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BANANAS

(*MUSA* VARS.)

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BANANAS

(Musa vars.)

Description.—Local bananas show a diversity of forms, but for general cultivation, consideration may be confined to the well-known varieties. These are as follows :—

Embon—This banana is identical with the Gros Michel of the West Indies. The fruit is large, of good flavour and keeping quality, and may be generally considered the most satisfactory local dessert banana. A large bunch will weigh 75 lbs., consisting of 8 to 10 hands.

Masak Hijau—A similar fruit to Embon, but differs in being green when ripe with flesh less dry and of a sweet subacid flavour. The bunch is smaller than Embon.

Mas—This is considered a choice variety and although the fruit is small and the yield considerably less than both Embon and Masak Hijau, it realizes a higher price in the local market. Bunches average 15 lbs. in weight.

Rastali—A variety mainly in demand by Asiatics, and although of poor keeping quality, is very popular. The flavour is distinct and slightly acid. Average weight of bunch is 35 lbs.

Rajah—Although not in such demand in Malaya as are the foregoing varieties, it is of importance in Java and Sumatra. The flesh is rather coarse and is used locally, especially by Asiatics, for cooking. Its keeping qualities, however, are not good. The bunch is medium sized.

Propagation.—Strong suckers, 3 to 4 feet high, which bear long narrow leaves, should be established at distances of about 12 feet, or approximately 300 plants per acre. Holes, 2 to 3 feet square should be dug and partly filled with organic matter, e.g. surface soil, weeds, or preferably cattle manure. One sucker is than planted in each hole. When land has been opened from jungle, burnt soil and ashes may be placed in the hole.

Cultivation.—In selecting land for banana cultivation, a sheltered situation, with as deep soil as possible, is advantageous. The banana requires at all times a large amount of moisture, but stagnant water must be avoided by drainage. Low-growing leguminous cover crops may be established immediately after the suckers are planted. These, however, must be kept away from the banana stools to allow mulching and manuring when necessary. Bananas thrive in soils rich in organic matter and when the soil is heavy, they require plenty of lime. In addition to cattle manure, the use of a potash fertilizer is recommended.

The shoots produced after two or three years are weak, necessitating replanting of the area after about four years.

If the land has been opened from jungle, it should be possible to plant a second crop of bananas before allowing the land to fallow or be placed under some other form of cultivation. In the former instance, provided the land has not suffered from erosion and is of sufficient fertility, holes may be dug between the original spacing and fresh suckers planted. Although the yield of bunches will be less than formerly, the cost of planting will be proportionately lower.

Harvesting.—Each clump of bananas will produce at least one bunch of fruit containing 5 to 9 hands within a year's time from planting the suckers. The weight of each bunch varies according to variety. Whereas Mas will only yield a bunch weighting 15 lbs., a large bunch of Embon will scale 75 lbs. Each stem dies down after fruiting and is replaced by others, the clump remaining productive for a number of years, according to soil conditions. In the second year, two bunches per clump should be harvested, i.e. 600 bunches per acre per annum. Thereafter the yield diminishes and unless steps are taken to provide adequate supplies of manure, a rapid falling-off of production results. During harvesting operations, all surplus leaves and trash should be returned to the soil round the base of the clump. The fruit bunches should be removed before fully ripe and care taken to prevent damage to the fruits in transit.

Uses.—In addition to the use of bananas as a dessert fruit, they may be employed in curries and in cooking, and in this form are popular with Asiatics. Banana flour has also been produced in Malaya and has been described in detail in a publication of the Department.

References—

Articles on bananas are obtainable from the Agricultural Economist and Editor, Department of Agriculture, S.S. and F.M.S., Kuala Lumpur.

Banana Growing in Malaya. *Malayan Agricultural Journal,* Vol. XVIII, No. 2, price 50 cents.

Manufacture of Banana Flour. *Malayan Agricultural Journal,* Vol. XVIII, No. 3, price 50 cents.

DERRIS.

The question of the cultivation of derris (*akar tuba*, Malay) has become of increasing importance during recent years owing to the growing tendency to replace arsenical preparations by vegetable insecticides.

This leaflet was published originally in 1934. Since that date much work has been carried out on this crop, particularly with regard to the elucidation of the more important varieties of derris, both from a chemical and a botanical standpoint, occurring within the two species *Derris elliptica* and *D. malaccensis*. A second edition, embodying the results of this work, was published in 1937.

That edition is almost exhausted and the opportunity has therefore been taken of preparing a further revised edition containing the latest essential information on this crop.

BOTANICAL.

The following is a list of the varieties at present included in the two species *D. elliptica* and *D. malaccensis*, and cultivated in Malaya.

Derris elliptica

Changi Nos. 1, 2 and 3.
Singapore Nos. 1 and 2.
Sarawak creeping.

Derris malaccensis

(Kinta type).
Tuba merah.
Sarawak erect.

The last named variety has been described botanically and given the name of *Derris malaccensis* var. *sarawakensis*. The English name is used, however, in preference to the Latin to avoid a confusion of nomenclature and to conform with that adopted for the other varieties.

All the above varieties have definite characteristics and are distinguishable in the field. For example, *D. elliptica*, Changi Nos. 1, 2 and 3, and Singapore Nos. 1 and 2, are of a semi-prostrate type, while *D. elliptica*, Sarawak creeping, is definitely prostrate. *D. malaccensis* (Kinta type) and Tuba merah are semi-erect, while *D. malaccensis*, Sarawak erect, as its name implies, is erect.

For a botanical description of the varieties of *D. elliptica*, together with *D. malaccensis*, Sarawak erect, reference 1 should be consulted. Reference 2 gives a preliminary description of *D. malaccensis* (Kinta type) and Tuba merah.

COMPARATIVE TOXIC CONTENT OF VARIETIES.

While correct comparative evaluations of the toxicities of roots of the different varieties can be obtained only as a result of controlled experiments on various classes of insects, chemical tests constitute the means by which commercial consignments are valued. Thus, at present, the rotenone content and/or the ether extract of the root are invariably used as a basis for purposes of valuation. These chemical tests must, however, be regarded as arbitrary since on neither basis is it possible to compare accurately the insecticidal values of roots of different varieties.

Originally the root was valued on a basis of ether extract. The standard was either 18 or 20 per cent., calculated on the root as offered for sale. A premium was sometimes given if the ether extract was in excess of the specified figure, while a reduction in price was invariably made if the root failed to conform with the standard.

For some years past there has been an increasing tendency to value the root on a rotenone basis and at the present time a much better price is offered for root with a high rotenone content and ether extract than for a product containing the same amount of ether extract with only a small proportion of rotenone. As regards rotenone, the minimum figure on which transactions are based is usually 5 per cent. A slightly higher price is offered for root with a guaranteed content of 8 per cent.

As will be seen later, it will be possible in the near future to market a product in which the rotenone content is of the order of 10 per cent. At the present time there is likely to be only a moderate demand for root of such a high rotenone content. The reason for this is that the bulk of the derris root marketed at present is ground and used as a dust after mixing with some inert filler. For this purpose a root of medium rotenone content is more satisfactory. Root with a high rotenone content is primarily suitable for the preparation of a derris extract or impregnated dust. Reference 3 should be consulted.

It is to be hoped, however, that, with the broadening of the basis of the application of derris as an insecticide coupled with the adoption of accurate methods of sampling and analysis, a sliding

scale for the price of root based on its rotenone content will eventually be introduced. It is only fair to pay the producer according to the standard of quality of his product.

Recent work conducted by the Department has shown a wide range of toxic contents within the varieties. Special attention should, therefore, be given to the selection of planting material. Further information on this subject, which will also be mentioned later, will be found under references 4, 5 and 6.

As a result of extensive series of analyses the following standards are put forward tentatively for the average toxic contents of roots from 2 year old plants of the more important varieties, arranged in order of value according to present standards. The figures are calculated on a 10 per cent. moisture basis, this figure representing the moisture content of commercially dry root in Malaya.

Species and Variety.	Rotenone.	Ether Extract.
	per cent.	per cent.
D. elliptica, Changi No. 3 ...	10.5	25.0
D. elliptica, Changi No. 2 ...	8.0	20.0
D. elliptica, Changi Nos. 1 & 2 ...	7.0	20.0
D. elliptica, Sarawak creeping ...	6.5	22.0
D. malaccensis, Sarawak erect ...	3.5	22.0
D. malaccensis (Kinta type) ...	1.5	20.0

The above figures indicate that the first choice as regards variety is *D. elliptica*, Changi No. 3, since it combines high rotenone with high ether extract. It is followed by *D. elliptica*, Changi No. 2, and *D. elliptica*, Changi Nos. 1 and 2. Roots of the last two varieties may be said to represent the bulk of the Changi root marketed at the present time in Singapore.

D. elliptica, Sarawak creeping, is a comparatively recent introduction to Malaya. Extensive trials with this variety at the Central Experiment Station, Serdang, have shown it to be a suitable type for cultivation on inland soils.

The two *D. malaccensis* varieties, although lacking in rotenone, contain a satisfactory proportion of ether extract. The roots are, therefore, only acceptable in a market where ether extract constitutes the standard by which the root is judged.

D. malaccensis (Kinta type), as its name implies, is cultivated in the Kinta district of Perak. Owing to the present low prices for derris root possessing a low rotenone content neither of the *D. malaccensis* varieties is recommended for planting on a commercial scale.

SOILS.

Derris grows satisfactorily on a fairly wide range of soils, but is preferably planted on soil of a friable nature to allow of ample root development and to facilitate harvesting.

Good growth is seen on the lighter coastal alluvial soils and also on shallow peat. In the latter instance the height of the water table and satisfactory drainage are important factors.

Hilly land should not be chosen owing to liability to soil erosion and the risk of shortage of moisture. Inland, gravelly soils and those containing a high proportion of clay are generally unsuitable, mainly on account of difficulty of root penetration and increased cost of harvesting.

On the other hand the crop is grown successfully on exceptionally sandy soils by market gardeners both in Singapore Island and in the Kinta district of Perak, in the latter instance even on old mine tailings. In both cases, satisfactory crops are secured only as a result of frequent applications of liquid manure. Such a procedure is possible only where derris is grown under these special market garden conditions.

PROPAGATION.

Derris is propagated from mature cuttings, but certain varieties root more readily than others. *D. elliptica*, Changi No. 3, is most satisfactory is this respect, and even cuttings containing a single node will root readily. Short cuttings also are suitable for varieties of *D. malaccensis*.

Generally, cuttings 9 to 12 ins. long are used; these may be planted closely in shady beds and kept moist. Rooting often commences within three weeks of striking the cuttings. The cuttings in the nursery when rooted are lifted and transplanted, preferably during wet weather.

Cuttings may also be planted direct in the field, but many vacancies occur if dry weather prevails. After field-planting the soil around the cutting should be compacted by treading.

Chinese growers in Singapore often plant direct in the field at wide distances apart. Long cuttings are used, each twisted into

a single knot at the lower end. As lateral branches develop they are layered to induce subsidiary root formation.

To ensure an even stand of plants from the beginning some cultivators adopt the practice of planting two cuttings per planting point. This necessitates double the ordinary amount of planting material per acre and hence is uneconomical if this has to be purchased.

Experience has shown that the planting of derris cuttings is best undertaken towards the end of the year, when wet weather prevails. It is too risky to rely on the short wet season in the earlier part of the year, both the period and incidence of rainfall being too irregular.

SELECTION OF PLANTING MATERIAL.

Much work has been and is still being carried out regarding the question of maintenance of toxic content of root from generation to generation in view of the variations found between the toxic content of roots of individual plants compared among themselves and with the parent plants from which they are derived. For example, the figure for the ether extract of the roots of a plant of *D. elliptica*, Changi No. 3, aged 23 months, was 28.10 per cent.; those for ten members of the vegetative progeny at the same age varied from 29.01 to 22.55 per cent. with an average of 25.93 per cent.

While no explanation can yet be offered to account for these wide variations in the members of a progeny the results of analysis tend to show that the average toxic content of a mixed population remains of the same order from generation to generation.

When planting this crop every care should be taken, therefore, to ensure that the cuttings are derived from plants which have been checked botanically and of which the average toxic content is also known.

These points cannot be emphasized too strongly. Too often in the past growers who have bought planting material without taking these precautions have been disappointed in the prices offered for their root which has not come up to expectations in toxic content.

CULTIVATION.

The land should preferably be clean-cleared before planting. Adequate drainage is essential, as derris fails to grow satisfactorily on land holding stagnant water.

Planting systems differ with circumstances. The usual distance is 3 ft. × 3 ft. square, corresponding to 4,840 plants per acre.

Recent work indicates, however, that the yield of root per plant may be influenced considerably by the planting distance, and experiments are therefore being laid down to ascertain the best planting distances to ensure maximum yield of root per acre.

Supplying, if necessary, should be undertaken at an early opportunity, in order to secure an even stand of plants.

Regular weeding is essential, particularly during the early stages of growth, to lessen competition and to enable the plants to become firmly established. With certain varieties, *e.g., D. elliptica,* Sarawak creeping, and to a lesser degree Changi No. 3, their prostrate habit and characteristic stem rooting propensity result in early suppression of weeds and the formation of a complete cover over the land. In contra-distinction *D. malaccensis,* Sarawak erect, has an erect habit which may, on soils of only moderate fertility, necessitate routine weeding throughout the entire growing period.

It is evident, too, that a wider system of planting will probably result in higher weeding costs owing to the increased period elapsing before the land is covered.

In the Netherlands Indies, staking the prostrate plants is recommended, with the result, it is claimed, of an increase of root approximating to 30 per cent. Such a system necessitates additional expense for poles and more frequent weeding, and has the disadvantage of having a large proportion of the soil surface exposed to the sun.

As indicated previously, Chinese growers secure high yields of root as a market garden crop by combining derris cultivation with pig farming and using the manure so obtained as a fertilizer. *D. elliptica,* Changi Nos. 1 and 2 are grown on Singapore Island, and these varieties under the special conditions of cultivation tend to produce a proportion of long whippy roots which are baled without drying and are exported for use in a fresh state. Such root is also offered for sale in the local markets.

On virgin land manuring is unnecessary, since growth of the plants and root production are usually satisfactory. It has, however, been shown that this crop removes considerable amounts of plant nutrients from the soil. In the case of land that has been under cultivation for some time, therefore, unless the soil is comparatively fertile, some form of manuring becomes necessary. Manurial experiments conducted at Serdang indicated that whereas with *D. malaccensis,* Sarawak erect, marked increases in the yield

of root resulted from the application of manures and of lime, there was no corresponding increase in the case of *D. elliptica*, Sarawak creeping. It should be noted, however, that the yield from the latter variety, was far in excess of that of the Sarawak erect under the most favourable manurial treatment. References 7 and 8 should be consulted for further information on manuring.

Derris is a short cultivation crop and lends itself readily as a catch-crop during the early stages of establishing a main crop. It is, however, a sun-loving plant and fails to thrive when shaded. It should not be planted too close to the main crop on this account, and also because of its climbing habit and the general desirability of avoiding disturbance of the roots of the main crop during harvesting.

HARVESTING.

It has previously been considered that the toxic content of the root reaches a maximum when the crop is about 24 months old.

Recent work with individual plants has given apparent indications of the maximum development of toxic content at the much earlier age of about 15 months, the quantity of root alone increasing as the plant matures.

There are also indications that the toxic content at a particular age may vary slightly according to the development of the plants, which in turn is influenced by the spacing. Experiments are being laid down to investigate both these points.

If the crop is allowed to remain on the land too long, the plants have a tendency to develop thick roots, which may not be acceptable to the trade. Further, in the case of *D. malaccensis*, Sarawak erect, experiments have indicated that the toxic content of the root diminishes after 24 months. Reference 9 should be consulted.

For the present, therefore, cropping is advised when the plants are between 18 and 24 months old, depending upon growth and root formation.

When harvesting, all stems and branches are removed and the whole of the root system lifted with the stump. Provided the soil is sufficiently light in texture, harvesting is readily done with the ordinary Assam fork. It is immaterial whether the roots are broken during the process, though care must be taken to lift all the roots, including the finest, which have a high toxic content (See reference 10). After harvesting, the material is taken to a sorting shed.

Chinese growers in Singapore employ a system whereby only the lateral roots are harvested, leaving the main or tap root to

support the stems and leaves, until growth recommences. The branches are laid flat on the ground again and covered with soil at close intervals to induce further root formation. This procedure may be continued for a number of years in succession. A sandy soil favours this form of cultivation but it is obvious that adequate manuring is necessary to ensure continuous root production under such conditions.

PREPARATION.

The roots are roughly cleaned and all portions of stem, foreign matter and large root removed. The removal of stems is carried out more easily when the roots are fresh than dry. Stems are condemned by the trade and sellers are penalized if such material is present. Roots greater than $\frac{1}{2}$ in. diameter are also unacceptable to the trade. Roots shrink on drying and an air-dry root of $\frac{1}{2}$ in. diameter corresponds to one of $\frac{5}{8}$ to $\frac{3}{4}$ in. diameter when fresh.

A light rinsing of the fresh roots with water is recommended if much soil is still found to be adhering. Rinsing will greatly improve the appearance of the final product. Provided the roots are not rubbed hard while being rinsed the loss of toxic content judged by the development of a slight milkiness of the water is of little consequence.

After cleaning, the root is dried. A simple method used by the small producer is sun-drying until the root is brittle enough to snap when bent. Sun-drying may take from 7 to 15 days, according to weather conditions and will reduce the moisture content to about 10 per cent.

When dealing with a large crop, artificial drying must be undertaken. On estates the freshly cleaned root is, therefore, either folded into small bundles or chopped into short lengths before drying. Either method facilitates considerably the subsequent handling of the root.

A bundle, which is about 9 ins. to 1 ft. in length and about 2 ins. thick is made by folding the roots; it is secured by tying the middle of the bundle with the free ends.

When chopping, the length of the individual pieces varies according to the method of packing. If the root is to be baled the length should be about 6 ins.; if packed in chests the roots should be chopped into pieces not exceeding 2 ins. in length. It would be impracticable to attempt to bale root chopped into 2 in. lengths.

Drying is carried out in a flue-heated chamber or on a kiln similar in design to a hot-table copra kiln.

The flue-heated chamber is fitted with racks having wire bottoms on which the small bundles or the chopped root are laid out. A jack-roof should be fitted to the chamber to facilitate the escape of moisture.

A kiln possibly is preferable for chopped root owing to the tendency of the pieces to become entangled in the wire, unless the mesh is very small.

The temperature of the chamber or of the surface of the kiln should not exceed 130°F. Drying is complete in about 3 days.

In both cases the root should be turned over occasionally to ensure even drying.

The method of chopping the root is not favoured by local buyers purchasing from small producers. Whole roots are preferred to ensure freedom from adulteration. In the case of an estate filling a contract, such a contingency does not arise as the root is invariably sold on the basis of chemical analysis.

PACKING.

The root is exported usually in bales covered with sacking, the overall measurements of a bale being 42 ins. × 30 ins. × 28 ins. If whole root is used, the bale when packed weighs approximately 175 lbs. If chopped into 6 in. lengths or folded into small bundles before baling, the net weight of the root can be increased to about 240 lbs. In this way a substantial reduction of freight charges can be secured.

As mentioned previously root chopped into 2 in. lengths is exported in chests. These are similar to those used for rubber and tea. This method is favoured in the Netherlands Indies, more than 50 per cent. of the root exported from that country being packed in this manner. A chest measuring 19 ins. × 19 ins. × 24 ins. should hold about 112 lbs. Compared with the method of packing root chopped into 6 in. lengths in bales it can be calculated that nearly twice the weight of the finer chopped root can be packed into the same space. It is claimed that the further reduction in shipping charges more than compensates for the increased charges incurred in chopping and cost of chest.

It is advisable to bale or pack the root immediately after drying, otherwise the material is liable to attack by boring beetles.

SAMPLING.

The question of representative sampling is of considerable importance in view of the subsequent analysis of the root.

Sampling is most easily carried out when the root is being baled or packed in chests.

In the case of chopped root a quantity, say 2 lbs. for a bale and 1 lb. for a chest, is taken little by little from the bulk material as the press or chest is being filled. When the press or chest is filled this amount is set aside and the process repeated for each succeeding package. It is essential for the same amount to be taken from each package.

When the required number of packages has been completed the separate samples are mixed intimately on the floor and the heap quartered down until 1 lb. remains. This amount which represents an average sample for the particular number of packages, is retained for analysis. The remainder is returned to the bulk material.

In the case of small bundles of root, the most satisfactory procedure is to select bundles at random, removing a cross-section of the bundle with a sharp knife. This mass of small pieces corresponds to that drawn in the process described for chopped root. The same number of bundles must be drawn from each bale. The selection of the final sample for analysis is carried out as described for the previous method.

YIELD OF ROOT.

So far figures for yield of root have been somewhat variable.

When planted as a sole crop at Serdang the yields were about 600 lbs. per acre for *D. malaccensis*, Sarawak erect, and about 1,900 lbs. per acre for *D. elliptica*, Sarawak creeping, (See Reference 7).

Records from estates on which *D. elliptica*, Changi Nos. 1 and 2 have been planted as a catch-crop show yields varying from 1,000 to 1,200 lbs. per acre.

The proportion of air-dry to fresh root lies between 40 and 45 per cent.

USES.

Derris is an essential ingredient of many proprietary insecticides, one of its main advantages being that it is practically harmless to domestic animals. It may be used in the form of dust or as a spray. For these purposes the material must be finely ground.

In the United States, derris is used principally as a dust against the pea aphid, Mexican bean beetle and various species of cabbage worms. In England, considerable success has been obtained with derris as a specific against warble fly, and treatment of

infested cattle with a derris wash is one of the methods recommended by the Ministry of Agriculture. Derris is also extensively used as a dust in the treatment of numerous pests on fruit trees, flowers and other vegetables.

The fresh root is used in Malaya as an insecticide mainly in market gardens. For this purpose, the root is pounded to a pulp under water, using 1 lb. of fresh root to 18 galls. of water. The milky liquid so obtained is sprayed direct on the plants. Such a solution may be preserved in a closed container by adding a small amount of formalin.

REFERENCES.

Articles containing information on derris referred to in the text are obtainable at a price of 50 cents each post free from the Agricultural Economist, Department of Agriculture, S.S. & F.M.S., Kuala Lumpur.

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(6) Further Selection Experiments with *Derris malaccensis. Malayan Agricultural Journal,* Vol. XXVI, No. 1, 1938.

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(9) Variation in Toxic Content of Roots of *Derris malaccensis* var. *sarawakensis* with Increase in Age of Plants. *Malayan Agricultural Journal,* Vol. XXVII, No. 4, 1939.

(10) Notes on the Preparation of Derris Root for Export together with a Suggested Method for Evaluation. *Malayan Agricultural Journal,* Vol. XXIV, No. 10, 1936.