

AGRICULTURAL SERIES.

**DEPARTMENT OF AGRICULTURE,
FEDERATION OF MALAYA.**

Agricultural Leaflet No. 31.
(Replacing Leaflet No. 27)

CACAO

(Theobroma cacao).

Published by the Department of Agriculture,
Federation of Malaya,
and Printed by ART PRINTING WORKS,
80, Ampang Street,
Kuala Lumpur.

October, 1955.

CACAO

There is a convention that the crop is normally called 'cacao' and the commercial product 'cocoa'. However, it is Malayan practice to pronounce both words the same,—**koko**, this being the Malay name for the tree.

Agricultural Leaflet No. 27 is now out-of-date and this leaflet incorporates the practical knowledge gained in growing cacao in Malaya since 1949. The recommendations now given are based on trials undertaken by the Department of Agriculture and by certain estates, of which the Malayan Cocoa Ltd. estate at Jerangau, Trengganu, is the most important. Certain of these recommendations are unlikely to need revision, but others will undoubtedly require alteration from time to time in the light of experiments not yet concluded.

The Cacao Tree

Cacao is a small evergreen tree growing to the size of a mature chiku tree. The flowers and fruit are borne on the trunk and main branches. While flowers can be found at all times of the year, at certain periods flowering is profuse. Similarly, some fruits ripen at all months in the year, but for the most part they ripen into a major crop during March, April and May.

Growth of the tree is not uniform but proceeds in a series of flushes—two or three a year. The main growth flush follows heavy rain after a dry period.

The first side branches develop when the tree is 12 to 18 months old, the first flowers a few months later (but do not develop) and the first ripe fruits may be expected at three or three and a half years.

The tree will give its maximum yields at about 15 to 20 years. Its length of life in Malaya is unknown but may reasonably be expected to equal that of Malayan fruit trees.

The cacao tree likes a certain amount of shade and is intolerant of strong, hot winds.

The Fruit

The fruit, called pods, are somewhat similar in size and shape to small papayas. They take five months from setting to ripening. When partially developed, i.e. one to three inches long, many of these young pods—called cherelles—wither and turn black. This is not a disease but a natural method of limiting the number of fruit which the tree can sustain.

The young pods may be green, red or pink in colour. When ripe, the colour is yellow, pinkish-yellow, yellow-orange or, occasionally, dark red. If not harvested when ripe the contents of the pod deteriorate after about three weeks.

(2)

Inside the ripe pod are 30 to 45 beans, each covered with white, sweet mucilage. It is one of the purposes of fermentation to remove this mucilage.

The clean, dry beans are sold and shipped.

100 ripe pods = 20 lb. of wet beans as extracted from the pods = $8\frac{1}{2}$ lb. dry cacao ready for sale.

Individual cacao trees may produce, when mature, over 100 pods, but it is wise to assume an average of 18 pods per mature tree per year giving approximately $1\frac{1}{2}$ lb. of dry cacao beans.

Soils

For the successful cultivation of cacao the selection of the right type of soil is all important. In Malaya, the soils most suited to cacao are:

- (a) those derived from fine-grained granites—the redder the soil in colour the better;
- (b) those derived from the more basic rocks of the Pahang Volcanic Series or other basalt or dolerite rocks;
- (c) the better-drained alluvial clays of the west coast;
- (d) the recent silts and clays deposited on either side of the larger rivers.

While cacao can stand periodic flooding, the permanent water table should not be less than $2\frac{1}{2}$ to 3 ft. below the surface of the soil.

In hilly or undulating land where soils have been derived from Triassic and Carboniferous sandstones, shales and other sedimentary rocks, the only practicable possibility of growing cacao is on the lower slopes and valley bottoms, provided that these are well drained.

It is urged that no attempt should be made to grow cacao without first consulting the Department of Agriculture as to the suitability of the soil.

Propagation By Seed

BEANS

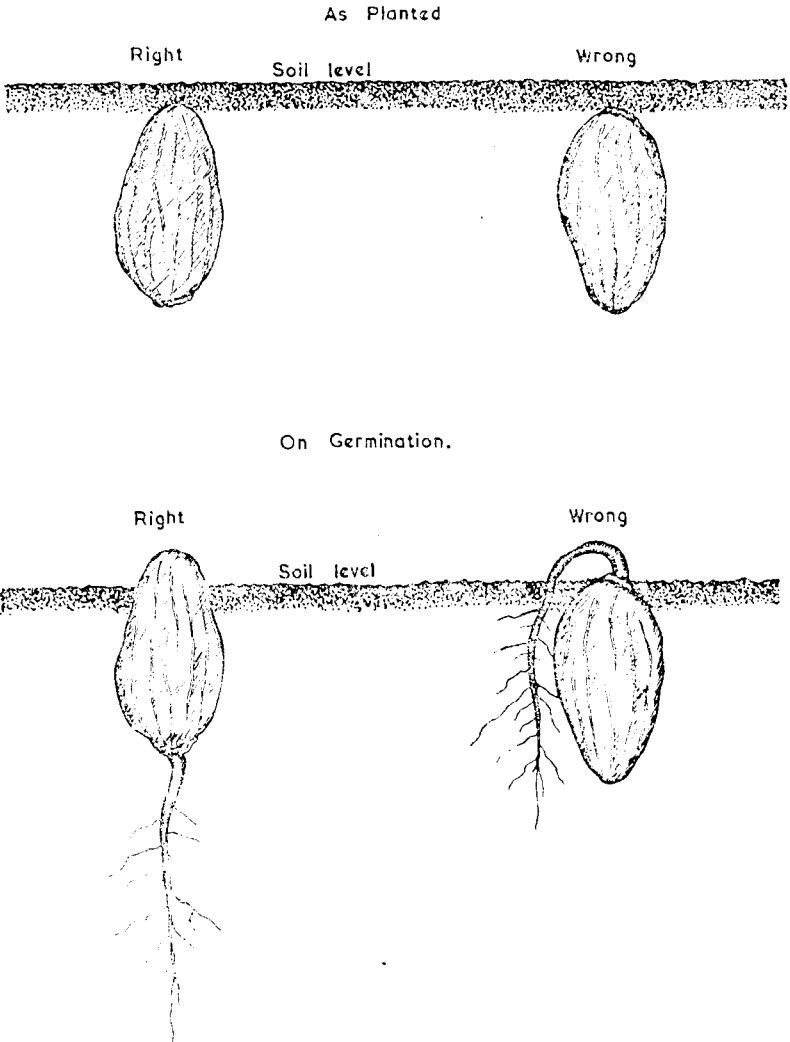
The ripe pods should be broken open, using a parang, and the beans (seed) extracted. Before planting, the mucilage surrounding the beans should be removed. This can be done by rubbing the beans in dry earth or sand. The beans should be planted the same day that they are extracted from the pod. On no account should the beans be allowed to dry out as this kills them.

Basket planting is at present recommended. Only one bean should be planted to each basket. Germination, which is nearly 100 per cent, takes place within two weeks. Seed not germinated within three weeks should be discarded.

It is most important that the bean should be placed in the soil correctly, i.e. with the blunter end downward. This is the end from which the root appears. The bean should be pressed into the soil by finger and thumb—the top of the bean being only just below soil level (Fig. 1).

Figure 1.

Planting the Bean.



CONTAINERS

Plant baskets are the containers most frequently used. The recommended size is 9 in. deep, 7 to 9 in. wide at the top and

6 to 7 in. wide at the bottom. The base should have an open weave so as not to obstruct root growth. Such baskets can be made locally of split bamboo or similar material and the price will vary from 12 to 25 cents each.

Where seedlings may have to be held in baskets for longer than six months it is advisable to treat the baskets with a preservative which is not toxic to plants. A copper naphthenate-kerosene mixture has been used by the Department for the last eight years and has always given good results provided that the copper content is not too high, in which case the basket would not rot away in the ground and might obstruct root growth.

At present there are two proprietary solutions of copper naphthenate on the market and these are known as "Cuprinol" and "Cuprotect". In each case the copper content is specified and this should be reduced to about 1.2 per cent by dilution with kerosene.

Baskets are dipped in this mixture for about two minutes, allowed to drain and then thoroughly sun-dried. They should then be kept dry for at least one week before use.

Another type of container which has recently given good results is the wooden veneer tube which should be treated before use with a copper naphthenate-kerosene mixture containing about 3 per cent copper. These tubes are somewhat more awkward to handle than baskets but they are much cheaper and can be used several times. Furthermore, the planting operation is a very neat and efficient one and there is no obstruction to root growth.

Suitable veneers can be obtained from local plywood factories at \$5 per 100 for the 9 x 15 in. size. The grain of the wood must be parallel with the 9 in. edge. The veneers are treated with preservative, allowed to drain and then thoroughly sun-dried. After storing for about one week, they are formed into tubes around a wooden or metal cylinder with diameter $4\frac{1}{2}$ in. Two galvanized wire (gauge 22) rings are slipped over the tube to keep its form and it is then removed from the cylinder. These tubes cannot be stored empty but must be filled at once; a handful of coir or other fibre is placed in the bottom of the tube and then it is completely filled with a potting mixture.

POTTING COMPOST

The potting mixture, or 'potting compost' as it is termed in commercial horticulture, should be well aerated and moisture-retaining, with an adequate supply of available phosphorus and a reaction only slightly on the acid side of neutral. A completely standard compost is not practicable in all localities but the standard Serdang mixture has always given good results and this is given below:—

7 parts loam, pH 5.5 to 6.0	} plus 1 oz. double superphosphate per basket.
3 " dried cattle manure	
2 " sharp sand	

With Serdang loam the pH correction is achieved by adding 6lb. of finely ground limestone per cubic yard but the quantity will vary somewhat from place to place.

Where good textured topsoil is available, as at Jerangau, a simplified potting compost consisting of topsoil only plus $\frac{1}{2}$ oz. each of double superphosphate and ground limestone per basket can be used.

FILLING CONTAINERS

Place a handful of coir fibre or similar palm fibre at the bottom of the container and fill up with potting compost until overflowing. Strike the surplus off level with the top of the container and consolidate by tapping it twice on a firm surface. Where a basket is used, the edge should be compacted gently but firmly with the finger tips. The surface is then levelled off and the basket is ready to receive the seed.

WATERING

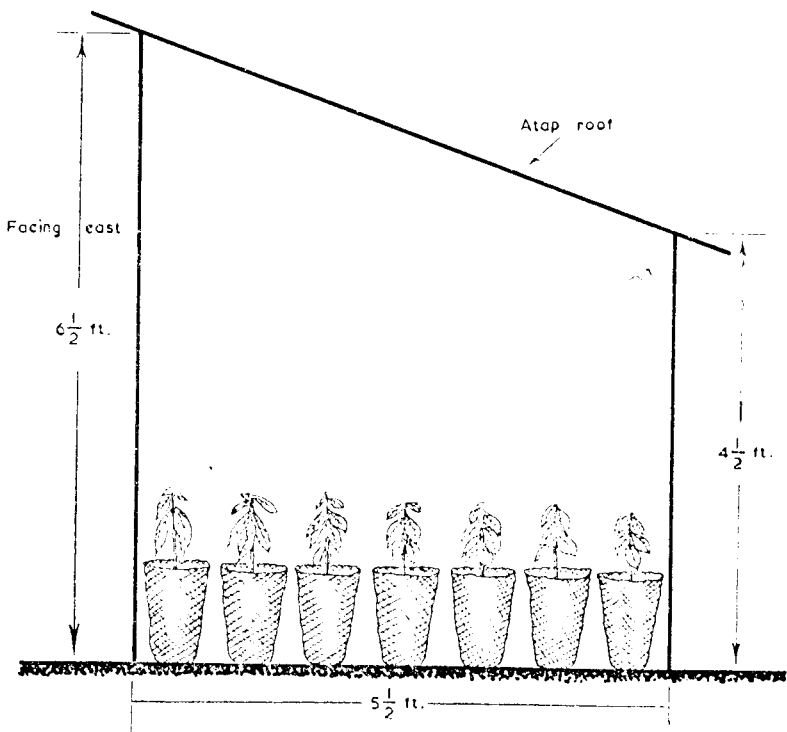
Light watering is recommended once a day, but care should be taken not to water to such an extent that the potting compost becomes saturated.

SHADE

Cacao seedlings definitely require shade and protection against heavy rain splash. It is therefore advised that shelters should be erected, and dimensions for these are given in Fig. II.

Figure II.

Shelter for Seedlings.



The seedlings appear to benefit from early morning sun and the shelters should therefore face east. Sites for the shelters should be protected from strong winds as these are detrimental to the seedlings. Ample room, e.g. 5 ft., should be left between each row of shelters to permit easy access for watering and transport of plants.

SPRAYING AGAINST PESTS

Spraying is only necessary if serious attack by leaf eating caterpillars or beetles is apparent. Any suitable, recognised spray can be used, though a stomach poison such as lead arsenate is preferable.

MAMMALIAN PESTS

Rats, squirrels and musang may cause damage to the germinating beans and it is advisable to surround the nursery area with wire netting if these pests are locally prevalent.

TIME IN THE NURSERY

The basket seedlings should be ready for planting out in the field at four to five months old. By this time they should be about 18 in. tall and the taproot will be coming through the bottom of the basket. It is preferable to plant out when the seedlings have no new, tender flush of leaves.

ALTERNATIVE METHODS

It is appreciated that the cost of producing basket seedlings as set out above is high and that further heavy expense is incurred in carrying the basket seedlings from the nursery to the field.

Two alternative and cheaper methods are under trial but cannot yet be recommended. These alternatives are:—

- (i) Planting seed at stake. Very considerable losses have been sustained by rodents destroying the seed and germinating seedlings. Rain splash has proved harmful and growth of the seedlings has generally been much less robust than basket seedlings. Nevertheless, planting seed at stake is common practice in West Africa and further trials are being carried out here.
- (ii) Bare or semi-bare root seedlings. Small-scale trials with these have given variable results. Experiments are continuing and there is promise that a satisfactory technique may be evolved within the next few years.

Field Planting

PREPARATION OF THE LAND

For commercial planting, only one technique is at present recommended, i.e. planting through thinned jungle. This method was adopted by the Gold Coast cacao peasant farmers and has recently

been used as estate practice in the Congo with success. It has proved, so far, satisfactory in Malaya.

The main advantages are threefold: the soil is never fully exposed and therefore suffers little loss from erosion, even on steep slopes; there is no necessity for, and therefore no delay in, establishing temporary or permanent shade for the cacao; it is relatively cheap. The disadvantages are as follows: lining for the cacao stand is less easy than in clear-felled and burnt jungle; the degree of jungle tree thinning requires knowledge and some intelligence; falling limbs from the remaining jungle trees during heavy wind storms are probable.

The first stage in jungle thinning is to underbrush all vines, ground vegetation, low growing palms and small trees up to 4 in. in diameter. When this cut vegetation has withered the land is sufficiently clear for lining, which should then be done.

After lining, planting holes should be dug 1 ft. deep and 1 to 2 ft. square and left open.

The next stage is to reduce the number of the remaining jungle trees. It is here that some skill and intelligence is required. The aim is to obtain dappled sunlight at midday without leaving any large windows of full sunlight. The largest trees should be felled since these will have reached maturity and may be expected to be particularly susceptible to storm damage. Low-canopy trees with heavy foliage, such as certain figs, should be felled as also should all trees showing decay or not growing vertically. The final stand will be in the order of 50 jungle trees per acre. The degree of light now falling on the ground should be such as to encourage fern and broad-leaved seedlings rather than grasses. If, after planting the cacao, the shade appears to be excessive in certain parts, selected jungle trees can be ring-barked and poisoned. It is advisable to complete the jungle thinning several months before the cacao is planted, so giving time for the twigs and smaller branches of the felled trees to disintegrate and hence facilitate access to the planting holes.

There are three alternative methods of preparing the land, but which cannot yet be advocated for commercial planting until field trials have been completed. These methods are:—

- (a) Clear felling the jungle and establishing cacao through the secondary growths which rapidly spring up.
- (b) Clear felling the jungle, burning, and planting temporary and permanent shade, e.g. bananas, *Gliricidia*, *Erythrina*, durians, etc.
- (c) Clear felling, burning and planting temporary shade only, e.g. bananas, tapioca, dry padi, maize, etc. In this instance the cacao would need to be very closely planted.

PLANTING

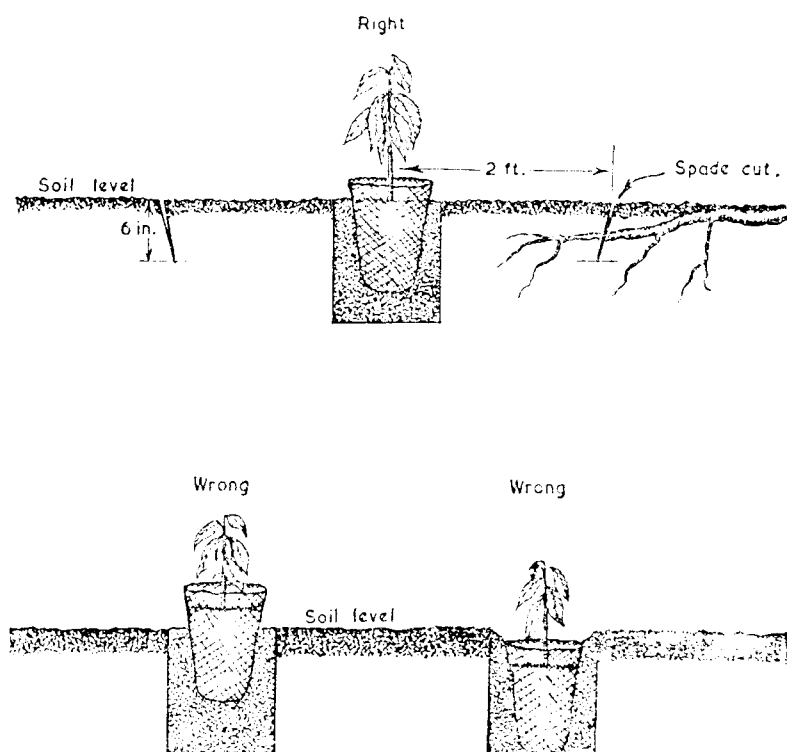
There is no need to attempt to remove the basket from the seedling at the time of planting. However, if the basket is strongly made it may be advisable to remove the bottom before planting, except where it has a very open weave. Some of the soil from the dug hole should be put back and consolidated so that the level of the top of the basket soil is the same as that of the surrounding ground. The remainder of the soil—mixed with fertiliser—should then be pressed firmly into the space between the basket and the sides of the hole.

Watering is unnecessary, but should a hot dry spell immediately follow transplanting, 2½ ft. portions of palm fronds can be stuck around the seedling to give additional shade.

It is advisable to cut, with a spade or changkol, any surface tree roots within a radius of 2 ft. from the seedling and within 6 in. of the surface.

Figure III.

Planting the Seedling.



SPACING

There is much controversy over the best spacing for cacao. In other countries, estate practice used to be 12 x 12 ft. or 14 x 14 ft., giving 302 and 222 plants per acre respectively. The modern tendency, supported by West African experiments and observation of peasant farms, suggests a much closer spacing, i.e. 8 x 8 ft. giving 680 trees to the acre.

Until experimental results in Malaya are available it is recommended that the spacing for commercial plantations should be 8 x 8 ft.

The disadvantage of this close spacing lies in the cost of the greater number of basket seedlings required. On the other hand, the close planting results in a quicker cover of the ground by the cacao canopy thereby saving weeding costs, and dispensing with the need to fill vacancies, should—as is probable—some 5 per cent of the stands fail to establish.

There is no objection to the branches of one tree intermingling with those of another. Indeed the aim is to obtain a stand of cacao trees through which one can walk in any direction and with the ground supporting no weeds but covered with a litter of dead leaves. Harvesting is thus made easy and costs of maintenance reduced to negligible proportions.

Estates may find it necessary to leave access paths every 40 yd. or more in order to permit the use of a mechanical sprayer, but this will not be necessary on smallholdings.

ALTERNATIVE METHOD

An alternative method, adopted throughout the peasant farms in West Africa, is to plant the cacao very close, approximately 5 x 5 ft. giving some 2,000 trees per acre, and thin out the stand gradually once the canopy has been formed, i.e. about the 4th to 7th year. The final stand is between 600 and 700 trees to the acre.

As long as seed is in short supply in Malaya this alternative method cannot be recommended, but experiments are in progress.

Maintenance

Maintenance of the cacao plantation consists of periodic slashing of the ground vegetation until such time as it is killed out by the shade of the cacao trees. Weed growth immediately surrounding young plants should be hand pulled or cut. A parang—not a changkol—should be used, since cacao is a surface feeder.

Regular manuring is essential, and spraying against insect pests may be necessary.

Pruning is confined to the removal of those water shoots or suckers arising from the main stem with the exception of those immediately

below the first side branches. Broken or damaged branches should be cut off cleanly.

Mistletoe (**Loranthus**) should be removed whenever seen.

It should be remembered that cacao does not like a sudden change to drier or sunnier environment, therefore any thinning of the shade should be undertaken gradually.

Manuring

There is no evidence yet in Malaya on which to base recommendations for the manuring of mature cacao. But for seedling and young cacao, experiments have clearly shown the need for phosphatic manures and the lack of need for nitrogen. Indeed, applications of ammonium sulphate alone can actually have a depressing effect on growth.

The fertilisers at present recommended are shown in Table I.

These manurial recommendations are intended only as a guide and should be modified, if necessary, to suit local conditions. They may well be too generous for the Kuantan, Jengka and Segamat series of soils derived from basic igneous rocks. However, until such time as reliable information is available for these soils series it is strongly recommended that the above schedule should be followed.

Where cattle manure or other organic manures are readily obtainable they can also be applied, in addition to the above fertilisers, with benefit. It is also advisable to put cut trash or vegetation round young cacao as a mulch, but this should not be in direct contact with the cacao stems.

Harvesting, Fermenting and Drying

Harvesting should be carried out at two- or three-weekly intervals throughout the year. At certain seasons the harvest will be very small and the object of removing the few ripe pods at such a time is mainly to prevent pods from acting as a host for pests and diseases.

The pods are cut off from the trees with a sharp pruning knife or parang, care being taken not to cut into the bark of the tree. The pods are then collected into convenient heaps on the plantation, cut open with a parang and the wet beans taken out. The pods should not be left in the heap more than three days before opening. The cacao husks collect water and breed mosquitoes; they should be lightly buried.

The wet beans, from which the central fibrous stalk has been discarded, are carried in baskets to the house or fermenting shed and placed in a large basket or wooden box of about 20 cu. ft. capacity with a depth not exceeding 3 ft. If a basket is used for fermenting, the sides, but not the bottom, should be lined with two or three layers of banana leaves; if a box is used, it should be provided with ample

TABLE I
Recommended Fertiliser Mixtures

Mixtures	Ingredient				Analysis		
	Sulphate of Ammonia per cent	Double Super-phosphate per cent	Christmas Island Rock Phosphate per cent	<i>Superphosphate</i> of Potash per cent	N	P ₂ O ₅	K ₂ O
Young Cacao No. 1	—	20	80	—	—	37.60	—
" " No. 2	25	—	75	—	5.25	27.75	—
" " No. 3	15	—	75	10	3.15	27.75	6.5
Mature " No. 4	25	—	60	15	5.25	22.20	9.7

TABLE II
Manuring Schedule of Recommended Mixtures shown in Table I

Time of Application	Adequate Jungle Shade		Deficient Shade	Quantity per Point
	Rengam Series or More Fertile	Other Soils		
In the planting hole	1	1	1	oz. 2-4
At 1 to 2 months				2
At 6 months	1	1	2	3
At 12 "	rock phosphate	3	2	3
At 18 "	" "	3	2	4
At 2 years	" "	3	2	6
At 2½ "	" "	3	2	6
At 3 "	" "	3	2	6
At 3½ "	4	4	4	6
At 4 "	4	4	4	6

drainage holes at the bottom. The object is to permit the 'sweatings' to drain away freely. The top of either should be covered by banana leaves.

Fermenting boxes should be made of pegged, hardwood planks so that one side can be removed to facilitate tipping out into the next box, which is usually placed at a lower level. If nails or screws are used they should not come into contact with the beans since metal objects blacken the pulp and are themselves corroded. For the same reason wooden shovels are used to handle beans in bulk, and some authorities even advocate that pods should be split open with a wooden bat, but this is not a common practice.

It is important that the fermenting boxes or baskets should be kept under cover to assist in raising the temperature of the cacao beans.

After 48 hours the temperature of the cacao beans should have risen to the extent of feeling hot to the hand; they are then thoroughly mixed and stirred, and the banana leaf cover replaced. The beans are again mixed after a further 48 hours.

After seven to eight days fermenting, the beans are taken out and placed on mats raised off the ground in full sunlight for three hours, after which the beans are shaded by covering with mats or palm leaves to prevent too rapid drying on the first day. When out to dry, the beans should not be spread thicker than $1\frac{1}{2}$ in. Too rapid initial drying gives shrivelled beans; too slow drying encourages moulds.

At night the beans should be collected into a basket and kept under cover.

On the second and subsequent days of drying the beans can have as much sun as possible, placing them under cover at night. They are dry enough for bagging and shipment when a handful can be felt to crackle on squeezing. This, if the weather is reasonably fine, may be expected after seven to 10 days drying.

During the time on the drying mats the beans should be periodically stirred; broken or flat beans should be picked out and discarded together with those showing a hole at the base. These are germinated beans, reflecting ripe pods which have been left on the tree more than three weeks. The presence of germinated beans reduces considerably the market value of the parcel.

Sometimes two or three beans remain stuck together. Though not strictly a commercial defect, they should be separated on the drying mats.

The sooner dry beans are passed for export the better; in the damp climate of Malaya deterioration through mould by poor storage is likely. Furthermore, the larvae of certain small moths (e.g. *Ephestia cautella*) attack stored beans, hence care should be taken to use only new and clean bags and to avoid prolonged storage.

Cacao beans readily absorb other flavours, particularly of smoke, and it is most important to see that no wood smoke comes in contact with them. "Smoky" or "hammy" beans are practically unsaleable. It is equally important that all bags and containers used for cacao are clean and preferably new. Cacao should not come into contact with tar, creosote or similar substances.

In the process of fermenting and drying there are two major difficulties. Good fermentation requires a quantity of wet cacao beans not much less than 100 lbs., equivalent to a harvest of 500 pods. It is unlikely that the first harvests will be of this magnitude, and it must be accepted that the first consignments from Malaya may be marked down on the score of inadequate fermentation.

The second major difficulty concerns drying. With the main harvest likely to occur during March, April and May, heavy showers of rain during the day must be expected. When these fall the cacao must either be brought under cover or some light temporary shelter must be put over the drying mats. Artificial drying may even have to be considered.

Quality Check

All cacao for export must be dry, free from extraneous matter and of good odour.

The physical quality is judged on the percentage of defective beans and the percentage unfermented. These percentages are ascertained by taking out a random sample of 300 beans.

From these 300 are first counted the number of broken, germinated and flat beans (shell with nothing inside them). The remaining beans are cut longitudinally with a sharp knife and counts made of "slaty", i.e. unfermented beans. Fully and partially fermented beans are a chocolate and violet colour respectively; unfermented, slate or grey colour. Counts are made of mouldy and weevilly beans.

Defective beans include: flat, broken, germinated, mouldy and weevilly. The percentage of these should not exceed five for a Grade I cacao or ten for a Grade II. Similarly, there should not be more than five and ten per cent respectively of slaty beans.

These grades are based on West African standards and are given here solely to indicate the type of defects regarded as important by manufacturers.

Diseases and Pests

CACAO DISEASES

The three root diseases red root disease (*Ganoderma pseudoferreum*), white root disease (*Fomes lignosus*) and brown root disease (*Fomes noxius*) all attack cacao in Malaya and appear to be about as serious on this host as on rubber. Symptoms of the disease are the death of the tree, which often occurs so suddenly that the leaves remain

on the tree. Treatment consists of removing dead trees with all their roots and also any diseased roots of surrounding, apparently healthy trees. Control depends on the careful removal and burning of all diseased parts.

Thread blight is not uncommon. The white fungus strands are easily visible spreading along the smaller branches, twigs and leaves. The result of attack is the death of affected parts; the disease is rendered conspicuous as the dead leaves remain hanging on the tree by the strands of fungus for several months. Parts affected with thread blight should be cut off and burnt; this should be done as soon as possible as, although unlike the root diseases it is not a killer, the disease can cause considerable damage.

There are several diseases causing the die-back of the smaller branches and twigs, but in general the presence of these diseases merely reflects an unsatisfactory environment for the trees. Similarly, leaves showing dead patches reflect faulty fertiliser treatment.

Pod rots are of fairly frequent occurrence. Several fungi, the commonest being *Botryodiplodia theobromae* and a species of *Colletotrichum*, are associated with these rots but they are not vigorous parasites and little damage is caused. As a precaution, however, diseased pods should be removed regularly and destroyed by burning or burying deeply in the ground.

Malaya is fortunately free from the more serious diseases Witches' Broom (*Marasmius perniciosus*), Swollen Shoot (virus) and *Phytophthora* pod rot (*P. palmivora*), although it is probable that the last named will eventually appear as the causative organism is present on other hosts.

INSECT PESTS

The main insect pests are leaf eaters, sucking bugs, branch borers and bark caterpillars.

Leaf Eaters.

Apogonia

This is a small, nocturnal beetle which eats an irregular pattern starting from the edges of the leaves. No serious damage has been recorded from cacao grown under thinned jungle, but under other methods of cultivation **Apogonia** and other chafer beetles have proved very troublesome.

Grasshoppers

Grasshoppers, at certain times of the year, have caused considerable damage on young cacao under all forms of cultivation. Spraying with lead arsenate is recommended should severe attacks develop.

Sucking Bugs.

Mealy Bugs

Mealy bugs will distort the growing points of young cacao but the damage caused is usually not sufficient to warrant control measures.

Far more important is the mosquito-like **Helopeltis** which is indeed, at present, the most dangerous insect pest of cacao in Malaya. This bug punctures the young cacao shoots and leaf stalks; each puncture mark later turns black, and if there are many such punctures the shoot is killed. The tree's reaction is to send out more new shoots which in turn are killed. The bug itself is not easy to see. Pods at all stages of development are also liable to attack, the black puncture marks later developing into whitish scabs.

Helopeltis is seasonal and can be extremely severe locally, but does not usually attack cacao less than two years old. As soon as the pest is noticed it is advisable to dust the trees with gamma-B.H.C. or, alternatively, to spray or fog with D.D.T.

The local "pockets" of attack mean that treatment need be applied only to those pockets and their immediate vicinity and not to the whole plantation.

There is some evidence that cacao growing under thinned jungle or with other adequate shade is less susceptible to attack by **Helopeltis** than cacao growing in exposed conditions.

Branch Borers.

Branch borers are sufficiently common to warrant attention. Whenever noticed, ortho-dichlorobenzene should be injected into the hole.

Clearwing Caterpillars

The cream-coloured larvae of a species of **Conopia** (Aegeriid) have been found damaging the trunks in one planting area in Selangor. The loose, scabby bark should be scraped away and Dieldrex 15 at 1 part in 20 (1 fl. oz./1 pint) applied. Damage is also caused to pods after **Helopeltis** attack, but only slight injury to seeds results.

MAMMALIAN PESTS

The partiality of rats, squirrels, musang and monkeys for cacao beans has already been noted in connection with cacao planting. They create a very real menace to trees in bearing and destroy the pods even before they are ripe. Whereas periodic shooting will keep monkeys away, the other pests remain. No satisfactory trap or poison bait has yet been evolved but regular shooting gives partial control.

On the analogy that small plots of padi are more susceptible to bird damage than large plots, it is hoped that as the area under cacao expands damage by mammals will become less. In the meantime, experiments are continuing on the use of poison bait.

Varieties and Planting Material

Only cacao of a type approved by the Department of Agriculture, Federation of Malaya, should be planted.

The reason for this is that there are many types of cacao which, through poor yield or defective beans, are quite unsuited for commercial planting. Unfortunately the few plots of cacao planted in Malaya prior to 1949 consist of these undesirable types. On no account should seed be taken from them for commercial planting.

For the purposes of this leaflet varieties of cacao may be divided into four groups, which are:—

Criollo

West African Amelonado

Upper Amazon

Trinitario

CRIOLLO

The Criollo types are associated in the chocolate industry with having very large beans of light-coloured break and fine aroma. The demand is limited to the manufacturers of the highest quality chocolates, and the beans may sell at a premium of some 25 per cent over ordinary (or standard) cacao.

The trees are not robust and are particularly susceptible to insect attack. The type in Malaya known as Kampong Criollo, has, however, very small beans and would not be accepted as Criollo by the manufacturers on this account. A few acres planted for observation in 1951 has been destroyed by insect pests.

Other Criollo types have been introduced, but planting material will not be available until their performance has been tested and proved.

WEST AFRICAN AMELONADO

This is the type which accounts for nearly 80 per cent of commercial cacao. It is the type which planters are at present advised to cultivate in Malaya. The planting material has been introduced into Malaya from those very same, old, parent trees in the Botanic Gardens, Aburi, Gold Coast, which gave rise to the Gold Coast industry.

Amelonado comes true from seed and expensive vegetative propagation is unnecessary. The pods are green, ripening to yellow, contain about 42 beans which are purple inside, and require seven days to ferment. The flowers are all self-fertile and the trees are heavy yielding.

Growth is not, however, particularly robust and the variety is undoubtedly susceptible to diseases and pests.

The uniformity of this type is a great asset and the product is well known and in strong demand.

UPPER AMAZON

Collected from the tributaries of the Amazon river in the early 1930's for the purpose of breeding for resistance to Witches' Broom disease in Trinidad, this type was later introduced experimentally to the Gold Coast, whence to Malaya.

The type is remarkably vigorous, robust and comes into bearing even earlier than West African Amelonado. The yield in the Gold Coast experimental plots is considerably greater than Amelonado.

Small commercial samples of beans from the Upper Amazon type have not received favourable reports from the London market, but have been acceptable in New York. Commercial quantities are still very small and are the result only of experimental plantings.

This type has beans rather smaller than W.A. Amelonado, purple inside, and probably rather more difficult to ferment.

The pods are green, turning yellow, and of similar size to W.A. Amelonado, but with a rougher surface. The tree is self-sterile but is cross-fertile. Plants come reasonably true to seed.

Upper Amazon will not be considered as approved planting material until more is known of its acceptability on the world's markets.

TRINITARIO

This type is in fact a mixture and does not come true to seed. Indeed the variability of plants raised from one pod is very great. The plantations in Ceylon, Indonesia and Trinidad are of this type. The quality of the beans is generally higher than W.A. Amelonado but the yields are lower.

There is a high degree of self-sterility. Self-steriles cannot set fruit with other self-steriles, as do the Upper Amazons. The relatively few self-fertiles need to pollinate all the self-steriles before a crop can be set.

Certain individual Trinitario trees are very good indeed, giving a high yield of good quality beans; they may be vigorous and resistant to diseases and pests. But these good qualities are generally lost in the seedling offspring. It is, therefore, necessary to propagate the selected trees vegetatively, i.e. by buddings or cuttings—the latter being preferable. Care must be taken that the selected trees are self-fertile.

Trinitario seed from good parents in the West Indies, West Africa and the East Indies has been introduced into Malaya by the Department of Agriculture since 1950. As expected, these trees are giving a very variable performance, though certain individuals promise to be

outstanding. It would, however, be premature to recommend the commercial planting of these as clones until more is known about them, and the market value of the beans assessed.

Certain of the specially selected Trinidad (Imperial College Selection) clones, i.e. rooted cuttings, have also been introduced to Malaya recently and are being multiplied vegetatively by the Department of Agriculture. Unfortunately there is also doubt about the market value of the cacao produced from these which may be little if any more than the value of W.A. Amelonado.

Prior to these Trinitario introductions there were a few plots, e.g. at Cheras and Serdang in Selangor, and individual trees of this type growing in Malaya. These have been carefully examined and found to be valueless; as already stated, seed should not be taken from them for commercial planting.

General

The Department of Agriculture is actively engaged in a programme of cacao breeding in an endeavour to produce a type of cacao which can be propagated by seed but which combines the best qualities of the types mentioned above. This is a long term project but may yield results of great practical importance within the next decade.