PROGRESS WITH RESEARCH ON TEA IN THE LOW COUNTRY

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In the Tea Centenary Year of 1967, the Low-Country Station of the Tea Research Institute of Ceylon at Ratnapura attained its fifth year. The Institute purchased 416 acres of land at the end of 1961, but it was only in 1963 that the Estate, re-named St Joachim, was taken over from Palmgarden Group. The Station now contains 266 acres of old seedling tea and 45 acres in various stages of replanting with clonal tea. A factory for both large scale and experimental manufacture of tea and a laboratory for agricultural research were completed in 1964. With only two bungalows to start with, 28 more were built for all grades of staff. Accommodation for labour was greatly increased. Roads were improved, and the landscape developed under the direction of Mr D. M. A. Jayaweera, Superintendent of the Royal Botanical Gardens, Peradeniya.

A substation at Kottawa, Talgampola, ten miles from Galle, was opened in 1960. It is now 60 acres in extent with 40 acres planted in clonal tea.

A programme of 33 field experiments has been set down both at the Low-Country Station and its substation at Kottawa, supplemented by 41 more experiments on commercial estates. The results so far obtained with these experiments are discussed in this article.

The fertilizer experiment on 35-year-old seedling tea at Endane Estate, Kahawatte, was perhaps the first of its kind in the low country. From 1956 to 1963 various levels of nitrogen, phosphorus, potassium and magnesium were tested, but there was no response to any of these nutrients. Shot-hole Borer infestation was a serious limiting factor to high yields, and for this reason dieldrin was introduced as a treatment in the 1961-63 cycle. Cycles had hitherto been of 18 months duration. A close examination of the yields indicated that although yields generally decline after 18 months, the mean yield of the dieldrin-treated plots continued to rise. Moreover, there was now evidence of a response to nitrogen in the yields of the third six months. With permission from Endane the experimental cycle was extended to 24 months, and with it there was an enhanced response to nitrogen. Endane Estate was quick to benefit from these results ; the estate cycle was extended from 18 to 24 months, and this is possibly one of the factors contributing to the increase in the yields at Endane from 1474 lb per acre in 1960 to 2000 lb in 1966. The experiment is still being continued. Significant increases in yield of the order of six and nine percent respectively, have been obtained by increases from 0 to 40 and 40 to 80 pounds of nitrogen per acre per year. No responses have so far been obtained to the application of phosphorus, potassium and magnesium.

The fertilizer experiment on clonal tea at Palmgarden Estate, Ratnapura was again the first experiment of its kind on VP tea in the Low Country. The experiment was started in 1960 on four-year-old VP tea of the clone TRI 2023. Nutrients tested were nitrogen, potassium and magnesium, with phosphorus supplied uniformly to all plots. A few additional plots were, however, used to compare three levels of phosphate. So far there has been no response to phosphorus, potassium and magnesium. Nitrogen increased yields by six and ten percent respectively, when it was increased from 75 to 150 and 150 to 225 lb N per acre per year. Increasing the frequency of application of nitrogen also increased yields. The maximum yield was obtained with the highest level of nitrogen at the highest frequency

of application *ie* 450 lb N per acre per cycle in 11 applications, that is, applied every two months, the first and last application being given two months after and two months before pruning respectively. Over the two experimental cycles, 3174 lb of tea per acre per year were obtained with only 75 lb N per acre per year. It is difficult to explain this finding. Other experiments are necessary to determine whether adequate and regular application of fertilizer in the first few years contributed more to the development and growth of the tea than fertilizer applied in the later years. A mean yield of 2381 and 4298 were obtained in the first and second years of the cycle and the response to nitrogen was more in the second year of the cycle than in the first. Yields continued to increase even towards the end of the two-year cycle, and this points to the benefits of a longer cycle. The results of the Palmgarden experiment are comparable with the yields on this field of the estate. Average yields of 2879 and 3995 lb per acre per year have been obtained in the first and second year of the cycle with 240 lb nitrogen supplied in 11 applications in the T' 795 NPK fertilizer mixture. By contrast, we know of estates applying about 500 lb N per acre per year in monthly applications and securing yields of 6000-8000 lb tea per acre in the second, third and fourth year of the cycle. It is true that these high yields have been obtained with high levels of nitrogen, but it must be stressed that we still lack precise information relating nitrogen and yield, without which neither the optimum level of nitrogen nor the economics of fertilizer application can be determined. This situation is being corrected by a series of experiments investigating levels and frequency of application of nitrogen and yield in the low country, in addition of course to those undertaken at the higher elevations. It should be mentioned that the low-country experiments are run in close collaboration with the Agricultural Chemist of the Institute.

The detection of zinc deficiency in tea by the Institute in 1962 is of great importance in the low country where symptoms of zinc deficiency are widespread and often acute. In experiments at St Joachim and Mahawela Estates in Ratnapura zinc sulphate at 10 and 20 lb per acre per year respectively, increased yields by ten percent. Spraying four to five times per year was found adequate to correct zinc deficiency. Symptoms are generally more pronounced in the second than in the first year of the cycle, but spraying is recommended throughout the cycle.

Reconditioning of tea land before replanting in tea has been regarded as necessary. While this is perhaps true of eroded lands carrying a poor cover of tea or of nematode infested soil, a reappraisal of this practice is required. Is reconditioning of the soil necessary and if so for what duration ? Can Guatemala Grass be replaced by other species, particularly of legumes ? What fertilizers are required during rehabilitation ? These are questions that are being posed, and experiments have already been set down at the Low-Country Station to investigate this important problem. In the meantime, it should be mentioned that half-acre experimental plots of tea grown without rehabilitation show much promise. Associated with this problem is the prospect of growing a suitable plant species between rows of tea. A species that establishes easily and grows rapidly enough to cover the soil as soon as possible after uprooting of old tea would possibly be of great value, particularly under the intense solar radiation, high temperature and heavy rainfall prevalent in the low-country. Such a species, preceding tea by a few months and subsequently growing alongside tea may in fact protect the soil, improve it and shield the young tea plants from wind, where this is a serious problem.

The need to have shade over tea was almost taken for granted until questioned in recent years. Although the results of experiments initiated over the last two years have still not been fully evaluated, there are low-country estates, apart from St Joachim, that have removed shade completely from seedling tea, clonal tea and even young VP clearings before they are brought into bearing. The importance of separating shade and shelter effects has been recently pointed out. *Fragraea fragrans*

a species that shows much promise for shelter belts in the low-country, has been very effectively used for this purpose at the TRI Sub-station at Kottawa. Raised without much difficulty from seed, it is quick-growing and elegant, and apparently does not compete too seriously with adjacent tea plants.

Yields of old seedling tea in the low-country have been raised to 1000 or more lb. of tea per acre per year, except where the dose of fertilizer is still too low, or where other limiting factors such as shot-hole Borer or zinc deficiency are serious. Poor stands of tea have also been responsible for low yields in the low country. In recent years an attempt has been made to restore the number of bushes per acre by supplying vacancies in old seedling tea with vigorous clonal plants. While this had undoubtedly been more successful than the infilling with seedling tea previously practised, difficulties have arisen in the application of fertilizer, pruning and plucking of mixed populations of seedling and more vigorous clonal tea. If a more vigorous plant than the ordinary seedling is required for infilling, the biclonal seedling derived by cross-pollination of clones TRI 2023 and TRI 2026 seed bearers grown in alternate rows, may possibly be the answer. At the Low-Country Station, this proved quite successful ; establishment and growth was rapid, and failures were very few.

The poor spread of seedling bushes is a factor that deserves attention. In a recent visit to Ceylon, Dr F. R. Tubbs ascribed this to insufficient care in pruning. In simple experiments at the Low-Country Station pruning with ' lungs ' left at the perephery of the bush was better than that with lungs in the centre. Cut-across pruning gave nearly the same yields as rim-lung pruning. In the course of the cycle, however, these differences decreased. Tea that was rested before pruning gave lower yields than tea which had no rest period.

The clonal selections made by the Institute are still the best. The clones TRI 2023 and TRI 2026 surpass all others in the low country. Comprehensive accounts of selection and testing of clones have been given in recent issues of *The Tea Quarterly*, but brief mention may be made of the main lines of work in the low country. Although some estates have achieved success in clonal selection, there is generally a paucity of clones specially selected for conditions prevailing in the low country. For instance, no clone was able to withstand the drought that prevailed in some parts of Balangoda in 1966. Young seedling fields were also affected, but not to the same extent. Selection for drought-tolerance was accordingly done in 1966. At the Low-Country Station, populations derived from biclonal seed of TRI 2023 × TRI 2026 appear vigorous and promising and selections have been made both in the nursery and the field. Selections have also been made in nursery plants raised from Endane seed, and in old seedling fields at St Joachim Estate.

With increasing extents of VP tea and the dense cover obtained with it, information on appropriate spacing and optimum plant density are urgently required. In experiments, spacings of $3\frac{1}{2}$, 4 and $4\frac{1}{2}$ ft between contour rows and within-row spacings ranging from $1\frac{1}{2}$ to $2\frac{1}{2}$ ft have been tested. Although the closest spacings gave the best cover and yield in the early stages, a spacing of 4 × 2 ft is the best later. This, of course, would vary with the clone and fertilizer level used, and these interactions are also being determined.

Diverse methods are adopted in bringing clonal tea into bearing. While some prefer to form a suitable frame early by ' bending ' once or twice, others permit unrestricted growth for somewhat longer and then ' centre ' by cutting the main shoot about 9 in from the ground. With both bending and centering, subsequent cuts are made at higher levels. A combination of bending and centering is sometimes adopted, and other methods are also used. Experimental comparisons are being made in the low country, and the results so far obtained favour bending.

Weeding by labour is one of the most expensive operations in low-country tea. Estates have accordingly been quick to take advantage of herbicides for the control of weeds in tea. Of the herbicides tested experimentally, paraquat (Gramoxone) has so far been found to be the most suitable. Adequate control of weeds is obtained with half pint paraquat per acre sprayed every two months. The addition of one to two pounds of the commercial formulations of diuron and simazine to paraquat sprays has given control of weeds over a longer period, but the cost is also increased thereby. It is accordingly more economical to use Paraquat alone. The degree control of weeds required in tea has also been investigated, and it is found that the mere presence of weeds in tea does not depress tea yields, particularly at moderate levels of nitrogen, *viz* 100 lb N per acre per year. At 200 lb N per acre per year, however, weeds reduce crop. Control rather than eradication of weeds is, therefore, required, and in any case there must be some cover of weeds on the soil before paraquat can act.

While diseases of tea have not been serious in the low-country, insect pests such as the Shot-hole Borer, the Tortrix, Twig and Looper Caterpillars have caused so much damage that in 1966 the Entomologist recommended the suspension of dieldrin spraying except in young clearings. Low-country estates have expressed grave concern that the Shot-hole Borer may again limit increases in yields. The Institute has underway, and intensive, many-pronged research programme to counteract this pest.