

SOME PHYSIOLOGICAL ASPECTS OF PRUNING.

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In my address to you today I shall confine myself to describing some of the effects of pruning upon the life of the tea bush, particularly upon the changes caused in the relations of its various organs to each other and in its internal organisation.

In common with all living plants, the tea bush is dependent upon the reception, storage and ultimate degradation of energy. Energy is absorbed by its leaves from the rays of the sun and is used in the building up of complex substances from simpler substances. The most important case is the primary formation of sugars from the elements carbon, hydrogen and oxygen. In this process energy is stored away, the store houses being the sugar, or more complex substances of similar constitution, of which starch may be taken as an example. The formation of sugars can only take place in the light, whereas they are continuously being broken up to provide energy for processes which cannot be carried on by the aid of sunlight.

Thus we may regard the tea bush as the difference between two opposing series of actions: one series absorbing and storing energy from the sun, and the other series using these supplies as sources of energy for processes involved in growth. This difference which we call the tea bush can be further divided into the structural framework and the energy reserves and chemicals which the plant can call on to enable it to recover from a treatment which drastically lowers its ability to absorb energy—such a treatment as pruning, for example.

The life of a tree can be divided into two phases. The first is known as the vegetative phase and it is in this period that growth takes the form of leaf and shoot production. In the second or reproductive phase, less leaves and shoots are produced, and the energy of the plant is turned to flower and seed production. The reduction in amount of flush and in the size of the shoots composing it is the first indication in the tea bush of the change from the vegetative phase to the reproductive phase. Flowers make their appearance and increase in quantity as this gradual alteration progresses. Cohen Stuart has concluded that flower production has little influence on the flushing of the tea bush in Java. It is probable that would be the case in the early part of the change only.

The change to reproductive activity has attracted considerable attention on the part of physiologists. The American school of horticulturists has paid much attention to the biochemical aspects of this question. From their work three theories have arisen: the first attributes reproductive activity to deficiency in nitrogen; and the second to a high reserve of carbohydrates such as sugar and starch. The third theory has gained most supporters. It suggests that the type of growth exhibited by the plant is strongly influenced by the ratio of carbohydrate to nitrogen within the plant. Vegetative growth has been found to be associated with a lower ratio of carbohydrate to nitrogen than in the case of reproductive growth. The work of Kraus and Kraybill is of interest in this connection. They found that a plant containing very low amounts of carbohydrates but plenty of nitrogen showed poor growth, but when larger amounts of carbohydrates were present vigorous production of shoots and leaves occurred. If the ratio of carbohydrates to nitrogen was still bigger; less vegetative growth occurred but reproductive activities started. If the ratio of these substances was still further increased, both flower production and shoot production were suppressed.

If this theory is accepted as applicable to the growth of the tea bush, "shutting up" at the end of a pruning cycle may be caused by either too low or too high a ratio of carbohydrate to nitrogen. If the cessation of growth is due to it being too low, resting will enable the bush to accumulate carbohydrates. If too high, application of nitrogen, or the removal of part of the leaf surface, might be suggested. Neither of these treatments would obviate pruning which is necessary to maintain the form and size of the plant. Pruning is the only method of remedying the rise of the plucking table and the irregularities which result from differences in the growth of the branches composing the bush.

After the bush has been pruned, its leaf area has been partially or entirely removed, and with it the capacity of the bush to absorb energy for use in the manufacture of carbohydrates. The number of

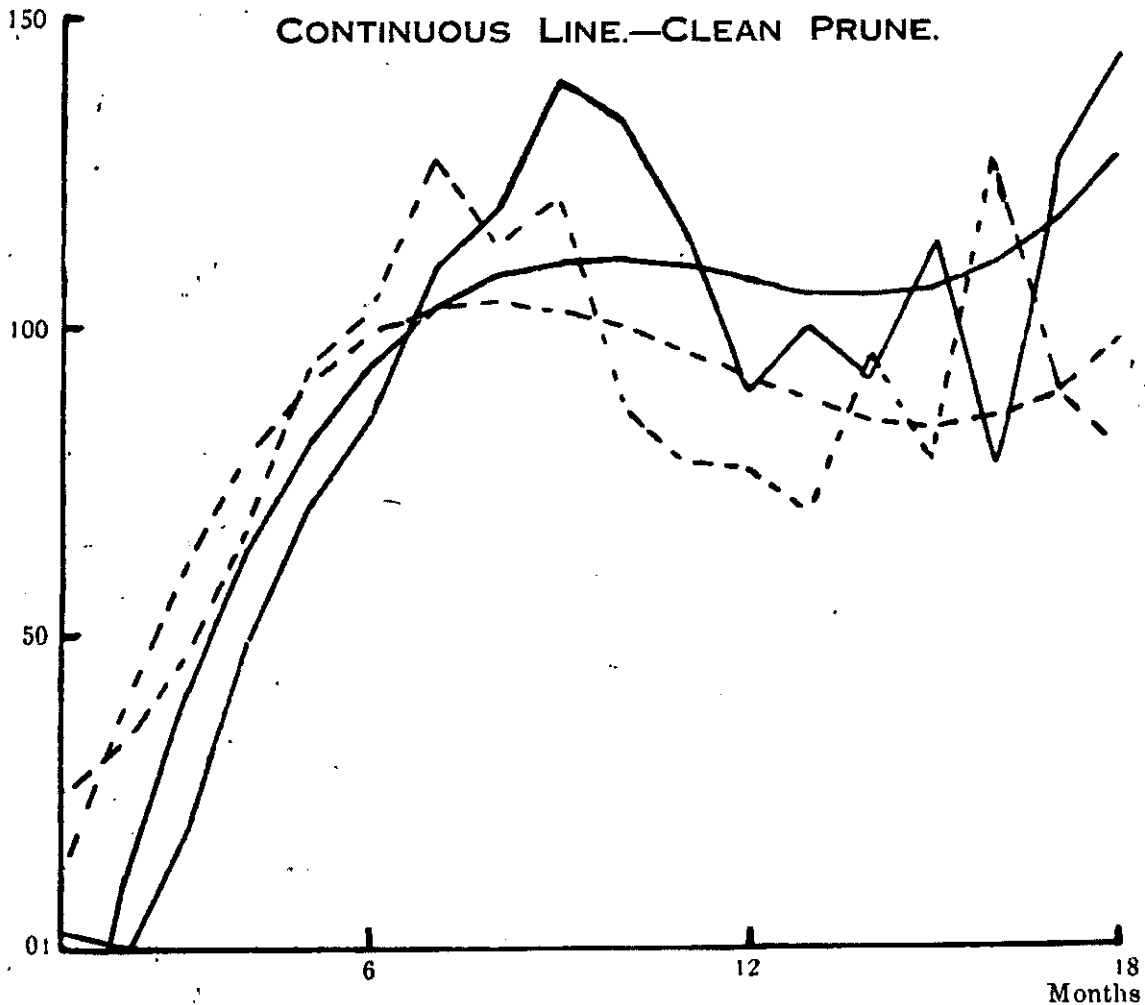
potential growing points has been reduced, while the balance between the activities of the roots and the stems has been destroyed. It is fortunate that the bush reacts to such treatment by restoring the *status quo*, if its resources are such as allow of it. How can the bush be assisted in its task? The obvious method is to reduce the size of the task set it, subject to the necessity of maintaining the requisite shape of the bush and of inducing a return to vegetative activity. In other words, substitute a mild prune for a severe one whenever possible.

The lightest form of pruning used in Ceylon, if plucking is excepted, is the cut across. In contrast to the normal type, the ratio of top to root is not reduced so drastically, while the leaves left on the bush obviate the danger of the plants being unable to recover in the case of a deficiency of carbohydrate reserves. Cut across bushes show a quicker return to active visible growth. They have been found to have given about four times the new shoot growth forty-five days after pruning as bushes clean pruned at the same level. This more rapid growth of new shoots is borne out by data obtained from estates practising the two forms of pruning. Figures 1, 2 and 3 illustrate yields from fields cut across and clean pruned. The original data and curves calculated from them are shown. The smooth curves in Figure 1, from data covering a portion of the pruning cycle only, supplied by an estate near Ratnapura, show this quicker return on the part of the cut across field. Figs. 2 and 3 are similar diagrams made from data from estates near Matale and Talawakéle respectively. They also illustrate this, but in these two cases a tendency is shown for the greater part of the yield in cut across fields to be produced in the early part of the cycle; which is also shown, but not so clearly, by the Ratnapura data. An estate near Balangoda has given yields similar to those from the Ratnapura estate. Both cases show less falling off on the part of the cut across field than the other two estates. It must be understood that far-reaching comparisons may not be drawn from such data as these but the differences found are supported by the fact that grape vines show a similar difference when lightly or severely pruned. This question of distribution of yield is obviously of importance and will be examined on St. Coombs. There is little doubt that cutting across increases the yield, but in comparing the two methods, experience of them in one's own district must be considered. Increasing the yield by curtailing the cut across cycle so as to eliminate the low-yielding period would probably be found to force the bush too much, and to reduce or destroy benefits resulting from a milder form of pruning. There is little doubt that climate will also be found to have a large bearing on the matter although data are lacking in this subject.

Fig. 1.

Lbs. Made
Tea per acre

BROKEN LINE—CUT ACROSS.
CONTINUOUS LINE.—CLEAN PRUNE.



Lbs. Made
tea per
acre

Fig. II.

BROKEN LINE—CUT ACROSS.
CONTINUOUS LINE.—CLEAN PRUNE.

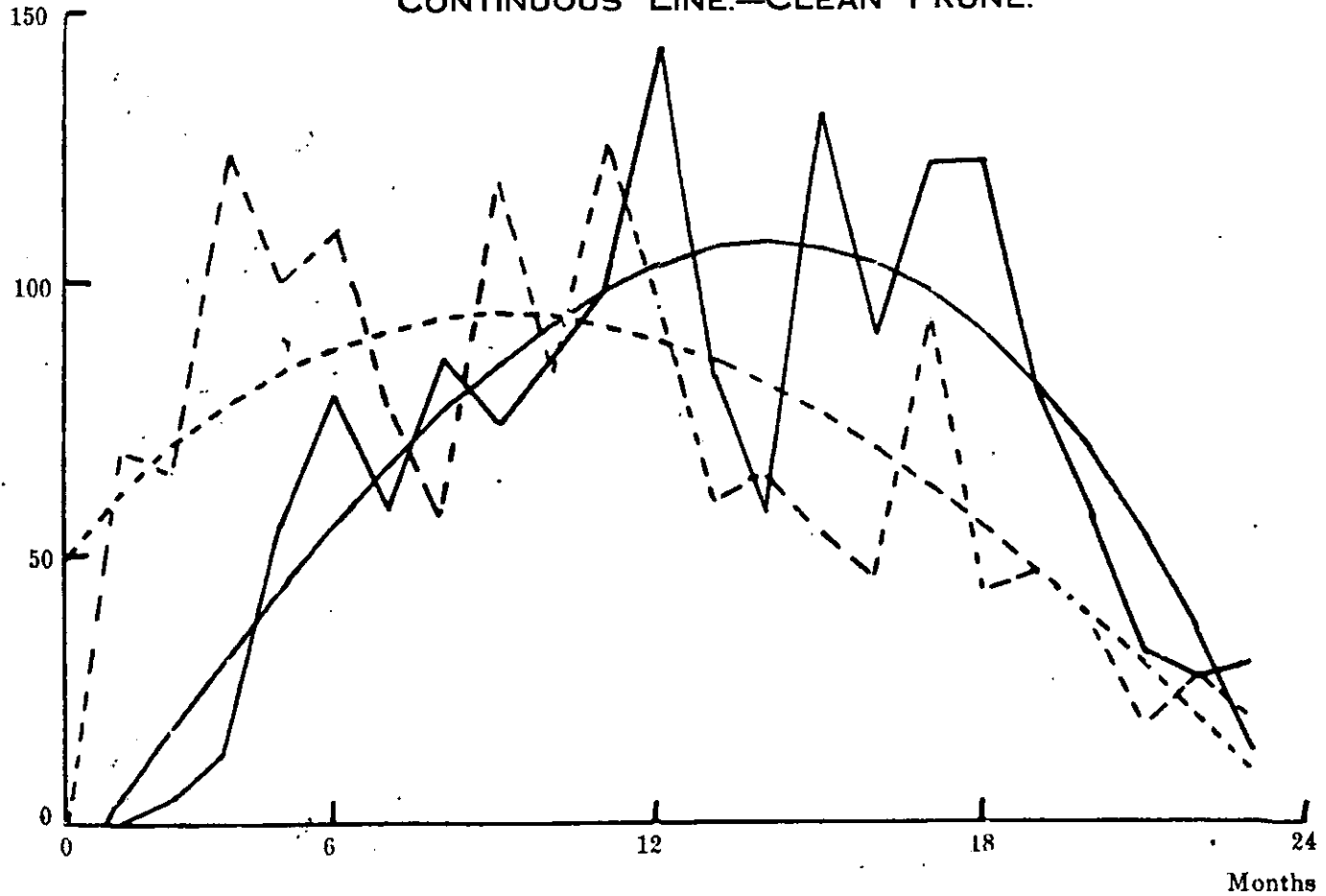
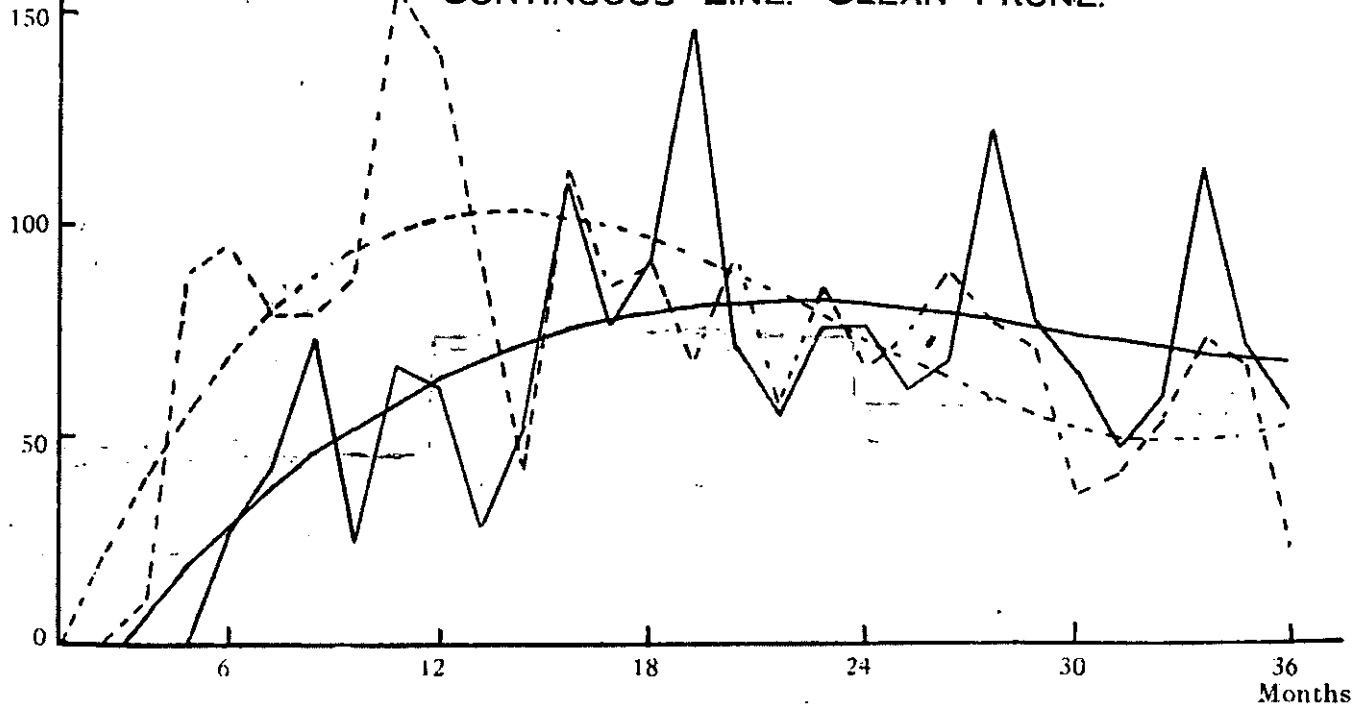


Fig. III.

Lbs. Made
Tea per acre

BROKEN LINE—CUT ACROSS.
CONTINUOUS LINE.—CLEAN PRUNE.



Cutting across is becoming increasingly common in Ceylon, especially since the connection between the severity of pruning and percentage of deaths after pruning in the low-country has been further elucidated by the Mycologist. One method is to alternate cutting across with normal pruning. This practice is being further modified by the insertion of several cut across cycles between normal prunings. The number that can be inserted is still a moot point, although adherents of the method can point to estates both in Ceylon and India on which continuous cutting across has been carried out for a large number of years.

A method used in India and described by Hope in a *Tocklai Bulletin*—the "Bagjan" method—was elaborated in order to obviate cutting down. The bush is cut across at the same level every time. After a time the branches become club headed, a few vigorous shoots being produced from each club, which form the basis of the cycle's plucking table. The less vigorous shoots die and often fall off later. If the formation of such clubs is to be avoided, a cut at a lower level is necessary occasionally, the frequency being dependent on elevation and the state of the bushes. This lower cut will result in the removal of nearly all the leaves of the bush, since the inside of the bush will have become nearly leafless. This effect of cutting across at a constant level is well known to anyone who has birdsnested in a quick hedge at home. Since such a lower cut will approximate to a clean prune in its effect upon the leaf area of the bush it may be made the opportunity for a "sanitary pruning."

Another factor concerned in the speed of recovery of a pruned bush is the age of the wood cut into. Data obtained at the *Tocklai Experiment Station* showed that when bushes pruned annually on one year wood were compared with bushes alternately cut across and pruned into two year wood, the beneficial effect on yield of the cut across treatment was almost removed by the cutting into older wood.

At present, we have little data concerning the drain upon the reserves of the tea bush when the new growth is produced after pruning, but we do know that deficiency leads to delay in recovery, or even inability to do so. It has been found in America that after the lucerne crop has been cut, new growth is initiated at the expense of the carbohydrate and nitrogen reserves of the root and that their amount controls the success and rapidity of recovery. Aldous showed that the best way of killing bushes in pasture land is to prune them severely when their reserves are least. The severe pruning of a so-called "Diplodia" field has an exactly similar effect.

Asami, working upon the Japanese Persimmon, carried out some interesting experiments upon pruning which illustrate that reserves are not the only factors affecting recovery from pruning. He found

that the percentage of the original branch which was removed in the act of pruning, was closely associated with the time taken to initiate new growth. The smaller the percentage removed, the quicker the return to active growth. A similar effect was noticed by Cohen Stuart in pruning experiments carried out on tea in Java. Asami attributed little importance to the effect of age of wood upon the recovery time, but experience with English fruit trees at East Malling has shown that the age of the wood cut has a definite influence upon the growth response.

There is little doubt that pruning reduces the new growth produced in a season by temperate trees. The more severe the pruning, the greater the reduction in new growth. It has also been found that the size of the roots of pruned bushes is smaller than in the case of the unpruned bushes, although there is no evidence that roots die back after branches have been pruned. Even such a mild operation as the pinching back of the feathery laterals upon the trunks of young standard trees—an operation that may be compared to plucking—has been found to reduce the size of the roots and the thickness of the main stem. Observations upon the effect of pruning or plucking upon the activity, rather than the amount, of the root system, appear to be lacking. It is probable that the activity of the root, with which is closely associated the amount of new fibrous root, may be found to be connected with the amount of top growth of the bush.

This has been but a brief summary of a subject that could easily be expanded to fill a large book. The tea bush is an organization of chemical elements in whose combinations energy is stored. Some of this energy is available for use in recovering from such a treatment as pruning until sufficient leaves have been formed to maintain growth and to replenish depleted reserves. As the age of an unpruned bush, or the time that has elapsed from pruning increases, it tends to turn from vegetative growth to reproductive growth. Pruning is resorted to in order to obviate this tendency and to maintain the bush in manageable dimensions. As a result of pruning, vegetative growth occurs whose vigour is dependent upon the food supplies available, the position of the pruned branches and the age of the pruned wood.

We need much more information upon the effects of different types of pruning upon yield and its variations within the pruning cycle, which may be still further traced into effects upon the shoots composing the flush, upon the reserves within the bush and upon the activities of the roots. Among such questions as these, we find others, such as the phenomenon of bhanjy, needing attention. Just as the manager of a large works must be always seeking new methods of increasing the efficiency of his factory, so must we take all steps possible to increase the efficiency of the tea bush.