

PRUNING TEA A REVIEW WITH CURRENT RECOMMENDATIONS

R. K. Nathaniel

(Tea Research Institute of Sri Lanka, Talawakele, Sri Lanka)

General

The natural growth cycle of any tree starts with a vegetative phase and gradually passes into a reproductive phase producing less leaves and a preponderance of flowers and fruits (Tubbs 1931 a). This is attributed to a change in the relative proportions of carbohydrate and nitrogen in the tissues of the plant, and as the cycle progresses the ratio of carbohydrate to nitrogen is seen to increase.

As the carbohydrate comes from photosynthesis in the leaves, it is not possible to alter these conditions. However, by supplying nitrogen to the plant it could be possible to delay the time at which a tree ceases laying foliage buds and produces flower buds instead (Walters 1954). Conversely a restriction of nitrogen will tend to accelerate the time at which the reproductive phase becomes dominant thus reducing the vegetative status of the plant.

Pruning, to return a tree into active vegetative growth, is thus an artificially imposed growth change for purposes of commercial exploitation of a crop.

The necessity for pruning

Pruning of a tea bush is necessary to maintain its form and size, and is carried out at a time when the bush tends to turn from a vegetative to a reproductive phase (Tubbs, 1931 a). Pruning is the only method of remedying the rise of the plucking table and the irregularities which result from the differences in the growth of branches comprising the bush, and inducing a return to vegetative activity.

The primary reasons for a decision to prune are a decline in crop or an increase in the cost of harvesting (Pethiyagoda, 1972). As the cycle progresses the bush becomes taller and more congested, thereby making movement into the tea field more difficult and the harvested shoots becoming more inaccessible. At this stage the bush produces a greater proportion of dormant shoots thus depressing growth (Tubbs, 1946) with shoot size becoming progressively reduced (Portsmouth 1957 a). This involves a higher cost of harvesting, thus necessitating the pruning of such bushes.

Objectives of pruning

Tea bushes are periodically pruned in order to achieve the following (Pethiyagoda, 1972; Tubbs, 1936; 1943; Eden, 1958):

- (a) to maintain a height that will improve accessibility for harvesting;
- (b) to stimulate the bush towards a more vigorous production of leaves and shoots instead of flowers and fruits;

- (c) to maintain the frame of the bush in a healthy condition by removing damaged, diseased and moribund wood; and,
- (d) to utilize the acreage of the estate more profitably.

The first two objectives may be attained by any form of pruning, while the last two require the development of a plan to attain them. Pruning should be carried out in such a manner that the desired objectives are achieved in the cheapest and least risky way (Pethiyagoda, 1972).

The system of pruning adopted should be directed towards encouraging the spread of the bushes as well as producing new replacement wood to take the place of older branches that may have become unproductive (Tubbs, 1937 a). Replacement growth is directly linked with the height of pruning. If shoots are periodically produced in moderate numbers from lower down in the bush the necessity to prune low will be reduced. The removal of old diseased or knotted branches should be done systematically at each pruning avoiding the unnecessary removal of sound branches and thus creating more wounds. The rotting cavities seen so often on tea bushes are the direct result of infection through wounds created by die-back of pruned cuts, a certain amount of which is expected. It has been suggested (Gadd, 1931) that a secondary prune be adopted sometime after pruning, but before tipping, to remove die-back points and make such cuts as close to the growing shoot as possible, without injuring the bud.

The role of starch reserves in pruning

Starch is one of the principal carbohydrates formed in the process of photosynthesis, by which the leaves of plants in the presence of sunlight convert the raw materials obtained from the soil and air into elaborated food materials (Tubbs, 1931 a). These carbohydrates form the true food of all the higher plants, and their presence in plants is essential for growth. This periodic build-up of carbohydrates by photosynthesis is accompanied by their constant breakdown in the plants via growth processes.

This assumes a great significance in the case of a crop such as tea which is periodically pruned. In pruning of tea, if the bushes are left completely devoid of leaves, they are unable to make use of the raw materials necessary for growth and are inevitably dependent for their recovery entirely on the reserves of elaborated foods-starch which they have accumulated (Walters, 1954).

Inadequacy of stored carbohydrates in the roots of tea plants grown in the low-country, results in die-back after pruning if adequate foliage is not retained on the bush while pruning (Tubbs, 1937 a). This type of die-back commonly observed on low grown tea was earlier attributed to a disease known as Diplodia caused by the fungus *Botryodiplodia theobromae* which was invariably found on the roots of such dead bushes (Gadd, 1928).

It has been demonstrated (Tubbs, 1934 a) that the per cent extractible carbohydrates in tea roots rose from 11.3%, at sea level by 0.2% per 30 m rise in elevation to 25.17% at 2100 m amsl. Bushes that failed to recover after pruning commonly contained about 12% carbohydrate, thus suggesting that this was the minimum required for successful recovery from pruning. This carbohydrate variation with elevation is tied up with faster growth at higher temperatures along with enhanced root respiration, as encountered at lower elevation. Determination of the per cent total nitrogen in tea roots from different elevations (Tubbs, 1936 b) revealed that there was no direct relationship between root nitrogen and elevation.

Under up-country condition of Sri Lanka, Kandiah (1971) has demonstrated that the role of root reserves in shoot growth after pruning is indirect in that it is consumed in the root system itself to maintain root activity. The early reserve requirement for bud growth on a pruned frame is met from the resources stored in the stem bark, and hence it is important to have healthy branches on pruned frames at higher elevations.

Types of pruning

The types of pruning practised in commercial tea growing in Sri Lanka varies with the elevational category of the tea fields (Tubbs, 1933). A distinction is commonly made in respect of tea grown in the three elevational zones, namely low grown (below 600 m amsl), medium grown (600-1200 m amsl) and high grown (over 1200 m amsl). Generally low grown tea is pruned relatively higher than high grown tea. At lower elevations, due to the inadequacy of stored carbohydrates in the roots to assist in recovery from pruning, die-back of new shoots is seen to be greater (Tubbs, 1937 a). This necessitates the retention of sufficient foliage on the bush synthesise and supply the carbohydrate requirements of the developing buds during the period of recovery, as good recovery from pruning is associated with carbohydrate reserves in the roots (Tubbs, 1934 a, 1936 b).

The types of pruning commonly carried out in Sri Lanka fall within one of the following categories (Pethiyagoda, 1972; Tubbs, 1931 b).

(a) **Skiff:** This is slashing or levelling operation which merely smoothens and reduces the plucking table by a few centimetres. This is adopted at all elevations more as a tidying up operation than as a prune. It is also adopted to prolong a pruning cycle or to delay a rush of crop.

(b) **Cut-across:** This is the highest form of pruning used in Ceylon (Tubbs, 1931). Here the top of the bush is cut level, usually about 7.5 cm above the last pruning height, with no selective cleaning of the frames being done. In this type of pruning a variable quantity of foliage would be retained on the frames. Cut-across bushes show a quicker return to active growth, and produces a greater part of the yield in the early part of the cycle (Tubbs, 1931 a).

(c) **Lung-prune:** Here a certain amount of foliage is retained on completely unpruned branches - usually on the periphery of the bush — and not as a lower layer in all parts of the canopy as in a cut-across. This type of pruning permits adequate cleaning up of frame branches and could be of variable severity based on the height of prune.

(d) **Clean prune:** Here the main frame branches are cut to a predetermined height above ground level with variable degrees of cleaning, but with the removal of all leaves.

At lower elevations a cut-across or lung pruning is usually adopted while clean pruning is restricted to higher elevations. As lungs often help to reduce die-back after pruning (Pethiyagoda, 1967) they should be retained in any situation where unfavourable recovery may be expected. They appear to mobilize root carbohydrates immediately after pruning and also probably function as sinks for deleterious material coming from either within or outside the bush. Lungs also speed up commencement of recovery (bud-break) and encourage the new shoots to grow rapidly. They are removed about 10 days before tipping under low-country conditions (Tubbs, 1934 b). Under up-country conditions it is suggested that lungs

be removed as early as practicable (Nagarajah & Pethiyagoda, 1965) as delayed removal could result in heavy die-back of the pruned lung branches themselves. Tipping is the process of cutting back the new shoots developing after pruning to a level approximately to two mature leaves above the height of prune so as to form a picking table (Portsmouth, 1957 b). Under conditions of South India, tipping is carried out at much higher levels usually around 75 cm from ground level (Venkata Ram, 1976).

Recovery from pruning

A pruned bush first produces primary shoots on the pruned frames and later laterals upon the primary shoots (Tubbs, 1937 b). A cut-across produces a profusion of primaries showing less vigorous growth of individual shoots that plucking may be carried out as soon as they are sufficiently grown. In a more severe prune a far less number of primaries are produced and as they are developed on different levels on the frame their attainment of a sufficient height is not simultaneous, and hence allowed to grow for a period of time and tipped before harvesting could commence. Tipping induces the growth of laterals upon the primary shoots.

The size of the flush obtained early in the cycle is seen to be significantly greater than later in the cycle (Tubbs, 1934 c, 1937 b and 1937 c) in both up-country and low-country of Sri Lanka. The size of the flush obtainable early in a cut-across field is similar to that which is obtained rather late in a lung or clean pruned field (Tubbs, 1937 c).

Based on the number of buds developing after pruning, it was found that there was a clear relationship between the size of branch and the number and distribution of buds (Pethiyagoda, 1970). When expressed as buds per unit length of stems the larger branches appeared to be more productive. But this trend was reversed when the results are converted to buds per unit area of bark. The smaller branches were seen to produce buds further back from the pruning cut and hence showed more die-back, and buds on smaller branches were also seen to be initiated earlier. A larger proportion of buds initiating growth - over 50% - abort during the first ten weeks from pruning for unknown reasons in the up-country.

Pruning should be done to an 'eye' without leaving any slabs. and a clean cut should be made at places where healing is likely to occur rapidly (Gadd, 1929). Callus which should ultimately completely cover and seal the wound, arises from a zone near the perimeter and grows inwards towards the centre of the wound (Gadd, 1931). As callus of tea is slow growing some protection against wood-rotting organisms is necessary when larger wounds are made.

Die-back after pruning

The die-back of branches after pruning has been a cause for concern both in the up-country (Pethiyagoda, 1966) and low-country (Tubbs, 1937 a; Wettasinghe, 1974). In the up-country, pruning of old seed tea deserves special treatment on account of wood-rot and cankered branches due to age and faulty pruning in the past (Kulasegaram and Kathiravetpillai, 1981). In such instances it is not desirable to clean out the frames in one operation but the renovation should be phased over two to three cycles. While maintaining a certain height of prune throughout a field, individual bushes with expensive wood-rot and die-back could be pruned low or the affected branches removed or a judicious combination of both practices adopted effectively with advantage without loss of crop. Once renovation of primary branches has been

effected in this manner successive prunes have to be done at a higher level. A lower prune should then be resorted to only perhaps after three or four prunes, when height becomes unmanageable. Unnecessary reduction of frame either by a lower prune or by removing good healthy branches is inadvisable. Die-back after pruning in the low-country, has resulted in the invasion of the low-country live-wood termite (*Glyptotermes dilatatus*) which gains entry into the bush through snags which have suffered wood-rot (Sivapalan & Senaratne, 1977) and has caused much damage to low grown clonal tea. The style of pruning which has been widely practised in the past on low-country estates is a relatively light prune, with successive prunings being carried out at a higher point than the previous one (Wettasinghe, 1973) which results in the accumulation of a large number of snags. Sanitary measures of cleaning up such snags at the time of pruning is considered most necessary to contain the low-country live-wood termite problems (Sivapalan et al, 1977). The adoption of adequate bush sanitation has brought about a significant reduction in the extent of wood-rot, and the treatment of pruned cuts with wound dressings has further reduced the occurrence of wood-rot (Sivapalan, 1979). Bushes pruned in this manner would take a longer time to come back into production with a resultant crop reduction of about 225 to 335 kg made tea per ha in the first year of the cycle (Wettasinghe, 1973). However, these drawbacks could be overcome by extending the cycle to three years rather than the usual two years, when crop lost in the first year is made up in subsequent years of the cycle in relatively young clonal tea (Wettasinghe, 1980).

The speed at which a pruned bush comes back into production depends on the height of pruning and the extent of cleaning adopted. The greater the proportion of smaller and younger branches removed by the operation of pruning, the longer is the period of recovery and formation of the bush ready for harvesting crop (Tubbs, 1937 a). By cutting and weighing all dead material, about three months after pruning in the low-country, it was found that in clean pruned bushes at 42 cm the amount of dead material was 165 kg as compared to 103 kg for a 42 cm cut-across bush (Tubbs, 1932).

Current ideas on pruning

The current thinking on pruning and the recommendations given to the different elevational categories of Sri Lanka are given in appendix 1 to 5.

APPENDIX I

PRUNING — INTRODUCTION

A tea plant if allowed to grow naturally would grow into a multi-stemmed tree of about 5 to 10 m in height. The first step in attempting to cultivate it as a crop was to modify its habit of growth from that of a tree to a bush, and this was achieved by resorting to some form of pruning. Once the bushes are in plucking it becomes necessary to prune them periodically in order to maintain the form and size of the bush. As the cycle progresses the bushes increase their spread and height thus making the movement of pluckers more difficult and the pluckable shoot becomes more inaccessible.

Another feature which is evident as the cycle progresses is the tendency of the bush to flower and fruit, with a large proportion of the crop shoots going dormant or banji along with a reduction in the size of the individual harvestable shoot. Pruning is the only means of arresting the progress of the bush into the reproductive phase and bringing it back into a vegetative phase. Pruning is thus employed to stimulate the abundant production of young shoots which constitute crop yield.

Pruning also provides an opportunity and a means of maintaining the frames in a healthy condition. The removal of damaged, decayed or unproductive wood helps prevent the invasion of the frame wood by pests and diseases such as termites and wood rotting organisms. Pruning also encourages the development of new branches from lower down in the frame which could eventually be used to replace those frame branches which should be removed when they become unproductive. In this manner pruning becomes a means of renovating the frames and, thus, increase the longevity of tea bushes.

An indirect advantage of pruning is the enrichment of the soil with nitrogen, phosphate and potash through the eventual incorporation of prunings into the soil. To maximize this advantage all prunings must be retained in the field. This practice would also improve soil tilth, thereby improving the capacity of the soil to retain more water and fertilizer.

A variety of terms are used to describe styles of pruning, so much so that different names are given for essentially the same method of pruning. It is also evident that different individuals use the same term to denote different methods of pruning.

The common styles of pruning are described below, the essential difference between them being the extent and manner in which the foliage is retained on the pruned bush.

In a *Cut-across prune* the plucking table is cut back to a uniform level. Variable quantities of foliage are retained on the frames depending on the height of pruning. Selective removal of dead and decaying frame wood is not possible with this style of pruning.

In a *Lung Prune*, as with cut-across pruning, a certain amount of foliage is retained on the bush, but this is as completely unpruned branches and not as the lower layers in all parts of the canopy. When the lungs are retained on the periphery of the bush, the style of pruning is called rim-lung pruning. With this style of pruning it is possible to selectively remove unproductive wood. When the lungs are retained in the centre of the bush it is referred to as centre lung pruning. Centre lungs make the removal of unproductive wood more difficult.

In a *Clean Prune* the salient feature is that no leaves are retained on the frame. With this style of pruning too it is possible to selectively remove unproductive wood.

Stating the 'style of pruning' alone will not sufficiently indicate how a field should be pruned. Some indication of the height at which the bush should be pruned as well as the extent of unproductive frame wood that should be removed must also be stated. In practice this has been accomplished by the use of words such as 'low', 'hard', 'medium', 'light', etc along with the style of pruning. These adjectives were originally used to indicate the height of pruning. Thus, 'low' 'deep', 'hard' and 'heavy' were used to indicate that the pruning height, as measured from ground level, was low. 'High' and 'light' indicated that the pruning was high; and 'medium' mean intermediate. Subsequently, the term 'hard' was used to indicate that the height of pruning was low as well as to suggest the removal of unproductive wood resulting in one person's 'low' being all too often another's 'medium' or 'high'. To others 'low' was synonymous with 'clean'. Low in one district is high in another, or low for cut-across is high for clean prune.

In order to avoid confusion the method of pruning should be described in terms of the following three parameters; the style of pruning, the height of pruning and the extent of frame sanitation *ie.* removal of unproductive wood.

The common styles of pruning with stipulations for other parameters of height and frame sanitations are as follows:

Cut-across prune : Height of 55-70 cm with no frame sanitation

Rim-lung prune : Height of 40-55 cm with partial to complete frame sanitation

Clean prune : Height of 25-40 cm with partial to complete frame sanitation

Certain known factors, pertaining to recovery from pruning, determine the particular combination that would suit each locality or situation. Some of them are outlined below :

- (i) Chances of adequate recovery are best when the few weeks following pruning are characterized with weather which is warm, with alternating spells of rain and sunshine. Low temperatures retard bud break and shoot extension, which also occurs due to lack of water or prolonged cloudy weather. Over-cast conditions also increase damage to young shoots by Blister Blight and other fungal infection.
- (ii) It is observed that pruning immediately following a flush does not result in good recovery as root reserves may be depleted.
- (iii) Large doses of fertilizer applied close to pruning enhances scorch on young buds developing after pruning and increases branch die-back. As a large accumulation of unused fertilizer from successive applications is possible, an interval of about two to three months between the last fertilizer application and pruning is suggested.
- (iv) The more severe the prune, the greater is the ultimate stimulus to growth, but the greater also is the risk of casualties and die-back and slower is the recovery. Thus, where a more severe prune, than is customary, is planned it is well to ensure that conditions for recovery are as favourable as possible.
- (v) Lungs advance bud-break and generally reduces die-back and casualties. They should, thus, be retained in any situation where unfavourable recovery may be expected, such as when a delicate clone is pruned for the first time, when weather conditions for recovery are uncertain or when root reserves are suspected to be low. As lungs divert some resources to themselves, recovery could be retarded if they are retained for too long and hence should be removed at the proper time.

The particular combination of the above factors would vary from one situation to another. The main determinants are elevation, district and time of the year when pruning is undertaken. Hence the main criteria of when and what style of prune is to be practised will differ from one place to another and the subsequent circulars in this series will detail the recommendations for the major ecological regimes.

APPENDIX II

PRUNING TEA IN THE LOW-COUNTRY

Style of pruning

The style of pruning recommended for low-grown tea (up to 600 m amsl) is described as rim-lung pruning. In this style of pruning, two or three unpruned peripheral branches (rim-lungs) carrying, in all, about 250 to 300 leaves are retained on the pruned bush. These lungs assist in recovery from pruning. If an adequate number of lungs is not left behind on the bush, recovery and consequent development of new shoots will be adversely affected. If unfavourable weather sets in, a pruned bush devoid of lungs will not recover.

Time of pruning

All districts in the low-country receive adequate rain during both monsoons. However, both seasons are not equally reliable.

In Ratnapura, Kelani-Valley, Kalutara, Galle, Morawak Korale and Kegalle districts the main season is the south-west monsoon. Pruning in these districts could commence around mid-April and extend up to mid-July. If it is not possible to complete the Pruning Programme during this main season, the balance could be undertaken from September to November.

In Balangoda and Rakwana districts the main pruning season is the north-east monsoon, and pruning could commence around September and extend up to November. If it is not possible to complete the pruning programme during this main season the balance could be undertaken in the south-west monsoon rains.

In scheduling the pruning programme for any year it is advisable to accommodate all clonal and other high-yielding fields during the main pruning season.

Height of pruning:

The tea should be pruned at a height ranging from 40 to 55 cm (16-22 inches). A mean pruning height could be maintained over the field. Individual branches on a bush may, however, be pruned lower or even slightly higher. The decision regarding the height of pruning of individual branches would be governed by factors such as slope of the field, the position of wood rot, snags and knots on a branch, etc. It must be noted that the pruning height recommended above may be too low for old seedling tea which has been pruned lightly for decades, and as a consequence has developed high frames, in which case the pruning height may need adjustment.

Pruning suddenly exposes hitherto shaded stems to direct sunlight and their bark is likely to be damaged by sun scorch. This damage can be minimized by placing some of the prunings over the bush immediately after pruning, to provide some shade over the first few days, when the bark is most vulnerable to sun scorch. These prunings will have to be removed off the frame just before bud break to avoid mechanical damage to the sprouts.

Frame sanitation

One of the main objectives of pruning is to develop and maintain a healthy and strong frame. In pursuance of this objective all weak and debilitated branches, cankers, knots, snags and rotted branches must be removed at each pruning.

In the past, light to medium cut-across pruning has been widely practised in the low-country. With this type of prune, cleaning out of dead wood on the main frame is not practicable. Where tea has been repeatedly pruned in this manner, there would be an accumulation of wood-rot and cankered branches, and it may be more difficult to clean out the frames in one operation. Cleaning out would then have to be phased out over two prunings. If cleaning out is not done wood-rot could progress into the core of the bushes, resulting in severe debilitation. Eventually these bushes are likely to succumb during periods of stress such as pruning and during a drought. It is also known that soft spots caused by wood-rot serve as points of entry for live-wood and scavenging termites. It is advisable to protect the large pruning cuts with a fungicidal protectant, many proprietary formulations of which are available in the market.

Frame sanitation need not be done on old, low yielding tea, especially in fields due to be uprooted for replanting or diversification. In these circumstances a cut-across prune should be practised.

Moss and fern growth on the frames should be cleaned out manually after each prune, before bud break. Particular attention should be given to the collar region. The area around the hole should be clean weeded. This will encourage the development of sprouts from the collar.

Application of fertilizer and soil cultivation

Fertilizer application should cease at least two months before pruning. The first post-pruning fertilizer application should be given around tipping time. This could be conveniently coupled with the operation of forking.

Bringing into plucking

The lungs should be removed when most of the new shoots have developed 2 to 3 fully expanded leaves, i.e. about 6 to 8 weeks after pruning. It has been noticed that the lungs are often removed too early. The removal of lungs prematurely retards the growth of the new shoots. It must be emphasized that removing lungs too early is more harmful than late removal. The rate of recovery from pruning may not be uniform over a field, and the removal of lungs must therefore be done selectively. Lungs must be retained over an extended period on bushes which are slow to recover. Lungs should be cut above the pruning height, and preferably at the tipping level. It is also advisable to remove all the trailing peripheral branches at the time of removal of lungs. The tea should be tipped to about two leaves above the pruning height into hard green wood using tipping knives. The time taken from pruning to plucking is approximately 100-120 days. Alternatively the tea could be plucked in without knife tipping. The latter method would reduce the unproductive period considerably. Tipping or plucking-in should be carried out so as to facilitate the formation of a smooth plucking table. The slope of the plucking table should follow the general slope of the field. Initially pluck lightly until sufficient maintenance foliage has been built up.

Length of the pruning cycle

Generally the length of the pruning cycle for both seedling and clonal tea is

the low-country is two years. However, a longer pruning cycle of three years may be feasible on vigorous clonal tea.

It must be appreciated that close supervision is essential to ensure correct pruning. It is a useful practice to prune a patch of 15-20 bushes in each field under the personal supervision of the Superintendent. This demonstration could serve as a guide to the pruners. The method of pruning recommended in this circular would require more labour than the usual allocation on many estates. When this method is practised on tea which has not been cleaned out for a long time, we estimate the labour requirement at 45-60 labourers per hectare (18-24 labourers per acre). However, subsequent prunings would be easier, and may not require as many labourers.

APPENDIX III

PRUNING TEA IN THE MID-COUNTRY WET ZONE

Style of pruning

The style of pruning recommended for mid-country (from 600 m to 1200 m amsl) wet zone tea is rim-lung pruning where two or three unpruned peripheral branches (rim-lungs) carrying, in all, about 250-300 leaves are retained on the pruned bush.

Time of pruning

As areas in this zone receive adequate rainfall during the south-west monsoon, pruning should commence around mid-April and extend up to mid-July. If it is not possible to complete the pruning programme during this main season, the balance extent could be pruned from September to November.

In scheduling the pruning programme for any year it is advisable to accommodate all clonal and other high yielding fields during the main pruning season.

In areas prone to strong seasonal winds it is advisable to adjust the pruning time in such a manner that recovery does not take place during periods of peak winds.

Height of pruning

The tea should be pruned at a height ranging from 40 to 55 cm (16-22 inches). A mean pruning height could be maintained over the field. Individual branches on a bush may, however, be pruned lower or even slightly higher. The decision regarding the height of pruning of individual branches would be governed by factors such as slope of the field, the position of wood-rot, snags and knots on a branch, etc.

Pruning suddenly exposes hitherto shaded stems to direct sunlight their bark is likely to be damaged by sun scorch. This damage can be minimized by placing some of the prunings over the bush immediately after pruning, to provide some shade over the first few days, when the bark is most vulnerable to sun scorch. The prunings will have to be removed off the frame just before bud break to avoid mechanical damage to the sprouts.

Frame sanitation

One of the main objectives of pruning is to develop and maintain a healthy and strong frame. In pursuance of this objective all weak and debilitated branches, cankers, knots, snags and rotted branches must be removed at each pruning.

In the past, light to medium cut-across pruning has been widely practised in the low-country. With this type of prune, cleaning out of dead wood on the main frame is not practicable. Where the tea has been repeatedly pruned in this manner, there would be an accumulation of wood-rot and cankered branches, and it may be more difficult to clean out the frames in one operation. Cleaning out would then have to be phased out over two prunings. If cleaning out is not done wood rot could progress into the core of the bushes, resulting in severe debilitation. Eventually these bushes are likely to succumb during periods of stress such as at pruning and during a drought. It is also known that soft spots caused by wood rot serve as points of entry for live-wood and scavenging termites. It is advisable to protect the large pruning cuts with a fungicidal protectant, many proprietary formulations of which are available in the market.

Frame sanitation need not be done on old, low yielding tea, especially in fields due to be uprooted for replanting or diversification. In these circumstances a cut-across prune should be practised.

Moss and fern growth on the frames should be cleaned out manually after each prune, before bud break. Particular attention should be given to the collar region. The area around the hole should be clean weeded. This will encourage the development of sprouts from the collar.

Application of fertilizer and soil cultivation

Fertilizer application should cease at least two months before pruning. The first post-pruning fertilizer application should be given around tipping time. This could be conveniently coupled with the operation of forking.

Bringing into plucking

It is essential that lungs be removed when about 75% of the bushes have new shoots with at least 2-3 fully open leaves. Since all bushes in a field do not recover at the same rate, it will be necessary to remove lungs as and when bushes come into a satisfactory stage of recovery. This practice may result in having to go round the field two or three times removing lungs. It must be emphasized that removing lungs too early or too late can affect recovery. Lungs should be cut above the pruning level, preferably at the tipping level.

The tea should be tipped to 2-4 leaves above the pruning height into hard green wood using tipping knives. The time taken from pruning to plucking is approximately 120-150 days. Alternatively, the tea could be 'plucked in' without knife-tipping. The latter method would reduce the unproductive period considerably. Tipping or plucking-in should be carried out so as to facilitate the formation of a smooth plucking table. The slope of the plucking table should follow the general slope of the field. Initially pluck lightly until sufficient maintenance foliage has been built up.

Length of pruning cycle

Four year pruning cycles could be advantageously adopted in fields of healthy good jat tea, especially above 900 m, provided it is initially planned for a four year

pruning cycle. This is also possible in most clonal areas in the entire mid-country wet zone. However, in fields with poor soil conditions, low jat tea and areas prone to recurrent wind damage, it is preferable to adhere to three-year pruning cycles.

APPENDIX IV

PRUNING TEA IN THE MID-COUNTRY SEMI-DRY ZONE (UVA)

Style of pruning

Tea is grown in Uva from an elevation of ^{2000' - 6500'} 600 m - 2000 m amsl. Rim-lung pruning at all elevations is beneficial, although this effect is not so marked at the higher elevations. Below 1200 m rim-lung pruning is recommended. At the very high elevations clean pruning can be practised.

Time of pruning

1. It has been shown experimentally that a direct relationship exists between the yield 1 to 1½ months before pruning on the one hand, and die-back and recovery after pruning on the other hand. It is essential, therefore, that pruning should not be undertaken during the latter half or just after the heavy rush cropping period, at which time root reserves are generally low. ?

2. At elevations above 1200 m if pruned tea comes into a tipping stage during the dry windy period, the chances of stripping of leaves by wind and stems being attacked by *Phomopsis theae* increases. Further, if recovery is into a period of dry weather, the effects of insect attack, which occur during such a period, can be more severe.

3. Under Uva conditions there are definite periods of rush months and flavoury months, and it is to the advantage of estates to adjust their pruning times so that all fields are in plucking during these periods.

Considering the above factors the ideal time to undertake pruning in Uva is from September, when the bushes start to flush after the drought. Pruning could continue up to about late October, which is generally the start of the mini-rush. If difficulties are envisaged, due to a shortage of labour, in completing the pruning programme during the months of September and October which are considered ideal, pruning could commence in August.

Height of pruning

The tea should be pruned at a height ranging from 35-55 cm. A mean pruning height could be maintained over the field. Individual branches on a bush may, however, be pruned lower or even slightly higher. The decision regarding the height of pruning of individual branches would be governed by factors such as slope of the field, the position of wood-rot, snags and knots on a branch, etc. All last seasons growth, which can be easily identified due to the stripped nature of the wood, is best pruned at the mean level referred to.

Frame sanitation

Since one of the main objectives of pruning is to develop and maintain a healthy

and strong frame, all weak and debilitated branches, cankers, knots, snags and rotted branches must be removed from the bottom at pruning time. Where there is an accumulation of wood-rot and cankered branches, due to faulty pruning in the past, it may be difficult to clean out the frames in one operation. In such instances it could be phased out over two to three prunings. If cleaning out is not done wood-rot could progress into the core of the bushes, resulting in severe debilitation. Eventually these bushes are likely to succumb during periods of stress such as at pruning and during drought.

Moss and fern growth on the frames should be cleaned out manually after each prune, before bud break, with particular attention being paid to the collar region. The area around the hole should be clean weeded, as this will encourage the development of sprouts from the collar.

Application of fertilizer and soil cultivation

Fertilizer application should cease at least three months before pruning. The first post-pruning fertilizer application should be given around tipping time. This could be conveniently coupled with the operation of forking.

Bringing into plucking

It is essential that lungs be removed when about 75% of the bushes have new shoots with at least (2-3) fully open leaves. Since all bushes in a field do not recover at the same rate, it will be necessary to remove lungs as and when bushes come into a satisfactory stage of recovery. This practice may result in having to go round the field two or three times removing lungs. It must be emphasized that removing lungs too early or too late can affect recovery. Lungs should be cut above the pruning level, preferably at the tipping level.

4. 6 The tea should be tipped to (2-4) leaves above the pruning height into hard green wood using tipping knives. The time taken from pruning to plucking is approximately 120-150 days. Alternatively, the tea could be 'plucked in' without knife-tipping. The latter method would reduce the unproductive period considerably. Tipping or plucking-in should be carried out so as to facilitate the formation of a smooth plucking table. The slope of the plucking table should follow the general slope of the field. Initially pluck lightly until sufficient maintenance foliage has been built up.

Length of pruning cycle

At lower elevations, where pruning is generally higher, three year cycles could be adopted. At higher elevations, with a lower prune, cycles can be extended to 4 or 5 years.

APPENDIX V

PRUNING TEA IN THE UP-COUNTRY

Style of pruning

Tea is grown in the up-country from an elevation of 1200 m to very near 2200 m amsl. The style of pruning adopted is a clean prune which is much lower in height

than in most other districts. Below an elevation 1370 m it is beneficial to adopt rim-lung pruning.

Time of pruning

If pruning is carried out into dry weather it would almost certainly result in some die-back, with heavy sun-scorch of the frames, resulting in retarded recovery from pruning.

As most regions of the up-country are exposed to normal south-west rains, pruning could commence around mid-April and extend up to July. If it is not possible to complete the pruning programme during this main season the balance could be undertaken from September to November.

In scheduling a pruning programme for any year it is advisable to accommodate all clonal and other high yielding fields during the main pruning season.

Careful control of Blister Blight, during the period of recovery from pruning, is to prime importance in areas pruned during the main pruning season. If this is not undertaken the advantage of good recovery expected, by timing pruning, will be lost. In areas prone to seasonal winds, it is advisable to adjust the pruning time in such a manner that recovery does not take place during the periods of peak winds.

Height of pruning

The tea should be pruned at a height ranging from 35 - 55 cm. A mean pruning height could be maintained over the field. Individual branches on a bush may, however, be pruned lower or even slightly higher. The decision regarding the height of pruning of individual branches would be governed by factors such as, slope of the field, the position of wood-rot, snags and knots on a branch, etc. All last seasons growth, which can be easily identified due to the stripped nature of the wood, is best pruned at the mean level referred to.

Frame sanitation

Since one of the main objectives of pruning is to develop and maintain a healthy and strong frame, all weak and debilitated branches, cankers, knots, snags and rotted branches must be removed from the bottom at pruning time. Where there is an accumulation of wood-rot and cankered branches, due to faulty pruning in the past, it may be difficult to clean out the frames in one operation. In such instances it could be phased out over two to three prunings. If cleaning out is not done wood-rot could progress into the core of the bushes, resulting in severe debilitation. Eventually these bushes are likely to succumb during periods of stress such as at pruning and during drought.

Moss and fern growth on the frames should be cleaned out manually after each prune, before bud break, with particular attention being paid to the collar region. The area around the hole should be clean weeded, as this will encourage the development of sprouts from the collar.

Application of fertilizer and soil cultivation

Fertilizer application should cease at least three months before pruning. The first post-pruning fertilizer application should be given around tipping time. This could be conveniently coupled with the operation of forking.

Bringing into plucking

It is essential that lungs be removed when about 75% of the bushes have new shoots with at least 1 - 3 fully open leaves. Since all bushes in a field do not recover at the same rate, it will be necessary to remove lungs as and when bushes come into a satisfactory stage of recovery. This practice may result in having to go round the field two or three times removing lungs. It must be emphasized that removing lungs too early or too late can affect recovery. Lungs should be cut above the pruning level, preferably at the tipping level.

The tea should be tipped to 2 - 4 leaves above the pruning height into hard green wood using tipping knives. The time taken from pruning to plucking is approximately 120 - 150 days. Alternatively, the tea could be 'plucked in' without knife-tipping. The latter method would reduce the unproductive period considerably. Tipping or plucking in should be carried out so as to facilitate the formation of a smooth plucking table. The slope of the plucking table should follow the general slope of the field. Initially pluck lightly until sufficient maintenance foliage has been built up.

Length of pruning cycle

Generally the length of the pruning cycle for clonal as well as high yielding seedling fields is around five years. Low yielding tea, especially around 1200 m amsl or below, should be on four-year cycles. Tea at higher elevations may have their cycle lengths extended to six years.

REFERENCES

- EDEN, T. (1958). *Tea Tropical Agricultural Series*. Longman's Green & Co., Ltd. 201 pp.
- GADD, C. H. (1928). A new view on the causation of Diplodia Disease. *Tea Q.* 1: 89.
- GADD, C. H. (1929). Pruning in relation to wood rot of Tea. *Tea Q.* 2: 10
- GADD, C. H. (1931). The pruning of tea in relation to disease. *Tea Q.* 4: 45-53.
- KANDIAH, S. (1971). Studies on the physiology of pruning Tea. 1. Turn over of resources in relation to pruning. *Tea Q.* 42: 89-100.
- KULASEGARAM, S. & KATHIRAVETPILLAI, A. (1981). The effect of severity of pruning on growth and yield of high-country seed tea (*Camellia sinensis* L.) *Tea Q.* 50: 16-25.
- NAGARAJAH, S. & PETHIYAGODA, U. (1965). The influence of 'lungs' on carbohydrate resources and growth of tea shoots. *Tea Q.* 36: 88-102.
- PETHIYAGODA, U. (1970). Report of the Plant Physiology Division for 1969. *Tea Res. Ins. Cey.* 66.
- PETHIYAGODA, U. (1972). Pruning. Advisory Leaflet (mimeo) *Tea Res. Ins. Cey.* 2 pp.
- PETHIYAGODA, U. (1967). Current trends in physiological inquiry. *Tea Q.* 38: 249.
- PETHIYAGODA, U. (1966). The importance of timing of pruning in relation to recovery. *Tea Q.* 37: 80-85.
- PORTSMOUTH, G. B. (1957 a). Factors affecting shoot production in Tea (*Camellia sinensis*) when grown as a plantation crop II. The influence of climatic conditions and age from pruning on flush shoot production. *Tea Q.* 28: 8-20.
- PORTSMOUTH, G. B. (1957 b). Factors..... crop. IV. Interclonal variations in the effects of apical dominance. *Tea Q.* 28: 30-43.
- SIVAPALAN, P. (1979). Progress Report of Project A/TERM - Low-Country Live-wood tea termite 164th Extension & Experiments Committee (mimeo). *Tea Res. Ins. S.L.* pp.

- SENARATNE, K. A. D. W. (1977). Some aspects of the biology of the tea termite (*Glyptotermes dilatatus*) Pan 23: 9-12.
- SIVAPALAN, P., SENARATNE, K. A. D. W. & KARUNARATNE, A. A. C. (1977). Observations on the occurrence and behaviour of live-wood termites (*Glyptotermes dilatatus*) in low grown tea fields. Pans 23: 5-8.
- TUBBS, F. R. (1931 a). Some physiological aspects of pruning Tea. *Tea Q.* 4: 40-44.
- TUBBS, F. R. (1931 b). Pruning terminology. *Tea Q.* 4: 101-102.
- TUBBS, F. R. (1932). Die-back. *Tea Q.* 5: 108-111.
- TUBBS, F. R. (1933). Recovery from pruning. *Tea Q.* 6: 11-24.
- TUBBS, F. R. (1934 a). Pruning in relation to estate profits. *Tea Q.* 7: 4-10.
- TUBBS, F. R. (1934 b). Report of the Plant Physiologist for 1933. *Bul. Tea. Res. Inst. Cey.* 11: 37 pp.
- TUBBS, F. R. (1934 c). A note on the size of tea flush. *Tea Q.* 7: 142-145.
- TUBBS, F. R. (1936 a). Drought and pruning. *Tea Q.* 9: 25-30.
- TUBBS, F. R. (1936 b). On the growth and carbohydrate supply of the tea plant after Pruning. *J. Pomology & Hort. Sci.* 14: 317-346.
- TUBBS, F. R. (1937 a). Investigation on the planting, pruning and plucking of the tea bush. *Bul. Tea. Res. Inst. Cey.* 15: 1-59.
- TUBBS, F. R. (1937 b). The length of the pruning cycle. *Tea Q.* 10: 21-36.
- TUBBS, F. R. (1937 c). Report of the Plant Physiologist for 1936. *Bul. Tea Res. Inst. Cey.* 54 p.
- TUBBS, F. R. (1943). Length of the pruning cycle under present conditions. *Tea Q.* 16: 39-41.
- VENKATA RAM, C. S. (1976). Rejuvenation of unthrifty tea. *Warta. BPTK*, 2(4): 133-140.
- WALTERS, T. E. (1954). Starch deficiency. A review of its causes and effects with special references to types of pruning in the low-country. *Tea Q.* 25: 96-99.
- WETTASINGHE, D. T. (1973). Cultural measures of control of low-country live-wood tea termites. Proceedings of a Seminar in the L.W.T. problem in L.C. tea. *Tea Res. Inst. S.L.* 20-24.
- WETTASINGHE, D. T. (1974). Progress report of the Agronomist (Low-Country) 157th extension & Experimental Committee (mimeo). *Tea Res. Inst. S.L.* No. 1974/28 E. 02 pp 7.
- WETTASINGHE, D. T. (1980). Personal communication.