

NURTURING THE CRADLE YEARS

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INTRODUCTION

Of the 244,203 ha of tea in Sri Lanka, over 85% is still seed tea much of which is 60-80 years or more, predominantly of low jat with relatively high percentage of vacancies giving average to poor yields and showing a trend of declining crops while the balance area is planted with different clones, over 90% of which comprises the TRI 2020 series. There is thus ample scope of improving the tea yields by a systematic programme of infilling of the seed tea and of replanting with appropriate clones of known yield potentials. For infilling we recommend clones such as DN, CY 9, etc. We do not generally advocate the use of seed as the yields obtainable from them would be highly variable and generally low apart from the difficulty of procuring sufficient seed of high quality stocks. For replanting, the correct choice of clones to suit particular situations is of utmost importance. It is advisable to use about five clones in the replanting programme each year, wherever possible particularly when large extents are involved; the extents planted with each clone being dependent on their known performances and availability of planting materials. The use of a single clone or two only is fraught with hidden dangers and should generally be avoided. The establishment of multiplication plots of mother bushes of the new release clones along with the established ones, in a separate area, is a desirable practice.

NURSERY MANAGEMENT

Proper nursery management encompasses not only the activities that go on within the confines of the nursery but embraces all the preceding preparatory activities that are necessary to produce good shoots for use in the nursery and the successful performance of the plants after field planting. Hence proper planning and the correct timing of the various operations are essential if failures are to be minimised and delays in the programme avoided. The object of nursery management should be to raise healthy vigorous uniform plants of the selected clones, with minimum of casualties, properly trained and sufficiently hardened, in a reasonably short period of time, suitable for field planting. This can only be achieved by proper advanced planning, paying sufficient attention to details and regular and careful supervision of all the associated operations.

SOURCES OF PLANTING MATERIAL

There are several sources from which cuttings may be procured and all sources do not produce equally suitable cuttings. The main sources from which cuttings could be obtained are:

1. from multiplication plots of mother bushes;

2. from mature clonal fields.
3. purchase from outside; and,
4. from other sources *ie* new clearings, rested mature bushes, fields due for tipping, etc.

1. From multiplication plots of mother bushes:

This source furnishes the best cuttings and every effort should be made to establish multiplication plots of mother bushes. In establishing mother bushes it is useful to have the mother bushes spaced further apart than is customarily done, say, 3x5 feet for ease of various cultural operations, for better growth, for ease of collection of cuttings and for convenience of supervision. The multiplication plots should be sited in a sheltered area of good soil on a flat or gently sloping land, receiving adequate sunlight and preferably in close proximity to the nursery. The size of the multiplication plot would depend on the programme in mind regarding the extent to be planted each year and the clones required. The number of cuttings that can be obtained from a single mother bush will vary with the clone and the care given but generally a minimum of 100 cuttings per bush could be obtained 6-8 months after pruning in the up-country and about 5-6 months in the lower elevations. Another two batches of cuttings of poorer quality may be obtained at 3-4 month intervals for the year, if required, but the performance of these will not be as good as the first batch and is preferably avoided. On this basis 70-100 mother bushes would be required for an acre, allowing 30% for failures and weak plants. That is one acre of mother bushes would be required for replanting 50 acres. If cuttings are to be taken regularly, year after year, it is advisable to have two adjoining sections for each clone and collect cuttings only in alternate years so that the mother bushes may be rested for a year or so after the cuttings are taken. Hence *one acre of mother bushes should furnish adequate good cuttings for planting 25 acres and there would be more available, in case of necessity from the second batch or even the third batch as well.*

The mother bushes should be regularly fertilized with the T 200 mixture at the rate of four applications per year of 3/4, 1, 1½ and 2-3 oz per plant for the first, second, third and fourth year onwards respectively. Cuttings should be taken from the mother bushes only after a proper prune at 14-16 inches, for the high elevations and 16-18 inches for the low elevations for which lungs should be left. Prunings of the mother bushes in the south-west monsoon zone should be undertaken during November-December and in the north-east monsoon zone during May-July and the pruned branches spread on the frames to avoid scorch developing on the frames. Although the buds emerge at about the same time on the pruned frames, the central shoots soon show more vigorous growth than the peripheral shoots and eventually at the time of collection of shoots (6-8 months at the high elevations and 4-6 months at the low elevations) the central shoots are much longer with larger leaves, a thicker stem and possess about 20-25 leaves compared with 5-10 leaves on the peripheral shoots which would have gone dormant on more than one occasion at least. The terminal buds of the shoots may be nipped off about 2-4 weeks prior to collection of shoots to activate the axillary buds. A foliar application of zinc sulphate and urea at 2-3% each may be given together with advantage. Upto about 10 cuttings may be taken from the central

shoots while only about 3-5 may be taken from the peripheral shoots. Cuttings should be taken in the shade with a minimum of delay after collection of shoots and planted and shaded immediately. The plants from the central shoots are usually sturdier with a longer growing period than those of the peripheral shoots and hence it is desirable to plant cuttings from the central and peripheral shoots separately. After collection of the first batch of shoots, the mother bushes should be tipped a couple of inches above the pruned cuts and shoots could be collected again, if necessary in 3-4 months time. A third collection could be made over a similar period but should be discouraged in general in case of insufficient number of mother bushes there is some justification for using the second and third batches of shoots but the plants produced from them will be smaller in the same period of time and may require a longer period of growth in the nursery to reach acceptable heights for field planting. The mother bushes could then be rested for the next year before pruning again during which period the other section of the mother bushes could be used. Fertilizer applications should not be given within three months prior to or following pruning to avoid any possible scorch of developing foliage (Fig. 1,2,3)

2. From mature clonal fields

In most instances this is the source from which estates obtain their cuttings. this does not furnish the best of cuttings because the fields are generally on poorer soils, more exposed and subjected to wind, treated differently and receive a different type and level of fertilizer not ideally suited for recovery and growth of shoots. Supervision is also generally less on such fields and incidence of pests, diseases and damage by wind are likely to go unnoticed.

3. Purchase from outside:

Although this is also generally done by estates, which in some cases obtain good material, one cannot be assured that the best material is sold and often overgrown shoots which have passed into the reproductive stage are sold which certainly create problems of overcallusing, delayed rooting and premature flowering in the nursery. The plants also show a much slower rate of growth. Unless there is a regular programme of maintenance of bushes for sale of cuttings it is difficult to visualise how cuttings could be supplied at will and at short notice, particularly when large numbers are involved.

4. From other sources (new clearings, rested mature bushes, tipping fields, etc.):

Cuttings from tipping fields are somewhat comparable to those obtained from mature clonal fields except that these plants were not originally planned for collection of cuttings and the shoots from these fields would generally be collected rather earlier and hence would be too succulent and tender and maximum cuttings may not be obtainable from them. In other respects they suffer the same drawbacks as cuttings from mature clonal fields. Although cuttings from new clearings and from mature rested field plants can be made to root and grow, the plants obtained from them would in general be whippy, weak and show much variation and may have to be kept for a longer period to produce standard sized plants. Only few cuttings can be obtained from these two sources. Cuttings from rested mature bushes would in addition show overcallusing and premature flowering in the nursery. The use of cuttings from the above sources should, in general, be discouraged as they would pose problems in management and in addition produce weak plants unsuitable for the field in the usual time. (Fig. 4)

COLLECTION AND TREATMENT OF SOILS

Soils could be collected from almost any source provided they have reasonable structure and are not too sandy or clayey. Soils under grass such as Guatemala or Mana are ideal as they contain large amounts of organic matter in the form of their fibrous roots which provide ample aeration, helpful in rooting. Jungle, patna or even tea soils could be used. If jungle soil is to be used the soil at the surface, which is generally too rich, should be scraped off and the subsoil taken. The soil should not be collected when it is too wet in heavy rains or even when it is too dry as the soil structure will be impaired. In the south-west zone the soil should be collected in February/March and in the north-east zone in July/September. The actual time of collection could be adjusted to suit convenience as the crucial periods would be the time of pruning of the mother bushes and the time of field planting. The collected soil should be heaped up in an enclosed area, protected from rain and thatched or covered with coir matting. Before use it should be watered over the thatch or matting with a watering can the previous day. In the up-country the soil should be routinely fumigated with Methyl Bromide at the rate of 1 lb per 100 sq ft or 900 4-inch diameter soil filled bags or with Dazomet 98% Granular (Basamid) at 500 g per cube of soil. If Methyl Bromide is used the soil could be used for bagging in 10-14 days while if Basamid is used the soil could be used only after five weeks. The nursery beds could be fumigated with a soil fumigant like Shell-DD at 5 ml in a foot grid or with Dazomet at 10 g per sq m (1.2 sq yd) and worked into the soil with a hand fork. If Methyl Bromide is used it is preferable to arrange the soil filled bags on the nursery beds and fumigate in situ.

The pH of the soil should be between 4.5 and 5.0. If the pH is slightly higher, say 5.5-5.7, it could be lowered by the addition of sulphur or aluminium sulphate. Sulphur could be used at the rate of 1/3 - 1 lb per cubic yard of bulked soil or 1-3 oz per sq yd of soil to a depth of six inches. For effective pH reduction with sulphur, a period of 2-3 months may be required. Aluminium sulphate could be used at the rate of 8 oz per sq yd of soil and further 2 oz per sq yd, every three months, if further pH reduction is required.

THE NURSERY

The nursery should be sited on a flat or gently sloping well drained land, preferably close to the multiplication plots of mother bushes and, as far as possible, be centrally located. It should be protected from strong winds, free of overhanging branches of large trees, receive adequate sunlight and terraced where necessary. It should have a permanent source of water and be free of eelworms. The extent should be 30-50% more than the requirements to facilitate commencing nursery work early while still awaiting the removal of the older plants for field planting. If there is a history of eelworm infestation adequate settling tanks should be instituted to prevent infestation of nursery beds and bagged plants. This is relevant to the up-country estates. The nursery beds should be 3 - 3½ ft wide, preferably raised after having laid rubble and stones underneath to facilitate drainage, and of any convenient length with adequate space between beds to facilitate easy movement. The beds should preferably be in the north/south direction so as to receive full sunlight over the entire length of the beds. Wherever possible the establishment of high shade structure is preferable. Except for the high initial cost it has several advantages. The shade should be erected slightly sloping to receive more of the morning sun and also to prevent excessive drip during heavy rains.

Cuttings from different sources, from erect and inclined shoots, from different clones, from different batches, etc. should be planted in separate beds for easy management. The shoots should be collected, cuttings taken in the shade and planted and shaded immediately with the minimum of delay. Cuttings should be taken with a sharp knife with the stem 1 - 1½ inches long and with sloping cuts; the upper cut being made as close to the bud as possible without damaging it. Unsuitable cuttings such as those with very short internodes, with overgrown axillary buds, with flower buds, with damaged leaf, etc. should be generally discarded. As many as 10 suitable cuttings can be taken from well grown central leader shoots while only 3-5 may be taken from the peripheral shoots. It is not advisable to cut the leaf of the cuttings of large leaved clones as this may restrict shoot growth. It is preferable to plant the cuttings vertically so that the axillary shoot which emerges will also grow vertically and this will avoid cutting the leaf and also facilitate the direction of fertilizer solution and water into the bags rather than letting most of it to flow out if the cuttings were planted at an angle and the leaf resting horizontally. This also permits more vigorous growth as vertically oriented shoots show a faster rate of growth compared to inclined shoots. It is advisable to plant only one cutting per bag. If necessary two cuttings per bag may be used only in the border rows for replacements in case of some casualties but this may not usually be required. Planting the cuttings in polythene bags is more convenient and is desirable than planting cuttings in callusing beds for transference later as the latter would slow down growth somewhat. The size of the bag will depend on the particular situation but more particularly on the length of time the plants are intended to be kept in the nursery. The standard sized bag for general use would be 9x3½ inch diameter (or 5 inch lay flat) of 150 gauge polythene. About 175 bags can be obtained from a pound of 150 gauge polythene. The bottom end of the bag can be left open or sealed if necessary but it is preferable to have holes punched on the sides to facilitate drainage.

Polythene covers are extensively used in the propagation of various horticultural crops. Except for the initial cost of the polythene cover and the structural supports necessary, the method gives good results when carefully done, effects a saving in labour and of water and the supports and the cover could be re-used. In addition, the growth of the plants under the polythene cover is better, the most crucial stage is at the time of removal of the cover when the plants could wilt, if the process is not phased out. The plants could remain under the cover from 1½ to 3 months depending on the height of the cover over the bags. Some form of shading over the cover is necessary, which may have to be kept moist on bright and warm days in order to prevent scorch of the plants underneath. The plants thus produced generally tend to appear pale but with a 2-3% Urea and Zinc spray, given together this deficiency is easily corrected.

Shading of nursery beds could be effected with any convenient material depending on the situation and the availability of shading material and with some attention good results may be obtained. Using coir matting of ¼ - ½ inch mesh, more uniform shade could be provided to the cuttings and the chances of sun scorch are likely to be minimum compared to the use of ferns or thatched slated frames. Having too low a shade is not desirable because of difficulty of supervision and of excessive overshading. Shade should be gradually thinned out or reduced and the plants progressively exposed to more light. (Fig. 5,6)

Watering should be initially heavy after the cuttings are planted and subsequent waterings should be light and more frequent in the early stages. Excessive watering is harmful apart from it leading to moss development. Shading and watering should be carefully regulated to avoid scorch, rotting of cuttings and excessive moss development.

Fertilizer applications are made only after the cuttings have rooted. This period varies with the clones, elevation, etc, but generally around 2½ - 3 months. An idea of this may be obtained by sampling a few cuttings around this time. The fertilizer recommended is T 65 or in case of unavailability T 55. If T 55 is to be used, superphosphate should be incorporated into the soil before bagging, at the rate of 1-2 oz per sq yd of soil to a depth of 6 inches or 6-12 oz per cubic yard of bulked soil. The rate of application is 1 oz per sq yd (100 plants) per fortnight from commencement of rooting. The plants are watered with the solution and washed with clean water to avoid scorch. The rate may be doubled as the plants show vigorous growth. If the plants have shown insufficient growth towards the end of the nursery period an application of ½ oz T 200 per plant may be given. Since clones differ in their response to fertilizer, caution must be exercised particularly with the slow growing clones for which it may be desirable to commence with ½ oz T 65 per gallon per sq yd per fortnight and progressively increase same as growth becomes vigorous. Excessive amounts of fertilizer can also initially reduce growth and eventually lead to scorch and defoliation. At the first signs of defoliation fertilizer should be reduced or suspended and the plants watered sufficiently and shaded. Fertilizer applications should commence only after the plants have refoliated. Under good nursery management it should be possible to retain all the leaves, including the mother leaf, upto the time they are ready for field planting. If there has been any defoliation during this period one should suspect inadequacies in some regard and management should keep a watchful eye on the progress.

It is desirable to encourage the plants in the nursery to branch early and lower down on the main stem. Any form of cutting to encourage branching often leads to retarded root growth if more than a certain proportion is removed. The most effective treatment is disbudding which involves the removal of only the terminal bud and could be done at the 4-5 leaf stage, to advantage. Thumbnailing which involves the removal of the bud and the two adjoining leaves can be done at a later stage of 7-8 leaves without affecting root development and the branches also appear at the higher nodes than is seen with disbudding. Repeating the treatments again early on the newly developing shoots enhances the development of the axillary shoots.

Between the fourth and the sixth month most of the plants in the nursery have gone dormant after the initial phase of growth and it is during this period when most of the problems of defoliation and scorch begin to appear, often due to excessive fertilizer applications at this stage of peak dormancy. Growth has virtually ceased during this period and variation in growth becomes evident. Restacking the plants into two or three different height classes at this stage will avoid lot of problems in management and is a desirable practice.

USE OF GROWTH HORMONES AND OTHER BIOSTIMULANTS

The above chemicals usually have remarkable effects in ornamental and vegetable crops and in fruit culture where it enhances the change from vegetative to the reproductive stage early and improves the size, colour and

shape of the fruits. Most of these do not seem to have permanent effects in a perennial vegetative crop like tea. Gibberellic acid (Berelex) has a quick effect of improving growth of young tea and the yield of mature tea. While it is effective in breaking mature dormant buds it is ineffective in preventing the occurrence of dormancy. It may be useful in special circumstances but is no substitute for good management. Healthy plants may respond in the presence of higher levels of nitrogen but the expense does not seem to justify routine use of it in nurseries as good results can be obtained even without its use. Biostimulants supposed to contain growth factors and nutrients (Maxicrop, Bayfolan, Stimufol) have again the same limitations in tea although they have proved to be effective in other crops, particularly the herbaceous crops. A new biostimulant 'Ergostim' which contains an amino acid cysteine and a vitamin folic acid appears to show promise in improving the growth of young tea plants, enhancing recovery after pruning in mature tea and improving their yields. This may have scope for routine use in nurseries but is as yet not available commercially in Sri Lanka and its acceptability will depend on economic considerations. Further work on this is in progress.

MOVING OUT TO THE FIELD

Towards the end of the period in the nursery, the plants should be adequately hardened off by reducing watering somewhat and exposing them to full sunlight. Only the best plants should be used for field planting (*ie* replanting and/or infilling). Planting should be done under good and reliable weather conditions only. For purposes of infilling, it may be desirable to raise the plants in bigger bags and keep them somewhat longer in the nursery so that they may get a good start in the field. Prior to moving the plants out of the nursery, it is preferable to have the shade established in the field and the thatch ready to afford the necessary protection after planting. In wind-swept areas, the establishment of shelter belts and the controlled growing of inter-row crops such as *Crotalaria* would be desirable; the loppings of which could also be used as thatch. Additional protection by way of stakes for support may also be helpful.

BRINGING INTO BEARING

This can be done by cut-across, bending, a combination of the two or even centering and bending. Each of these methods have their own merits and demerits and the method chosen will depend on local situations and requirements. A cut-across can be done about a year or so after planting at 10-12 inches. A second cut-across can be given 4-6 months later at 14-16 inches and a third given at 18 inches depending on growth and brought into plucking at 21-23 inches. This is more suited for the naturally spreading clones and in instances where bending is clearly a disadvantage such as on poorer soils, plants with mature branches, in areas without shade where sun scorch can be a problem, etc. The only disadvantage is that if sufficient leaves are not present after the early cuts there is a possibility that root growth will be affected. In addition it discards growth already produced. Bending could be done about a month or so after planting, the main shoot bent along the contour rows. A second bending could be done 3-6 months later by bending and pegging the branches in the natural direction. The shoots are then allowed to grow to about 24 inches and cut back 12-15 inches, tipped at 18-21 inches and brought into plucking. The advantages are that it affords a quick cover of the ground, could be plucked somewhat earlier, no growth is wasted etc.

The disadvantages are that it is time-consuming, costly, pegs are usually removed in practice and bending ineffective, liable to break branches resulting in *Phomopsis*, vulnerable to sun scorch, more exacting as regards stage of bending, etc. A combination of the above two methods could also be done to advantage. Centering involves removal of the leader shoot after sufficient growth is made at a height depending on the number of branches that could be left below a sufficiently low height without seriously affecting root development. An attempt is made to leave at least 2-3 branches. The objective is to achieve a more even distribution of the cropping points in course of time, more or less somewhat similar to that achieved by bending. The left-over branches are then bent in the usual manner, tipped and brought into plucking.

CROP PROTECTION

Suitable crop protection measures should be carried out as and when necessary. Close supervision is of utmost importance to detect any outbreaks in time for necessary treatment at all associated stages in nursery management, *ie* multiplication plots, in the nursery and in the new clearings.

It will thus be clear that the success of nursery management depends on proper advanced planning, correct and well timed operations, close supervision at all stages, early detection of problems and the timely adoption of corrective measures.

SCHEDULE OF NURSERY OPERATIONS					
	<i>Prune mother bushes</i>	<i>Collect, treat and bag soil</i>	<i>Plant cuttings</i>	<i>Restack</i>	<i>Field planting</i>
South-west monsoon zone	Nov-Dec	Feb-Apr	Apr-May	Sep-Oct	Apr-May
North-east monsoon zone	May-Jul	Jul-Sep	Sep-Oct	Feb-Mar	Sep-Oct



Fig. 1 Multiplication plots of mother bushes used for collection of shoots for propagation.

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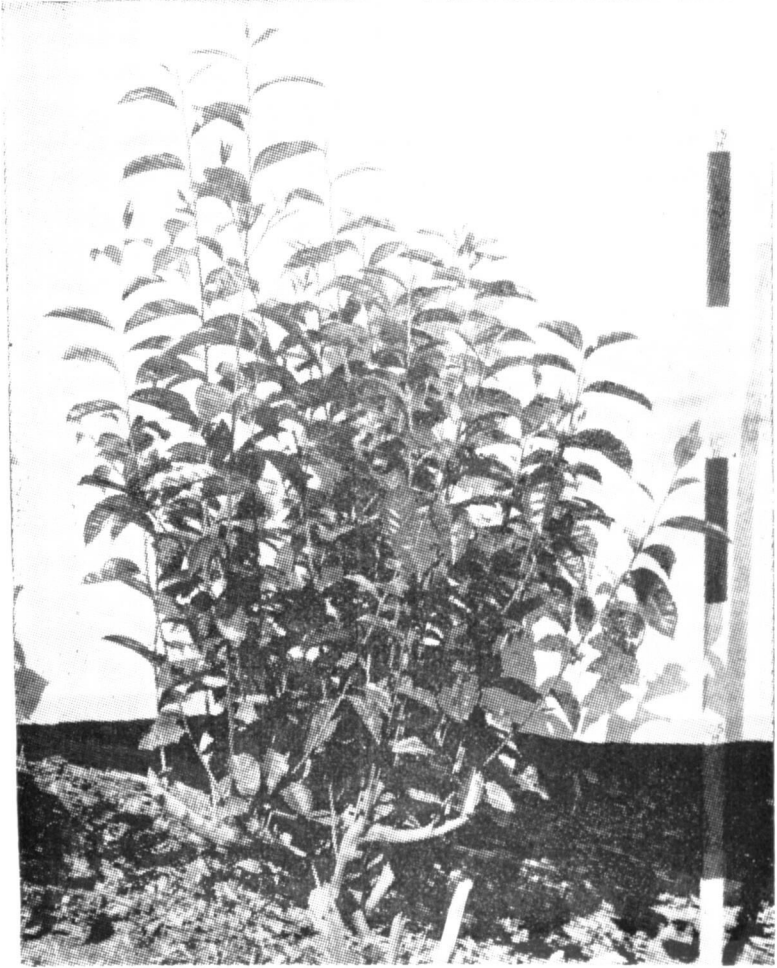


Fig. 2 Six-month-old shoots of clone TRI 2025 on pruned mother bush suitable for taking cuttings for propagation.

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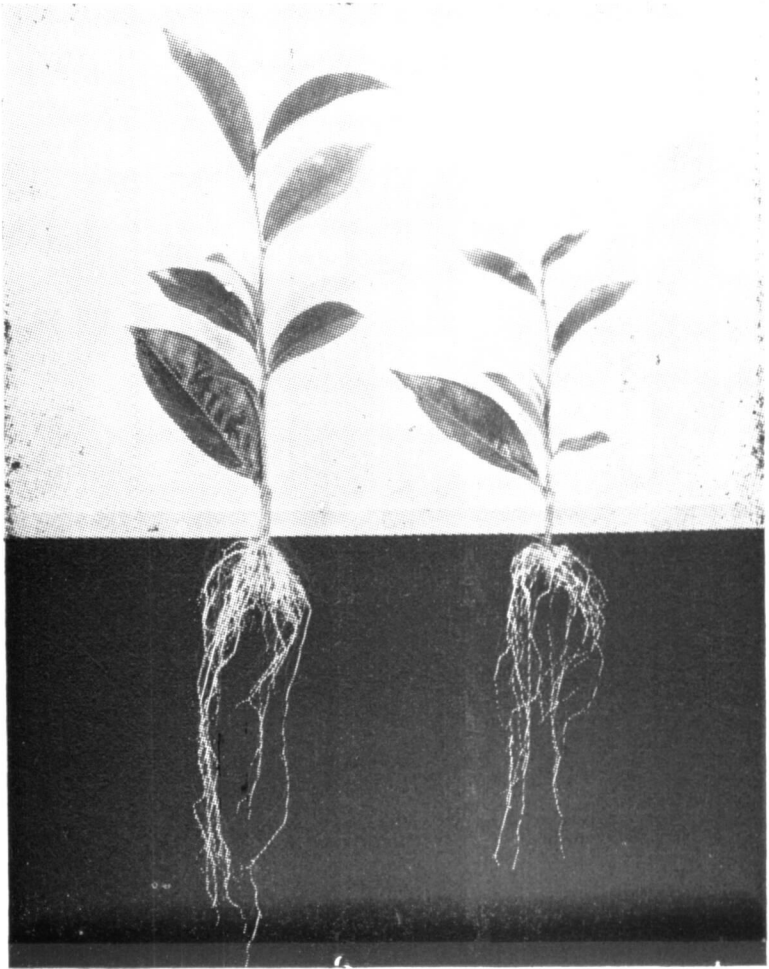


Fig. 3 Comparison of growth of cuttings at six months from central leader (left) and peripheral inclined (right) shoots of clone TRI 2016.

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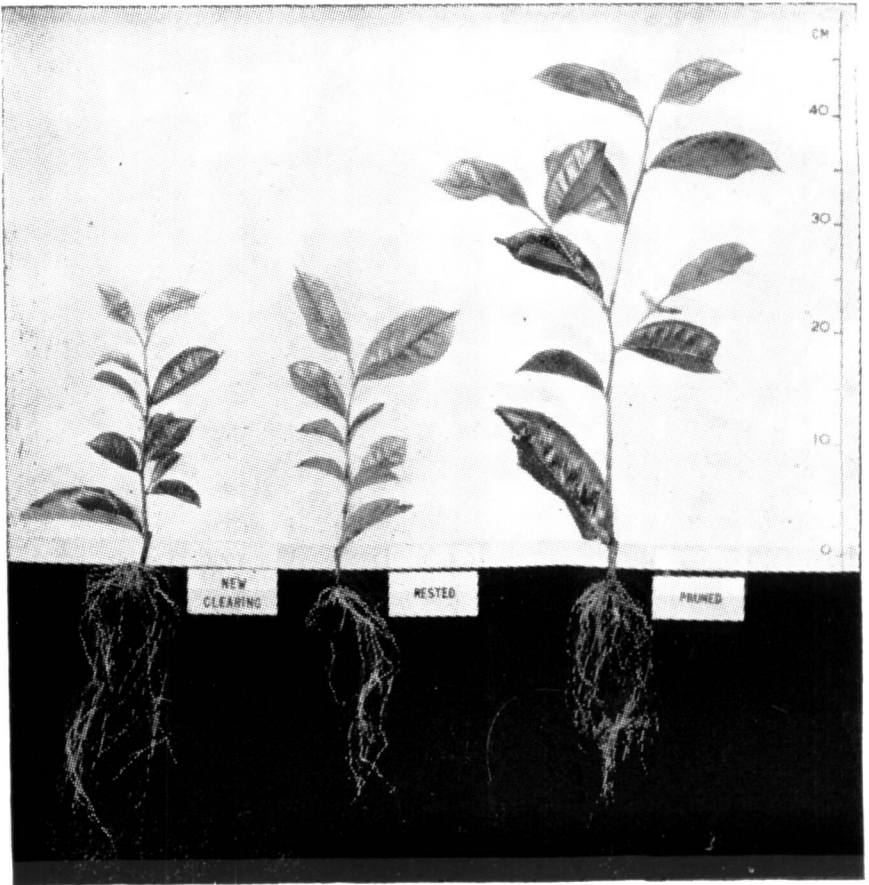


Fig. 4 Comparison of growth of cuttings at five months obtained from shoots of plants in the new clearing (left), rested mature bushes (centre) and pruned mature bushes (right) of clone TRI 2025.

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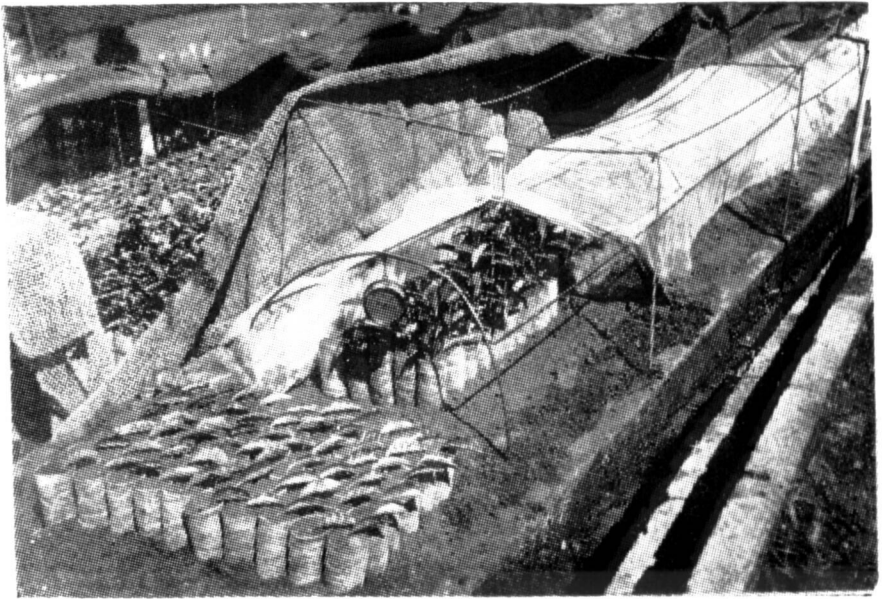


Fig. 5 Technique for raising plants under sealed polythene cover

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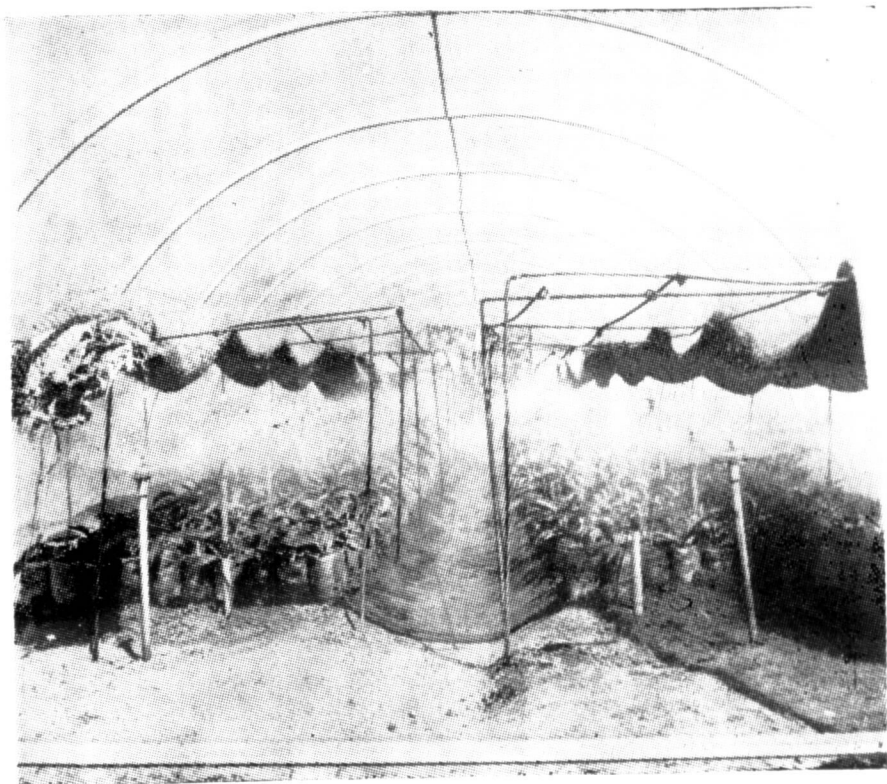


Fig. 6 Tea plants being raised under forcing conditions of a polythene house with automatic mist control in operation.

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