin.
(c) Liberian coffee therefore more suited to coastal soils - fairly extensively grown in alluvial mucks, organic clays - Selangor coast.
(d) Is grown on deep peat under special fertilizer treatment.
(e) Does not tolerate water logging - water table not rising above 3' below soil level.

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8.4 Shade Requirements:

Coffea liberica - shade not required. Can be grown under coconuts.

Coffea robusta - grows better under shade - lateral windbreaks essential.

8.5 (For more details Ref. Trop. Abst. Vol: XVII, No.9 J. 2202 - J.2447 - Sept. 1962. Royal Trop. Inst. Amsterdam. Review article by F.W.OSTERDORF), (Should be transferred to end of notes - WRS) Ostendorf (1962) reviews the views of various authorities for and against shade requirements.

He is of the opinion:-

(a) Not clear whether planting of coffee without shade is possible technically everywhere.

(b) Whether environmental conditions would permit it.

(c) Suarex de Castro * and Rodriguez* are of the opinion that for erosion control good soil cover should suffice.

(d) Budwski* - feels that some decline in yield can be overlooked in view of timber production by shade trees.

(e) Haarer*: pointed out that while unshaded plantations may be more profitable when prices are high - a period of less intensive management, enforced by low prices will mean the ruin of an unshaded plantation, whereas presence of shade trees will keep it in fairly good shape.

8.6 Nutrient Status

Requires a reasonably fertile soil. In Malaya - virgin granitic soil preferred by Coffea liberica. Coffea robusta requires more fertile soils.

(No more specific information available for Malayan conditions.)

9.1 Selection and preparation of seeds for planting

(a) Ripe coffee cherries picked from high yielding trees.

(b) Pulp removed by hand, or with a pulping machine.

(c) Seeds placed in water overnight to ferment.

(d) Seeds washed - and planted at once.

9.2 Nursery site

(a) Close to coffee orchard

(b) Location - convenient for watering and weeding - open sun - protected from strong winds.

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9.3 Planting coffee seed:

(a) Spread-seeds one layer thick on a seed flat - cover c ½" soil - keep moist - should be in the open sunlight.
(b) Cover flats with a sack when weather dry.
(c) Remove sacks - 50 days - coffee seeds - germinate - shoots sprout.

9.4 Seed bed for large number of seedling:

Dug - 3" to 4" deep - level the bed - location rainy, overhead irrigated, area - seed bed raised for drainage - seeds broadcast - 1 layer - seeds covered ½" layer of soil - covered to keep seeds moist - 50th day cover removed.

9.5 Stages for transplanting

(a) Match-stick stage - takes 70 to 80 days. Cotyledons not yet open, epigeal.
(b) Cotyledon stage: Cotyledons open.

9.6 When to transplant

(Can be transplanted at either of the above stages.)
(a) Match stick stage - low mortality - weed problem.
(b) Cotyledon stage - mortality greater - to reduce mortality - usually planted after cotyledons harden - 100th to 120th day.

9.7 Preparing Nursery bed

(a) Plough and harrow the land - level off.
(b) Furrows 3 to 4" deep - 1' apart - mark end of furrows with pegs.
(c) Well rotted cattle manure or compost worked into the soil. CIRP* - 1 cigarette-tin full for 4 sq yds of soil to be added.
(d) Nursery beds to be shaded - planted distance - 1' x 1'.
(e) Weeding done regularly - watering done - surface soil kept friable by hand cultivation.
(f) Kept under attap shade until 4 months old. Ready for planting - 5 to 6 months - 18" tall.

* Should be date reference individually - WRS
* Christmas Island Rock Phosphate.

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10. Preparation of land and planting

10.1 (a) Coffea liberica - planted on alluvial land - and shallow peats - previously under forest or rubber - land drained, trees felled and burnt during dry season prior to planting.

(b) Lallang roots forked out. Suitable planting distances: 11' x 11' triangular - 416 plants/acre. 12' x 12' triangular - 349 plants/acre. 10' x 12' rectangular- 363 plants/acre.

(c) Land lined - holes 2' x 2' x 2' - filled with top soil.

(d) To less fertile soils - organic manure, plus 6 to 8 oza CIRP/planting position added.

11. Planting

(a) After wet season (August to September.)

(b) Young plants lifted with ball of earth around roots. Seedlings with poor roots - i.e. twisted - discared.

(c) Seedling inserted into each planting point by making a small hole.

11.2 Fertilizer application

Liberian Coffee manuring schedule

Time of application	Fertilizer	Quantity Per bush
		6 to 8
In planting hole	CIRP	
1 to 2 months later	RRI mix M	4
1 year	"	4
1½ yrs.	"	8
2 yrs.	"	8
3	"	8
3½	"	8

Note: RRI Mix. M. contains:
47% of amm., 47% CIRP, 6% Muriate of Potash.
Nutrient content: $N:P_2O_3:K_2O$ = 9.9:16.9.3.6

12 Husbandry during development:

12.1 Weeding

Normal weeding rounds as practiced in other crops carried out. Assam forks: better weeding tools - do not damage roots as the changkol.

12.2 Pruning

Two methods - single stem, multi stem.

(a) Single stem: Practised in Malaya - good results with Liberian coffee - one main stem allowed - suckers removed - when ht 5½' - growing pt removed - topping repeated - bush kept at that ht - when bush is fully bearing - secondary branches removed on the main stem and primary

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branches within 8" of the soil level. Beyond this alternate secondary's are removed on each side of primary's. Once lower primary branches do not bear any more - removed - another branch allowed to develop from the same node. This renewal system of pruning is continued progressively upwards.

(b) Multi stem pruning: Practised in countries like Assam where Arabica and Robusta are grown. (Ref. Coffee, care of the young orchard, Y. Baron Goto and Edward T. Fuhurga*. ECTA+ circular 357, University of Hawaii - July 1956. or other ref. on coffee.)

* RRI = Rubber Research Institute of Malaya.
* Correct the ref. WRS.
+ = ?

12.3 Pests: Three important in Malaya.

(a) Coccus viridis - green scale - sucks sap - stems and leaves - weaken plant - control - white oil emulsion - 1.5% con.
(b) Cephonodes hylas, L. - moth - extensive damage i.e. defoliation of bushes - control-hand collected.
(c) Stephanoderes hampei, Ferr. coffee berry beetle - bores hole in berry - beetle collected - if attack great - no berries allowed to grow for a season.

12.4 Diseases:

(a) Rust - (leaf disease.)
Causal organism: Hemileia vastatrix attachs Liberica and Arabica. Checked* by better management and Bordeaux mixture or Perenox.
(b) Root disease: Fomes noxious & F.lignosus cause brown & white root diseases - treatment uneconomic - diseased trees removed and burnt.

13 Developmental pattern of plant.

Refers to coffea arabica:

13.1 Dimorphic branching.
13.2 Single vertical at stem - produce two lateral branches at 1' high and repeats branching in this pattern. (check this - WRS)
13.3 Distance at which lateral branches produced - become smaller as the main branch length increases.
13.4 Maximum height of main stem - 18' - 20'.
13.5 Should a primary branch be removed - it will not sprout again at the same node.
13.6 Fruit - produced at a node only once in the season. Fruit normally produced in the season (but see 13.7) following that in which growth was made.
13.7 A succession of flowers may develop at one node.

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13.8 Yield - related to no. of nodes at which flowers are produced.

13.9 Has the habit of producing heavy crop in one season - a light crop in the other (biennial bearing). (For details: Ref: Factors affecting the growth and yld of coffee in Kona, Hawaii - (J.H.Beaumout and E.T.Fuhunaga, Hawaii Agnic. Expt. Station.) Bull 113 -June 1958.)*

13.10 Flowers two years from date of planting.

13.11 Good crop - after 3 years.

13.12 In Malaya main cropping season - May to June and December to February.

14 Methods of harvesting the crop:

14.1 Only ripe berries picked. Regular harvesting rounds - 2 to 3 weeks interval.

14.2 Ylds: Coffea liberica - 650 to 800 lbs/acre of prepared beans - Gross annual return of $600 - $800/ acre per annum (current prices).

15 Methods of Processing

15.1 All outer layers of berry removed - to leave beans.

15.2 In Malaya - silver skin+ left intact in deference of local market.

15.3 Two methods of processing:
(a) Wet - superior produce.
(b) dry - local method.
(For details: Ref: Ministry of Agri. Federation of Malaya - Agric. Leaflet No.37. Coffee and Hawaii Agric. Exp. Stat. Bull 115 - Dec. 1957.)*

16 Current experimentation:

Literature not available in the library. (Enquire - WRS)

* Cite ref. correctly - WRS.
+ layer ? - WRS.

17 Crop prospects

Malayan surplus of Liberian coffee difficult to sell in the international market. Not liked by consumers - overseas. Competition from other producing countries great. Might be possible to build up a market in the Far East.

18 Bibliography (Cite and set out correctly and extend WRS)

(1) Y. Baron Goto and Edward T. Funga - How to grow seedlings - Extn. Circular 354. University of Hawaii - July 1956. 'Care of Yg. Orchard' - same authors - Extn. Circular 357.
(2) J.H.Beaumont and E.T. Fuhunaga - Factors affecting growth, and yield of coffee - Hawaii Agr. Exp. St. Bull. 113 - June 1958.
(3) Edward T. Fuhunaga - Hawaii Agric. Exp. Statu. Bull. 115 - Dec. 1957.
(4) Frederick L. Wellman - 'coffee' - World Crops series.
(5) Ministry of Agric. Fed. of Malaya. Agric. leaflet No.37.
Should see Burkill.

Draft* Malayan Agricultural Practice Catalogue (Project superviser, W.R.Stanton.) Section 13.3- Date 26.3.64

COCOA: IN MALAYA

1. Family: Steruliaceae.
   Genus: Theobroma, L.
   Specie: Cacao, L.
   Local Name: Cocco (by all races)

2. Uses:

   (a) Powder - beverage.
   (b) Chocolate.
   (c) Butter for medicine, food manufacture and chocolate.
   (d) Shells - Source of Vitamin D. Cattle feed.

3. Geographical distribution

   Experimental stage in Malaya.
   100 acres under coconut in Kuala Bernam Estate.
   60 acres under Oil Palms, Highland Estate, Klang.
   Exeriments carried out in:
   Serdang
   Jerangau in Kuala Trengganu

   Varieties: (a) Amelonado
   (b) Upper Amazon
   (c) Trinitario
   (d) Criollo

   (Varieties - strictly 'races' - WRS)

4. Origin:

   (a) Amazon and Orinoco - original home
   (b) Cultivated by Aztec and Maya people before the discovery of New World. - Selected large seeded Criollo.
   (c) Cocoa powder 1st made by Dutch - 1828.
   (d) 1st chocolate - 1848 - by English.
   (e) Spread to West Africa (Amelonado) and much later to Ceylon, Madagscar, Phillipines and East Indies.
   (f) Ghana - 1st planted 1879

(Trinitano (Forastero) was an introduced mainland types to W. Indies owing to greater origin than Criollo or Amelonado; latter is Criollo X mainland, Lyhid.
Trinitano represents coastal element of the Upper Amazon complex. - Details subject to revision - WRS.)

5. Introduction in Malaya - Not known (Trace original records - WRS.)
   Recent History in Malaya:
   1948: Department of Agriculture placed cocoa high on the list to be considered as substitute for rubber.
   1950: Amelonado seed garden - Serdang.
   1953: " " " 55 acres - Jerangau
   1954: 1st planted in Jerangau commercially
   1956: Small holders pilot scheme Trengganu
   1959: Minister of Agriculture - announced that cocoa not recommended as small holder's crop.
   Reason: die back

* Seminar material. Not to be quoted at this stage.

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7. Acceptability of crop

There is a possibility if 'due back' can be controlled.

8. Cultural requirements of the crop

(a) Climate

(i) Rain - not 60 - evenly distributed through the year.
Temp. - not 60°F
80" Rain } ideal
80°F }

(ii) Prolonged spell of dry weather - affects yields.

(iii) Prolonged wet conditions - affect ripening of pods.

(b) Soils
Deep alluvial loam with sruface layer of gumus.
Steep slopes - not suitable.
Not too acid.

(c) Aerial humidity - not available.
(d) Shade: necessary - excess or too little shade - bad
(e) Wind protection: wind belts essential.
(f) Nutrient status: Lit. not available.

9. Methods of sowing seed and other methods of propagation

(i) Does not breed true from seeds.
(ii) Rooted cutting preferred
(iii) By layering and budding

Tedious, takes months — rapid - but variation great.

Nursery technique

(i) land - excavated - depth 15"
Filled c stones. Easy drainage.

(ii) Bed size - depends on number of cuttings to be planted.

(iii) Rotting medium - coir dust and paddy husks - 4" depth on the bed

(iv) Shade: at hoights of 3½' - cloth or attap can be used - inc. humidity dec. light intensity.

(v) Cuttings - soft wood c brown streaks.
(vi) Cut slantwise - 6 to 9" long - planted to a depth of 3" aplices of 1 leaves removed - reduces transpiration.

(vii) Watering essential
A continous spray - for a month until rooting.
After 1 month: 2 to 3 hours morning and afternoon.

(viii) After 2 or 3 weeks after rooting - basketed - under shade - to harden.

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10. Preparation of site

Same as for other crops except:

(i) Original tree retained as shade.
(ii) 2ndary shade - Gliricidia sp.
(iii) A stretch of Jungle trees - wind belt.
(iv) Other conservation methods used.

11. Planting

(i) Lining - holes in a square - flat land
sloping land - along contours.

Spacing root stocks - 8' x 8'
seedlings - 11' x 11'

Will depend on the quality of soil and slope of land.

Depth of holes - 1½' square 1½' deep - av. soils. Filled with top soil - compost.

Transplanting:

(i) Lifted ☐ a ball of earth covering roots.
(ii) Long tap roots removed up to fibrous roots
(iii) After planting - soil firmly pressed down.

12. Husbandry during planting

Weed and Weed control

Same as for other crops.

Thinning

No thinning done.

Pruning

(i) Done over a pd in stages - does not tolerate cutting
(ii) Object - facilitates harvesting.
Moderate pruning - done if heavy - loss in yield.

For details (Refer to Agriculture leaflest No.30 Ministry of Agric. Fed. of Malaya.)

Pests and Diseases

(i) Helopaltis - control easy - insecticides (Dieldrex)

Diseases

(i) Dieback - cause not known
(for details: Ref: A.V.Haaldon - Var. trials Malayan Agric. Journal Vol. 43, No. 3 1961)

Fertilizer Requirements: No literature available for Malaya.

13. Developmental Pattern of the plant

(i) Rooting - 6 weeks
(ii) Planting in basket - 8 to 9th weeks
(iii) 12th week - ready for planting
(iv) Age of bearing - 4 to 5 years after transplanting
(a) Depends - physiological age
(b) Good conditions bears earlier
(c) Greater than girth in 1 year - fruits earlier

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14. Harvesting
Harvested as soon as pods - ripen.
Hooked knife c long handle - good implement.
Bark or floral cushions - should not be damaged.

15. Processing and storage
(i) Fermentation
(a) Basket lined c banana leaves - capicity of basket - should hold 50 to 60 lbs of beans.
(b) Beans removed from pods - placed in basket.
(c) covered c several layers - banana leaves left for two days.
(d) On 3rd day - contents inverted into another basket lined c banana leaves - ensured even fermentation-left - two days.
(e) 5th day - inverted into 1st basket
(f) 7th or 8th day fermentation complete.

Drying
Dried in the sun. Spread in a thin layer. Spread every day until dry.

Quality of dry bean
(i) mositure less than 8%
(ii) Wrinkled, flat, purple beans - poor quality
(iii) Free from cracks, shells, moulds etc.

Packing and storage
Kept dry, clean, free from weevils.
Above method - ideal for small quantities.

For large quantities
Fermenting - in large vats
Machines - used for drying.
(For more details: Ref. Agric. Series leaflet - No.30 - Fermentation and drying of Cocoa beans, Ministry of Agric. Fed. of Malaya.

16. Current experimentation in Malaya
(i) Fertilizer expts. on mature and immature - in the field.
(ii) Growing conditions - in field. (shade, clean weeding, mulching etc.)
(iii) Fert. Expt. on seeding cocoa in pots of soil
(iv) Breeding and selection against dieback
(v) Isolation of Pathogens from diseased plants

17. Future Prospects
(i) Attractive crop - however profits not high as rubber or oil palm.
(ii) 'Dieback' - main drawback - until controlled - no chance of spreading.

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Draft* Malayan Agricultural Practice Catalogue (Project supervisor: W.R.Stanton) — Section 21, Date 10.4.64

OIL PALM

(With additional notes from Tan Koonlin (unpub.)

1. Botanical name of the crop and family

Elaeis guineensis, Jacq.
Palmae
Local names - Klapa bali (Malay)
Kelapa Saivit (Malay)
Yew Chee (Chinese, Hokkien dialect; meaning oil seed)
Yeow Chai (Chinese, Cantonese dialect)
Choong Loi (Mandarin)

2. Use of the crop

(a) Palm oil from the fleshy pericarp.
(b) Palm-kernel oil from the kernel.
(c) Shells & fibre used as fuel. (fuel economy of factory based on this only.)
(d) Shell sometimes for road-making in estates.
(e) Kernel meal for animal feeding stuffs.
(f) Empty bunches - used as mulch - manure, or incinerated and the potash-rich ash used as fertilizer.

3. Geographical distribution and forms or varieties in Malaya.

3.1 Total acreage in 1960 in Federation of Malaya 13, 190 ac., all cultivated by 68 estates.
Johore State - 58,929 i.e. 46%
Selangor State - 40,707 i.e. 31%
Perak State - 24,059 i.e. 18%
Pahang & N. Sembilan - each less than 4%
3139 ac. - 2%; 2734 ac. - 2%
Penang & Province Wellesley - 982 ac. or 1%
Kedah - 0
Kelantan - 640 ac.
Malacca - 0
Perlis - 0
Trengganu - 0
} insignificant acreage or none.

3.2 Varieties in Malaya:- (1960 Census of Agriculture, Malaya)
(a) Dura-Deli (quite distinct from African Dura)
(b) Tenera (D x P) yields up to 22% oil
(c) Pisifera - used only for breeding purposes.
Only D x P (100%T) or D x T(50% D, 50%T) now used commercially.

4. When the crop was introduced into cultivation generally and how.

Native of West Africa. (Another theory attributes origin in South America.) Grown wild over large areas and been used as a source of fat and oil for centuries by the inhabitants of these regions. Its importance similar to the coconut in the Pacific Region. The oil palm groves there were

* Seminar material. Not to be quoted at this stage.

the result of deliberate or haphazard dissemination of seed by natives.

Export of palm kernels from West Africa started in 1842, but plantation method of cultivation was not introduced until early this century.

Introduced into the Dutch East Indies in 1848. Plantations were not started until about 1910.

Now cultivated throughout West African territories, the Congo, East Coast of Sumatra and West Coast of Malaya; also grown in Central America, the West Indies, and parts of South America. But West Africa, the Congo, Malaya and Indonesia remain the main exporting countries. West Africa - Kernel exports very significant as oil mostly consumed locally. East Indies - Oil exports four times or more than of kernels. Very little local consumption.

5. When the crop was introduced into Malaya

Earliest record - 1875, seeds from Ceylon into Botanic Garden in Singapore through the Royal Botanic Gardens, kew. Then used as ornamental plant.

6. How the crop spread through Malaya

In 1907, Ridley reports (Agricultural Bulletin of the Straits and Federated Malay States) that oil-palms were a common ornamental plant in Singapore. First palms very likely to have been planted about 1870, in Singapore Botanic Gardens, from seed from Java. In late 1902 or early 1903, 66 palms planted in Experimental Plantation, Batu Tiga, Selangor, but not practical interest taken in them. Malaya's industry based on planting material (Deli dura) taken from Sumatra, for in 1911 Fauconnier collected seeds from the best palms he saw on a Sumatran estate and planted up an avenue palms now still existing at entrance to S. Tinggi-Minjak estates near Batang Berjuntai. Seeds of these used to plant up Tennamaram estate, first commercial estate in Malaya, in 1917; and Elmina estate in 1919. Dept. of Agriculture, (SS and FMS), obtained material from Elmina for its breeding work in 1920-40, supplemented with African introductions, but Deli dura found to be still the best. From 1925 onwards noticeable increase in oil-palm acreage, largely encouraged by D. of A. which also helped by way of sales of seeds, experimental work, and practical advice to planters on field and factory aspects. (Evidence - many articles in M.A.J. pre 1939). Experimental work carried out in FES, Serdang; in 1956, due to lack of funds, staff and land, D. of A. initiated Cooperative Breeding Scheme with 4 estates, so as to continue breeding work on a wider scale under varying estate conditions. Tenera palms are major component in this

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breeding programme. Until 1960 oil palm cultivated exclusively under estate conditions mostly by European companies since then Chinese planters in Selangor and Federal Land Development Authority have entered industry, former small estates about 500 acres in size, latter in smallholder schemes of 4,000 acres or more. Material used by these obtained from European estates or their research stations.

7. (Section subject to revision) Position in the agricultural system in Malaya and comparison with that of other countries.

Rubber	-	3,500,000 ac.
Rice	-	924,000 ac.
Coconut	-	515,000 ac.
Oil Palm	-	127,000 ac.

In view of the unstable price of rubber and the competition from synthetic rubber, farmers are now interested in this crop. This is indicated by the move to replant old coastal rubber and coconut estates with oil palms. In a few years, it may replace the cocomut as second most important agricultural crop in Malaya. Government considers this crop one of the important items for diversification of cultural agricultural economy, as evident in the oil palm FLDA schemes established in early 1960's.

West Africa, the Congo, Malaya and Indonesia are main exporting countries.

8. Cultural Requirements - Malaya has one of the best environments for oil palms, better than most African countries.

(a) Temperature - optimum mean annual temperature is approx. 26°C (79°F). Lowest limit for growth approx. 20°C (68°F). Uniformity in temperature important.

(b) Rainfall - Optimum 80" - 120" evenly distributed throughout the year. Minimum tolerated is 40" a year.

(c) Light - High demand for light.

(d) Soil - moist, deep, medium loam, rich in humus and with good permeability for water suits oil palm best. Neutral, or slightly acid soil reaction is preferred. Coastal clays, if well drained, also very good. Laterites, sands, shallow peats, muck soils not favourable, but tolerated (WRS) - swamps, deep peat - decidedly unfavourable.

9(a) Seed Germination

High temperature, moisture and good aeration essential.
Three methods (i) Sand bed - 50% success.
(ii) Fermentation Congo Chest - 70% success.
(iii) Electrically controlled chamber - 80% - 90% success.

3rd method very expensive but most efficient of all and can deal with ½ million seeds a year.

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(b) Pre-nursery -(2 types)

(i) Basket Pre-nursery (using bamboo or polythene). Shade necessary for about 4 weeks. Fertilizer solution from - 2 oz Ammonium Phosphate ½ oz Kiesierite 4 gall water for 400 seedlings.

(ii) WAIFOR Raised Bed - Brick Border, Loamy top soil to promote good root growth. Spacing 4" x 4". Germinated seeds planted 1" deep. Keep in pre-nursery until plants are 4-5 months old - with 5-6 leaves.

(c) Field Nursery -

Sited preferably near water supply and where transport to the field is convenient. Fertile clay soil preferred so that earth can adhere to root system when plants dug out for transplanting. Plough land thoroughly and destroy cockchafers. If area low, drainage necessary. Planting distance - 2½' x 2½' if palms to remain here less than 1 year, 3' x 3' if palms to remain here more than 1 year. Select only good plants for field nursery. Inspection path every 10th row. Irrigation - totary water sprinkler. Fertilizer requirement:

50 parts of Sulphate Ammonia
22 parts of CIRP*
20 parts of Muriate of Potash
8 parts of Kieserite
} Mixture

* Christmas Island Rock Phosphate.

For coastal clay - use sulphate of ammonia alone. At following frequency:

Month	1st	2nd	3rd	5th	7th	9th	10th
Quantity(oz)	1	1	1	2	2	2	2(11)

Above amounts possibly high. In Malaya 5-6 ozs sufficient. Waste bunches from factory may be used as a mulch so as to conserve ground moisture.

Weed Control - Regular rounds are conducted.
Pests - rodents, Apogonia and Oryctes rhinoceros
Disease - Bud-rot.
Leaf blight - Curvularia sp.

9. Lining and staking - use dumpy level or compass on a tripod. On undulating land just cleared from jungle - necessary to establish leguminous cover crops immediately. A suitable mixture of seeds - ½ Calopogonium mucunoides
½ Centrosema pubescens
at 6 lb/ac.
Sown broadcast.

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The establishment of leguminous cover crop on land other than cleared jungle is often expensive and difficult and is not recommended; also not really necessary. Selective weeding of natural covers is sufficient.

11. Field Planting

(a) Before transplanting to the field, rigorous selection. Best ones taken. Root pruning done 4-6 weeks before transplanting to stimulate root initiation. Before holing the ground, make a general layout of the area - future drains, roads and/or railways. Arrange field planting to coincide with commencement of rainy season.

(b) Planting distance

Malaya - 32' x 32' x 32' triangular, giving 49 palms/ac.
30' x 30' x 30' triangular, giving 55 palms/ac.

(c) Planting Holes

18" x 18" x 15" deep.
Topsoil from the holes is heaped near them and the subsoil thrown further away. Holes left for a week or two and then refilled. Except with peat, top soil is scraped from the surrounding areas and mixed with the topsoil from the hole together with 8 oz (one cigarette tinful) of rock phosphate. This mixture is filled into the hole and the stake replaced.

(d) Planting

Before lifting palm from nursery, wet the soil. Make sure that soil sticks around the root system. Do not carry palms by the young spear of unopened leaves. If soil crumbles, the ball of earth should be wrapped with a gunny bag for transplanting.

A small hole is made in the refilled planting hole to accommodate the palm with the ball of earth surrounding its roots. The collar of the palm should be flush with the surface of the ground.

The soil is well pressed round the roots so that the palm is firmly fixed in the ground.

12(a) The Ground Cover

Establishment of legume covers necessary for replant areas. Weeding must be carried out regularly until the covers are well established; later periodic slashing of covers and ring weeding around the palms is sufficient.

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On new plantings selected natural ground covers should be encouraged. Harmful weeds such as lalang and Eupatorium must be removed and prevented from re-establishing themselves by selective weeding by (Digging out, or 'wiping' any aporadic lalang at intervals of two to three months and follow this by slashing other weed growth).

A small area around each palm of about 5 feet redius should be kept clean to avoid competition for plant nutrients, and to facilitate collection of harvested bunches and loose fruits.

When palms mature and shade the ground, the LC dies out and generally a nephrolepis cover establishes itself, luxuriantly on the coastal clays, which keeps ground conditions humid.

(b) Leaf Pruning

Should on no account be undertaken until the lowest fruit bunches are 3½ ft from the ground. From then until the lowest bunches are 5 ft from the ground the leaf immediately below a bunch is pruned when the bunch is harvested. Thereafter supplementary pruning of dead fronds and those below those supporting developing fruit bunches is carried out once a year.

(c) Manuring

Refer following two tables of fertilizer recommendation (by Dept. of Agriculture, Fed, of Malaya.) The fertilizers are applied in a broad band around the palms just beneath the spread of the leaves.

Fertilizer policy to be based on soil types and more popularly on foliar analysis.

Manuring program for Young Palms

Type of Soil	Time of Application	Fertilizer Mixture	Quantity per Appli.
Much Soil	Nil	Nil	Nil
Alluvial clay loam	6 mths after planting	RRI mixture X with Mg.	½ lb per palm

Fertilizer: RRI Mixture + Mg. Dosage in lbs/palm.

Months after planting	6	12	18	24	30	36	6-monthly intervals to bearing.
Alluvial Clay Loam.	½	½	¾	¾	1	1	1
All other suitable soils	1	1	1½	1½	2	2	2

Manuring program for palms in bearing

Time of application:- March and September each year

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Type of soil	Fertilizer Mixture	Quantity per Application
Much Soil	Nil	Nil
Alluvial Clay Loam	Rock Phosphate	1½ lb per palm
	Kieserite	½ lb per palm
Shallow peat	Muriate of potash	1½ lb per palm
	Magnesium limestone	½ lb per palm
Upland loam (poor)	NPK 5	3 lb per palm
Upland loam (good)	RRI Type G	2 lb per palm
	Kieserite	½ lb per palm

(d)(i) Pests:- Insects

Oryctes rhinoceros (black beetle) - attacks young leaf buds.

Rhynchophorus schach (red stripe weevil) - enters wounds left by rhinoceros beetles to lay their eggs. Serious damage caused by emerging larvae which burrow deep into the tissues.

Control - Hand-picking; destroying breeding places; avoiding accumulation of large quantities of organic matter such as wood, leaves and old palm stems.

Caterpillars of butterflies & moths - damage leaves e.g.

Setora nitens talk - nettle butterfly.
Mahasena corbetti Tams
Cremastopsyche pendula Joannis - bagworm
Control - spraying with insecticides or, in case of Setora, biological control with parasites.

(ii) Animals - Wild pigs, porcupines, rats, elephants, monkeys, squirrels.

Control - shooting, trapping, baiting. Fruit bunches may be dusted with barium carbonate as a repellent against rat attack.

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(iii) Diseases - Not numerous, few are serious.
Ganoderma Incida
Control - Diseased palm destroyed. No known cause or cure. Until very recently attacked only palms of 20 years or more
(Stem-rot)-Fronds turn brown and wither; trunk breaks, trunk turns brown and decays.
Bud rot - spear of unopened leaves rots and collapses and can be pulled out from bud cavity. Frequent in young palms. May be a physiological disorder, or due to an unidentified micro-organism; still under investigation.

Crown disease - attacks unmature palms, usually recover, cause still unknown.

Marasmius palmivora - (bunchrot) fruit bunches decay when approaching ripeness. Artificially pollinated bunches more susceptable than naturally pollinated. Also worse during wet weather. May also spread from unpollinated female flower bunches.

Control - by excising unpollinated or affected bunches when they begin to decay, when destroying them.

Root disease - not common. Blast disease. Usually Fomes lucidus, Rigidoporus microporus and Fomes lamaoensis.

Physiological diseases - due to nutrient imbalance.

Common ones - K deficient - Distinct spotting as "orange spotting". Discoloration beginning at lower leaves, fruit - malformation.

Bo dificient - short, narrow, stiff leaflets.

Mg deficient - "yellow frond disease".

13. (Some notes on developmental pattern)

Monoecious plant - during early years of flowering, more male inflorescences than female, but later on balanced sex cycle. More numercus small bunches of fruit produced in earlier years, with fewer layer, bunches produced in later years.
For foliar development, see Mr. Rosenguist's articles, (unpublished)
5-6 months ripen
lowest in Jan - Feb.
highest in Aug. - Sept.

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14. Palms start fruiting at 3 years after field planting but not harvested until 4th year, though some estates now do harvest at 3½ years. Leaves below ripe bunches are pruned, bunches excised by a knife or axe; where fruits are beyond reach of axe, i.e. 10 years of age or so, the harvesting knife is attached to bamboo pole up to 30' long. The knife used to harvest young palms is triangular shaped and flat; for tall palms, it is curved.

15. Methods of processing and storage

An oil palm factory is heavily capitalised, as only then can good quality oil be produced. Malayan palm oil of the highest quality in world market, since processed under most efficient factory conditions. Generally 3-4% ffa, ex-estate.

15.2 Fresh fruit bunches (FFB) after harvesting sent to factory by road or rail transport; sterilized by steaming in autoclaves to prevent further enzymatic activity in fruits which otherwise would increase oil fatty acids (ffa) in the oild, thus bringing down quality; also to loosen fruits; potash-rich empty bunches returned to field as mulch-manure or fertilizer.

15.3 Fruits mashed to soften pulp and free oil from tissues. Mixture of pulp and nuts passed through press, or alternatively through centrifuge, and oil extracted. Impure oil passed through clarification plant and purifier to remove solid impurities and moisture. About 90-92% oil should be extracted; if oil loss is 10% or more, part of or whole factory is inefficient and must be overhauled.

15.4 After oil extraction, dry fibre removed and blown to fire the boiler; kernel dried to loosen kernel from shell; nut cracked, kernel and shell separated in mud bath. Kernel dried in sun, or near boiler; must be done properly as colour of kernel affected, and eventually oil in it as well.

15.5 Oil stored in large tanks of 200 tons or more on estate, or in drums. Lorry, rail or sea tankers transport oil to bulking stations in Penang, Port Swettenham and Singapore to be shipped overseas. FFA% content likely to increase a little, even if carefully stored and transshipped but should still remain at 5% or under when it reaches foreign ports.

15.6 Kernels, after drying, bagged and stored in shed; then exported.

15.7 Most striking feature of palm oil factory is its self-sufficient in its fuel requirements, entirely provided by fibre and especially shell; so present use of tenera planting material, which has higher oil content but thinner shell than dura, may necessitate use of supplementary or even alternative supply of fuel - electric, diesel, or oil.

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Malaya produces no palm kernel oil as it is considered that the costs involved in extra-processing is not justified by prevailing prices.

16. (Abstract from annual reports of Guthrie's, SOCFIN's and Harrisons and Crossfield's research stations)

17. Problems and Prospects

Not a difficult or exacting crop to plant and maintain, but in order to ensure best yields, manuring program must be well formulated. Highest yielder of oil of all major oil-yielding plants per unit area. Takes only 4 years to mature, compared to rubber's 6 - 7 years; yields up to 1½ tons of oil under average estate conditions, possibly two tons or more with tenera material, which planted in mid 1950's has not reached its peak yield yet.

Diseases as yet few, none as devastating as those encountered under African conditions; however, likely that with greater extension in acreage, certain diseases unless control measures known and formulated in time, may become worse.

Processing probably biggest problem, in terms of capitalisation. To obtain highest yield at maximum efficiency must be processed under modern factory conditions. Opinion differs as to minimum size of area to support a capital-intensive factory, ranges between 2,000 to 5,000 acres, which would require a factory costing $1½ to $2 millions. Alternatively, several estates may pool resources to finance factory, or else send FFB to another factory for processing at a charve. Latter alternative at present followed by Chinese estates. So given high-yielding varieties (as is now being achieved through experimentation), properly planted and maintained under our favourable climate and fairly fertile soils, proper harvesting methods, efficient transport system, and efficient factory control, Malayan oil palm industry can continue to be highly efficient and very remunerative. Unlike rubber, vegetable oils market situation is fairly stable, and prices so far have not been discouraging. In view of improvements in standards of living, future demand for this product of the agricultural economy both in Malaya and the world is likely to expand steadily.

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COCONUT

1. Cocos nucifera, Linn.

Family Palmae.

Local names - Kelapa (Malay)
Yeah (Chinese)
Kalpa Vriksha (Sanskrit - meaning Tree of Heaven)

2. Use or uses of various parts of the crop

2.1 Trunk of mature tree - sometimes used for constructing houses and bridges in villages.

2.2 Leaves - when interwoven they are used as a roofing or thatching material. The mid-ribs of the leaflets for brooms. Other uses are for mats, baskets, fencing and when dry, for fuel.

2.3 Roots - said to have medicinal use.

2.4 Inflorescence - the unopened spadices are tapped to obtain a sugary sap which is either consumed in the fresh state (sweet toddy) or fermented state (toddy - containing about 5% alcohol). The sugary sap when fresh may be concentrated into 'sugar'.

2.5 Husk around the nut - the fibres (coir) are used for making ropes and cordage, matting, brushes and stuffing.

2.6 Shells of the nut - used as fuel, sometimes domestic utensils. In the East, they are one of the materials used by the craftsmen for their exquisite handicrafts.

2.7 Kernel - often consumed as fresh. When dried (known as copra) oil is extracted. The meal is used for livestock feed. The oil is used both for edible and industrial purposes, e.g. margarine, soap.

2.8 "Milk" from the Nuts - forms a refreshing beverage, a common drink sold by street hawkers.

* Seminar material, not to be quoted at this stage.

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3. The geographical distribution and the diversity of forms in Malaya

Total acreage in Malaya - 515,000 ac. (1961)
Johore State - 28%
Selangor State - 21%
Perak State - 19%
Kelantan State - 9%
The rest less than 8% in each state.

3.2 Varieties in Malaya

(a)Dwarf Type - Klapa Gading (Nyior Gading) Colour variants with yellow, golden, brick red. Klapa puyoh (Qualls coconut) green dwarf.

(b)Tall Type - Klapa jantong (Heart coconut)
Klapa bulat (Round coconut)
Klapa besar (Big coconut)
Klapa sepang (Heart coconut)

commonest in Singapore, Good for copra making.

(c)Strait settlement apricot - poor yielder, early maturity.

Klapa laga - too small for copra
Klapa nipah) making rare but high
Klapa hijan) yielders, good for
Klapa dadeh) copra.
Klapa duning- yellow coconut - more sugar in the milk and hence preferred for eating.

(d)Klapa logi -eaten in tender nut stage

(e)Klapa wangi-fragrant coconut. Preferred for making medicine.

(f)Klapa sekol-the shell of this type is fancied for making cups.

4. When the crop was introduced into cultivation and how

The original home of coconut still remains a mystery although many suggestions were put forward. In contrary to what is commonly believed dispersal of coconut is not due to ocean currents because the nuts that stay too long in sea water have been found to lose power of germination. It is considered that man himself distributed the coco-nut.

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5. Plantations of coconuts existed before the C19th in Penang, and later ones in Malacca, Province Wellesley and Singapore; at end of C19th in the S.S. Buckell p 602.

The Malayan dwarf type, Klapa gading has been recorded as being introduced by the Dutch at some unknown time (Burkell, 1935)

7. <u>The acceptability of the crop by the people in Malaya and its position in agricultural system.</u>

The crop is taken by all the three major races in Malaya, but in particular by the Malays a small proportion of the crop is consumed fresh. Mature nuts are popularly used in preparing 'curry' and some Malayan cakes.

Most of the crop is for extraction of oil. Coconut oil is used for cooking by the major non-european ethure groups in Malaya. However, some richer Chinese prefer groundnut oil and lard for cooking purposes.

Coconut palms are commonly planted around kampong houses. The fruits from these palms are home consumed. In some cases, the palms are planted for ornamental purpose. In Malaya, the area under cultivation is shown below where the figure is compared with those of rubber, rice and oil palm:-

Rubber	- 3,500 thousand ac.	1959 recorded
Rice	- 924 " "	
Coconut	- 515 " "	
Oil Palm	- 127 " "	

85% of the total coconut acreage are small holdings.

8. <u>Cultural requirements</u>

8.1 Rainfall - 50" to 100"

8.2 Temperature - 80 - 90°F

8.3 Aerial Humidity - about 80% (Too high humidity causes 'bud-rot' and premature decay of fruits).

8.4 Soil type - wide range from sandy to clayey provided drainage is efficient. Cannot withstand water logged condition. Peat found to be unsuitable.

8.5 Shade requirement - except at seedling stage, the crops requires plenty of sunshine.

8.6 Nutrients - Balanced nutrition - response not known in detail.

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9. Nursery operations

(a) Selection and preparation of site.
- sandy soil best, near water source, under mature palms preferably to provide shade.
Shade - not too dense.
Soil treated with organic matter or ash from burnt fibre. Seed bed may be raised 1 foot high.

(b) Method of planting seednuts
- Seednuts sown unhusked.
Place horizontally.

(c) Spacing - 18" x 12"

(d) Depth of planting - husk should be just above the surface of the soil.

(e) Time of planting - commencement of a rainy season.

(f) Care and management of nursery - kept well watered, periodical weeding, pest and disease control- termite (use BHC or DDT) Bud-rot

10. Preparation of site for the growing crop and its pre-treatment

Field thoroughly cleaned, old stumps and remains completely burnt, drainage system laid down. Correct marking out of the planting points and field drains, important to get regular rows and regular distances between drains. This makes cultivation much easier in subsequent years, and hastens uniform growth of palms.

Planting distance - 30 feet, square on clayey soil
28 feet, square on sandy soil
Dwarf type closer.

Planting hole: 2 ft cube on clayey soil
3 ft cube on sandy soil.

When digging holes, the top soil should be placed on one side and the lower layers on the other. In clay soils the holes should be left open until they dry out and the sides crack. It is important to prevent the soil at the bottom becoming compact. The holes are filled to within 6" of the top with friable top soil mixed with old cattle manure. On sandy soils the three-foot planting holes should have two layers of coconut husks, without shells, at the bottom to preserve moisture and then be filled to within 6" of the top with top soil mixed with organic matter.

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11. Transplanting

11.1 Seedlings selected should have (a) leaves, dark green leaves.
(b) short, broad leaf stalks.
(c) straight stems.
(d) no diseases or pests.
(e) have sprouted within four months of setting, with quick subsequent growth.

11.2 Transplanting best done at 3 leafed stage i.e. about 9 months after placing seed nut into bed.

11.3 Lifting of seedlings - do not pull up seedlings by the spear or leaves. Loosen soil all round first and lift the seedling gently by placing two hands beneath the nut. Lifted seedling to be planted at once.

11.4 Planting the seedling - Planted in the centre of the prepared and partly re-filled holes. Then cover up the nut with earth packed lightly. Seedlings should be supported by being tied loosely to a stake driven into the ground.

12. Husbandary during development

12.1 Weed control - circle weeding using fork or chemicals.

12.2 Cover crop - mixture of ½ Calopogonium mucunoides and ½ Centrosema pubescens at the rate of 6 - 10 lbs/acre. On 'Bris' soils - Stylosanthes gracilis.

12.3 Seedling replacement - unhealthy or deformed stands replaced. Little information for Malaya. Response of palms on Bris soil to proximity to middens is noteworthy. Palms on infertile soils (eg. sand) require about 3 lb. of muriate of potash per palm.

Manuring - lateriate soil - apply N.P.K. Also organic matter essential in this soil. In Ceylon, recommendation of fertilizer: For young palms as follows:-

Fertilizer mixture -		
	Sulphate Ammonium	2 parts
	Saphos-phosphate	2 parts
	Muriate of Potash	3 parts
		7 parts

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2nd year .875 kg of mixture
3rd year 1.25 kg " "
4th year 1.5 kg " "
5th year and subsequent year - 2 kg. of mixture

12.4 Pests

(a) Oryctes rhinocerus - major pest.

Control - manual : destroying breeding places. Examining palms periodically and hand collection of beetles and their larvae.

Biological means: The Scoliid wasp (Fam. Scollidae), Scolia species. Parasite attacks the grubs, but experiments not very successful.

Chemical means: BHC at 0.01% for killing larvae. DDT and other toxic chemicals can also be used but some are highly poisonous to cattle, and partly to human beings, so must be used with care.

(b) Rhynchophorus schach

Pest attacks after wound damage. Control hand picking and chemical as for Oryctes rhinoceros.

Other insect pests of importance and methods of control are:

(c) Mahasena corbetti Tams (The coconut-case caterpillar). The caterpillar of this moth, which lives enclosed within a conical case, feeds on the leaves. The larva of this caterpillar hatch out in the soil and can only attack the palm by isolate, by banding with a sticky material, the unattacked palms around the attacked area, thereby confining the caterpillars to that area. The area of attacked palms should then be similarly treated.

(d) Setora nitens, Walk - The nettle caterpillar - attack leaves young palms.
Control - hand picking, spray with lead arsenate.

(e) Turathata rufivena, Walk - attack male and female flowers.
Control - remove the sheath just before the spike would normally burst.

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12.5 Diseases

In Malaya, occurence less frequent than pest damage.
Plants usually show deficiency symptoms.
Bud rot occurs sometimes.
Also, wilting, lightning injury.
Root disease cuased by Ganoderma lucidium quite common.

13. Developmental pattern of the plant

Plant usually comes into bearing between the 4th and 6th years from planting and may continue to yield good crops for 60 years or more.

14 Harvesting (in Malaya)

(a) For very tall trees, must be climbed for efficient harvesting.

(b) Medium height - use curved knife attached to a long bamboo pole.

(c) East Coast - a trained monkey directed by his master.

(d) Nuts are left to fall naturally from the palm (not common practice) Method b - commonest.

15 Methods of Processing and Storage

For detail refer : Ministry of Agriculture,
Agricultural Leaflet No.41
The coconut palm. Page 21

15.1 Nut dehusked, split open, dried in the sun or by artificial means. Normally kernel removed from the shell on the second day, then 3 - 5 days required for sun-drying. Moisture content reduced to 5 - 7 per cent. Artificial drying two methods (i) smoke curing or drying over an open fire (direct drying) (ii) indirect drying by means of artificial heat, either on a heated platform or in an enclosed chamber (kiln) heated by flues.

15.2 Extraction of oil

Copra crushed by village "chekkus" or "ghannies" and power mills equipped with rotaries and/or expellers. Detailed procedure: refer Menon and Pandalai. (Yes?)

16. Pan-Malayan foliar analysis programme - estimate fertilizer requirement and response.

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17. On the West Coast clays and to a certain extent elsewhere coconut areas intercropped with short-term food crops like Wax gourd, pumpkins, sweet potatoes brinjals, and chillies. May fetch $300 - $600 per acre before coconuts are producing.

Also intercropped with more permanent crops like Bananas, coffee, fruit trees, cloves and tea.

Heavy manuring very necessary.

In East Coast areas. - Fodder grasses grown in coconut areas.
Cattle rearing introduced.
Stylosanthes gracilis found to be very suitable.

At present, smallholders would still plant coconut rather than oil palm (as far as these two crops are concerned) in view of processing facilities. In later years, when oil palm processing factory is set up on co-operative basis, they (might) turn to oil palm.

However, in North Malaya, old coconut estates are being replanted with oil palm. In a few years time, acreage of oil palm likely to be more than that of coconut.

18. Bibliography? Will require extensive research.

Menon + Pandalai: The Coconut Palm - A Monograph

Burkill (1935)

THE LANGSAT

1.	Botanical Name:	Lansium domesticum, Jack
	Family Name :	Meliaceae
	Local Name :	Langsat (Malay)
2.	Use	"One of the finest fruits of the Malay Peninsula" (who?) Buff coloured perciarp pulp eaten.
3.	Geographical Distribution	Indigenous to Malaya.
4.		
5.	Diversity of Forms	
7.	Position in Malayan Agriculture	Mainly door yard tree; mixed with other fruits. No attempts to have planned orchard planting.
8.	General Cultural Requirements.	Soil: good, low-lying, alluvial soil. Hot humid climate. Will grow up to 2,000 ft. in moist districts.
10.	Planting and Propagation	Raised from seed. Slow growth.
12.	Husbandry	As other Malayan fruit (refer Rambutan).
13.	Developmental Pattern	Season: August - September.
14.	Harvesting	Clusters are picked from branch. Cut by knife on a pole or climbing.
15.	Processing and Storage	No investigations.
16.	Current Experimentation	None recorded.
17.	Discussion	Not a major potential fruit. Market dependent on Kampong supply. (See Burkill (1935) for further details.
18.	General Bibliography (To be revised & extended)	Popenoe, W.(1957) Manual of tropical and sub-tropical fruits. M.A.J.(1935) Malayan Fruits, MAJ.23 No.23 p.130. Macmillan, H.F.(1956) Tropical Planting and Gardening. Burkill(?). Allen, B.M.(?)

* Seminar material. Not to be quoted at this stage.