RESEARCH IN RELATION TO ADVISORY WORK*

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There are two mutually exclusive heresies that continually crop up in the advisory work of the Institute. One is that a method perfected, or a discovery made, in one set of circumstances can be applied in others with equal success. The other is that every estate or district is a law unto itself and therefore generalization is impossible or unprofitable. Both of these statements are too sweeping: the truth lies somewhere in between. It is the function of scientific research not only to make, if possible, new discoveries but to trace and define the underlying similarities that exist in apparently different circumstances. Having done this, sound advisory work concentrates on applying these generalizations with such modifications as local conditions demand. I understand that in this district you are much exercised in your minds as to what application the work we do at St. Coombs has to your conditions, and I shall use my time with you today in trying to clarify this issue.

The problem is simplified for us to some extent by the fact that we are growers of a single crop. We do not have to arrange our agricultural system to include crops of widely different types and requirements. Our main concern is to fit our one crop and its cultivation into a variety of environments. Each specific environment is governed by two main factors (1) soil (2) climate which interact with one another and have a profound effect on a third, the biological factor. This factor is sometimes overlooked except in its harmful manifestations as plant disease. In this district the presence of Helopeltis is an example of a biological factor peculiar to your environment

In Ceylon the soil factor is more uniform than in many countries, and at any rate the tea districts show no tremendous differences in character of the soil. There are differences, but these are more in degree than in type. The rocks from which the soils are derived are closely related: the weathering conditions under which they have been formed are not markedly dissimilar This is very important because a uniform type of weathering will produce the same type of soil from quite different rocks. To come to practical properties, nearly all our soils are acid. They are porous and workable unless they have been grossly mismanaged. Although erosion is a serious problem our soils are only moderately erodible. They are in fact soils of good structure. Except when intensively cultivated they are low in nitrogen; they are deficient in phosphorus but have a relative abundance of potash. We have no salt problem and as far as we know there are no marked deficiencies in the rarer mineral elements, lack of which devastates agriculture in many places. The one thoroughly objectionable soil type that is entirely detrimental to tea is that derived from limestone. There is a little of this in the northern reaches of your district, but in the tea districts as a whole it is of small importance. There are, as I said, some differences. Up-country we have no typical laterite or cabook, but agriculturally our red earth soils behave similarly though to a modified degree.

* A lecture delivered to the Morawak Korale Planters' Association on November 24th, 1945.

When we come to climate, the story is different. Small as the area under tea is, there are within it marked variations in rainfall, humidity and temperature and of these temperature is probably the most important. As regards rainfall and humidity, the perennial deep-rooting habit of tea acts as a considerable safeguard against severe loss by drought, in comparison with what happens to annual crops in like conditions. As you are aware, the greater part of the solid tissues of a plant are derived from carbon dioxide in the air. The efficiency of the process of carbon assimilation is affected both by temperature and light intensity, but the predominating factor is light intensity. Temperature does, however influence the balance between that portion of the carbon which is used for active growth and that which is held in reserve, to the detriment of the latter. To put the idea colloquially : at low elevations tea leads a more hand-to-mouth existence than in the cooler regions. I shall return to this matter later.

High temperatures speed up the chemical processes not only in the higher plants such as tea but in the host of micro-organisms associated with soils and plants. Decay, the result of micro-organic growth is accelerated. In the soil, nutrients are more easily released and wasted, and in the plant the tissues when invaded by harmful organisms decay at a greater rate. You will observe that what I am describing is not a radical change in the physiology of the tea bush but a quickening of the tempo at which it lives.

So far I have dealt in general terms with the differences in environment that are encountered in our tea districts. I propose now to deal with some of the questions that have been investigated by the Institute and to indicate what generalizations emerge from the results obtained and under what circumstances these need modification in different environments. Ever since the foundation of the Institute we have been studying the problems of manuring. From what I have said about our soils it is apparent that our experiments at St. Coombs will have a wide application. The results of these experiments have been set out in our journal and annual reports and I will merely summarise the conclusions up to date. For doses of nitrogen up to and beyond those in practical use the proportionality of dose and yield is an established fact. During the rationing period for manures the applications of nitrogen have been limited. Some people thought that such small doses would be ineffective, but experience has not proved them correct.

Phosphates do not give a response proportional to their rate of application Above 30 lb. per acre the increase is very small and economically negligible. This is in accordance with experience on similar soils all over the world. Recently an observation of a novel kind has been made in respect of phosphatic manuring : that it has a remarkable effect on weed growth. Not only is a heavy weed population encouraged by phosphates, but even when no further growth is engendered the phosphate continues to increase in the weed tissues, and, under a system of clean weeding, is consequently lost for ever to the major crop. Potash applications are just beginning to show an effect when compared with plots starved of that element for 15 years. As regards weed growth the influence of potash is negligible in promoting growth but, as with phosphate, it piles up in the tissues and is consequently a dead loss.

These general results which apply over a wide range of environments may in practice be vitiated by an unfavourable pathological factor. Evidence is accumulating from the Entomological Division that shot-hole borer, by causing large scale branch breakage and loss of plucking points, can nullify the normal responses to manuring.

Turning from the question of manuring in general to time of application in particular, this is an aspect where climate has a marked effect and where uniformity cannot be expected. Manuring in a drought is not to be recommended, because not only are the feeding roots at a minimum of activity, but those remaining in action are likely to be damaged by dry weather cultivation. Temperature also has a bearing on time of application of manures in relationship to time of pruning. At high elevations applications of manure immediately after pruning have been found to be relatively ineffective. This has been traced to the fact that a clean-pruned bush is unable to use the nitrogen supplied as manure till it has grown a good canopy of leaf. In low-country districts where clean pruning is not practised, and where the leaf canopy is quickly re-established, the necessity for delay in application of manure does not exist.

The mention of different styles of pruning takes us back to what I said previously about tea in low-country districts leading a more hand-to-mouth existence than up-country tea as regards stored food reserves. One of the first discoveries made by the Institute was that of the real cause of deaths after pruning in the low-country. Previously these deaths had been attributed to the Diplodia fungus In fact they were due to the exhaustion of reserve food supplies in the root. By clean pruning, which at the time was extensively practised at all elevations, the bushes were deprived of the very tissues which manufacture carbohydrates on which new growth after pruning depends The experiments on pruning methods which followed this discovery verified the observation that carbohydrates do not accumulate to any extent in root tissues at low elevations and suggested a method whereby these deaths could be prevented. By adopting cut-across pruning which leaves a considerable amount of foliage on the bush, or by leaving 'lung' branches to function during the critical period, deaths and dieback were successfully prevented. One or other of these methods is now standard practice at elevations below about 3,000 feet.

You have asked me to deal with the question of regeneration of tea, and this is the place to do it. I shall not allow myself to be manoeuvred into an argument as to whether a tea bush suffers from senility. but shall stick to verifiable facts. When you say that a field needs rejuvenating you mean that its bushes are low yielders; the new wood is spindly or scarce; the old wood is scarred with pruning cuts, and furrowed with wood rot. I spoke earlier of the increased wastage due to higher temperatures favourable to micro-organisms. To set against your quicker bush growth you have the disadvantage of more rapid wood-rot. The old practice was to cut away all the worthless wood by collar pruning and try to grow healthy wood from below the collar. The devastating results of this method have been shown on countless fields, and, bearing in mind what I have just said about starch reserves, the result is a necessary consequence of the cause. The most rational way to rejuvenate a low-country field is to grow new plants and to grow them in such a way that the possibility of invasion of pruning cuts by wood rotting fungi is minimised. I shall return to this in a moment. Here I wish to say that rejuvenation by supplying is a well nigh hopeless task if the majority of the supplies are singletons. The competition from the adjacent bushes dooms them to failure. Supplying in patches is the only reasonable alternative, but it calls for a shrewd decision as to when to sacrifice a bush which is on the down-grade but not a perfectly obvious candidate for removal.

A programme of supplying poses the question 'With what?' The usual alternatives are stumps and seed-at-stake or bas-

ket plants. If the Institute's work on propagation of selected material by cuttings fulfils its present promise, this method of rearing young plants will have to be taken into consideration by progressive planters. Stumps have the disadvantage that by the time they have a good supply of self-supporting foliage a large centring cut is necessary, and that paves the way for wood rot. Seedlings and cuttings grow with a more favourable habit. They can be cut-across early in an operation that is little more than tipping into red wood. This besides leaving some foliage ensures that the smaller cuts have a real chance of callusing. The lower branches will thicken and in time build up a clean frame which need never be touched in its lower regions. In this way there is the possibility of eliminating the far too common sight of a bush with severe wood rot at the centre.

The proposal to use rooted cuttings as material for supplying is a novel one to which my colleague Dr. Gadd is devoting attention. In our experience growth of cuttings is equal to, if not greater than, that of seedlings of the same age when the propagating material used is good. In addition the resulting bushes are better and more uniform than those obtained from seedlings. I do not propose to deal with the technique of raising cuttings. You will find a detailed description of the method in an article in the *Tea Quarterly* by Mrs. Bond and myself. What needs to be insisted on is that though I have mentioned certain advantages that are possible with cuttings, the main factor in promoting success is to propagate a bush of good type It is no use using cuttings from bushes chosen at random. The whole argument for 'rejuvenation' is to finish with something that is better than the original. That means selection and pre-eminently selection from your own fields. The habit of the bush, the cleanness of its wood and abundance of flushing points are prime considerations. Supplying by cuttings is not a method that can be put into large scale operation now. It needs observation and experiment which only you can do. We have demonstrated its possibilities. Its practical application will be in your hands.