# DERRIS (TUBA ROOT)*

THE Malay word "tuba" is applied to a number of poisonous plants, amongst which various species of derris are the most important. The toxic qualities of derris have long been recognized by the Malays, who use an extract of it for fishing purposes, and by the Chinese who employ it as an insecticide.

## BOTANICAL

Two species of derris are commonly cultivated in the Malay Peninsula, *Derris elliptica*, Benth. (tuba puteh) and *Derris malaccensis*, Prain. (tuba merah). The former is a widely-spread plant, found from Chittagong through Siam, Cambodia and Malaya to New Guinea and the Bismarck Archipelago. It is doubtful whether it is ever found truly wild in the Malay Peninsula.

*Derris malaccensis* is indigenous to Malaya. Most, if not all of the local stock of *D. malaccensis* originated in Sarawak, hence its varietal names—*sarawakensis* and " Sarawak erect."

*Derris malaccensis* var. *sarawakensis* is an erect shrub-like plant, the stems not trailing on the ground, or forming a cover. It is widely known under the names " tuba rabut " and " Sarawak erect."

*Derris elliptica*, " Sarawak creeping," an introduction from Sarawak, has a prostrate habit, forming a close cover, with the stems often rooting profusely between nodes.

Other varieties of *Derris elliptica* have been described and are of importance in view of the fact that the toxic content of the varieties varies considerably. Intending planters are advised, therefore, to give very close consideration to this point before embarking on the cultivation of this crop, in order to make sure that the stock is the best obtainable.

## CULTIVATION

Derris is propagated readily by means of stem cuttings. The cuttings are mature wood and about 18 inches in length. They are planted thickly in nursery beds and kept in a moist condition. The nursery is preferably sited in a damp ravine adjoining the land it is proposed to plant. A layer of *lalang* grass is laid over the cuttings to conserve moisture, and watering is undertaken as may be found necessary. By this means the cuttings root in three weeks and when transplanted, at about six weeks, form a comparatively regular stand. If the cuttings are planted direct into the field, it is advisable to remove the leaves to prevent the stems from drying from excessive transpiration. It is generally found that if the cuttings are planted without the use of a nursery, a number die ; they should be replaced as early as possible by fresh cuttings so that an even stand is eventually obtained.

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The cuttings are planted in a slanting direction, with about two-thirds of the length of the stem below the surface.

The method adopted by Chinese market gardeners is to plant long cuttings, twisted into a circle, at distances of about 6 feet apart and to allow the plants to ramble over the ground. During growth, pig manure is applied to the soil. The crop is not harvested at one time, but roots are lifted as required.

Derris should be planted in a light soil of a sandy nature. Heavy clay soils are not recommended, owing to the difficulty experienced in harvesting the roots under such conditions. The land should be flat or gently undulating ; steeply sloping land should not be selected owing to the extreme danger of soil erosion.

When the cuttings have rooted in the nursery bed they are planted out in ridges at a distance of 3 feet apart, giving 4,840 plants per acre. The soil should receive a preliminary cultivation and be worked up into a fine tilth during the operation of ridging.

Derris is frequently planted as a catch crop with such permanent forms of cultivation as rubber and oil palm. In view of the increasing importance of the root as an insecticide, it is probable that it will be more seriously considered as a sole crop, or as a rotation crop.

## HARVESTING

The toxicity of derris roots varies according to their age ; it is most important, therefore, that harvesting should take place at the correct stage of maturity. Experiments have shewn that, taking into account both the yield of root and the toxicity, the optimum age for harvesting is when the plant is about 24 months old.

At the time of harvesting, the stems are cut and drawn on one side. Neither the stems nor leaves have any toxic value. The entire roots are then lifted, cleaned of soil and tied into bundles. It is important to harvest the smaller roots as the percentage of toxic principle contained in them is higher than that of the larger roots. The thickness of the roots should not greatly exceed that of a pencil.

The roots are sun-dried and baled. Sun-drying may take from 7 to 15 days, according to season. Where derris is produced on a large scale, a special flue-heated drying chamber is employed, in which the roots, after being chopped into 5 to 6 inch lengths, are dried at a temperature of 130° F. in about three-and-a-half days. The bale measures approximately 42 inches by 30 inches by 28 inches and contains about 250 lb. of dried root. It is essential to bale the root immediately after drying otherwise it is liable to attacks of boring beetles.

The yield of air-dried roots is approximately 45 per cent. of the weight of fresh root. The moisture content of the air-dried product is about 10 per cent. Under suitable conditions, the yield of air-dried root is about 1,000 to 1,200 lb. per acre.

## PESTS AND DISEASES

Derris is subject to considerable injury by numerous insects both in the field and in storage. The most serious of the field pests is a Chrysomelid beetle, *Craniotectus corbetti* Laboiss., which attacks the leaves. The beetle readily

succumbs to a spray consisting of pyrethum powder 1·67 lb., soap 1·67 lb., petroleum 0·8 gallons and water 40 gallons. The total cost of application including material and wages, amounts to $1·70 to $2·00 per acre. The spray would be reduced in cost and would probably prove equally satisfactory if petroleum were omitted.

Dried derris is liable to damage by several species of beetles in both the larval and adult stages. The adult beetles will attack the root a few days after harvesting, but prefer the very dry rot. They lay their eggs in cracks and irregularities on the outside of the root, and the larvae, on hatching, bore into the root and reduce it to powder.

Infestation is not always apparent as it is only the adults which eject frass from their tunnels ; it is therefore necessary to take samples of root and split them to ascertain whether beetle larvae or adults are present.

Unless the store is provided with windows covered with wire gauze of 1 mm. mesh, and with doors that fit perfectly, the protection of the crop against infestation by beetles is almost impossible.

Complete elimination of infestation can be secured if the root is ground to powder and packed in tins. Another method is to cut the dried root into pieces of about 2 inches in length which are then packed in plywood chests. A chest measuring 19×19×24 inches will hold about 100 lb. of dried root. If this method is used packing must be carried out expeditiously after drying.

The beetles and larvae are destroyed if the infested roots are exposed to bright sunlight for about five hours.

Fumigation with carbon bisulphide is also recommended. The roots must be treated in a room which is sufficiently air-tight to ensure the minimum escape of vapour, and fumigation extended for a period of 72 hours. The quantity of carbon bisulphide necessary will be 2 to 3 pounds per 1,000 cubic feet.

Subjecting infested root to heat for three days is also a satisfactory method of destroying the borers, and, if the crop is being grown on a rubber plantation, it will be found convenient to use the smoke-house for this purpose.

From the above account, it will be realised that the aim must be to obtain an insect-free product, and to attain this object the efficient storage of the root to prevent the beetles from gaining access is of first importance.

No serious fungus diseases have been recorded.

## COST OF PRODUCTION

It is estimated that under favourable conditions, the total cost of production of dried derris may be from 18 to 20 cents per lb., of which 10 cents represents the cost of harvesting, drying and packing and 8 to 10 cents planting and cultivation.

## TOXICITY

The utility of derris root depends on its toxic content. Knowledge of the toxic principles of the root is as yet incomplete, but considerable advances in this direction have been made in recent years, and four toxic compounds have been isolated, *viz.*, rotenone, deguelin, tephrosin and toxicarol.

It was thought at one time that rotenone was by far the most important these compounds, and this opinion appears still to be largely held in the nited States of America, for which reason consignments of roots to that untry are valued on their rotenone content. On the other hand, valuation ised on total amount of ether extract is employed by importers in the United ingdom.

Recent investigations in the Department of Agriculture indicate that ainst certain insects, rotenone is not a reliable index of the toxicity, there ing other compounds in the roots which are effective and which are repre- nted in the total ether extract. The opinion is advanced, therefore, that yers of derris would be well advised to value the root on the total ether tract rather than on rotenone content.

*Derris elliptica* appears to offer the best possibilities for commercial ltivation, since buyers who insist on rotenone favour this species as the enone content is about 7 per cent., while the total ether extract is about per cent.

The roots of *Derris malaccensis* give a high ether extract, but a low rotenone ntent. The amount of crude rotenone in roots of this species is about 1 r cent., although the ether extract is usually about 20 to 25 per cent., and erefore suitable for sale on the United Kingdom market.

## USES

The principal use of derris is as an insecticide. It is one of the essential gredients of several proprietary insecticides used as dusts and sprays.

To prepare an extract of the root for use on a small scale, the Chinese d Malays pound the root to a pulp under water, using about 1 lb. to 18 llons of water. The resultant milky liquid is then sprayed on the plants. has been stated that the toxicity of this liquid decreases on keeping, but ent experiments conducted by the Department of Agriculture do not con- m this statement. Derris may also be applied in a finely divided condition, own as a dust, and it is in this form that it is frequently presented for mmercial application.

Derris is an efficient contact insecticide against certain classes of insect, t it appears to be less effective as a stomach poison. The indications are at it acts as a repellent to certain insects, the nervous system probably ing affected through the integument. It also appears to be toxic to insects thout actual contact, indicating that it yields a volatile poisonous substance.

The literature on derris is a growing one ; information concerning its ectiveness by various methods of extraction and application and against wide range of insect pests is at present scattered through many scientific blications. The results of experiments in various parts of the world are ding to more precise information, pointing not only to its extended use and better methods of application, but also to its limitations. It is not claimed for derris that it is effective against all insects, but knowledge of the species of insects against which it is effective is rapidly increasing.

Amongst uses to which derris has been put may be mentioned the following :— An aqueous solution of rotenone has been found to be effective against thrips, white fly larvae, leaf-hoppers, larvae of beetles, and tent caterpillars. The dust form, with a carrier of diatomaceous earth intimately mixed with precipitated rotenone has been successfully employed against chicken lice, roaches and cabbage worms. Injury to peaches and apples by *Popillia japonica* Newn. was considerably reduced by derris root spray applied weekly, and a derris-soap wash consisting of derris powder 1 lb., soft soap ¼ lb., water 1 gallon, has been used with considerable success in England against the warble fly pest of cattle.

## MARKETING AND TRADE

Practically all the tuba root of commerce is derived from the Malayan Archipelago. The area in Malaya is estimated to be 3,500 acres, of which 1,075 acres are planted as a sole crop, the remainder being interplanted with more permanent forms of cultivation.

The exports have steadily increased during the past three years. Total exports in 1931 were 98 tons, valued at $53,633 ; in 1932 they were 210 tons valued at $92,334; and in 1933 they amounted to 642 tons, valued at $282,795.

Greater knowledge of the use of derris and also of its limitations as an insecticide are in a large measure responsible for this increase in demand, but the increased sales are also due to improved methods of packing and to an improvement in the product itself. The cultivation by responsible persons had also given greater confidence in its value. There is less likelihood of adulteration than formerly and greater effort is made to cultivate varieties with a high toxic content in view of the fact that sales are now generally based on chemical analysis.

At the time of writing the Singapore price of roots sold on ether extract basis is $42 per picul, and roots sold on rotenone content $53 per picul (These prices are equal to 31½ cents and 40 cents per lb. respectively). At these prices derris cultivation shows a profit. The future of the market for all agricultural products is uncertain, but it would appear that the prospects of an increased demand for tuba root compare very favourably with those of other raw materials.