SOME OBSERVATIONS ON THE GROWTH RATE OF SHADED AND UNSHADED TEA ON SLOPING LAND

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Investigations on the occurrence and magnitude of productivity gradients on sloping tea land showed (Hasselo, 1964) that growth of tea is related to the position of the plants on the slope in such a way that the growth improved going down the slope. They also showed that the increased growth could be largely assigned to the greater depth of soil available for rooting lower down the slope.

The discussion in this paper will be restricted to the effect of shade trees on growth of clonal tea in the first two years after planting in relation to position on the slope.

Experimental

Observations on the growth of clonal tea (clone T.R.I. 26) were made in a clonal cum shade trial at St Coombs Estate (Kehl, 1963), containing 16 blocks, 8 of which were interplanted with Dadap shade trees at a spacing of 14'×14' square (for further details see Hasselo, 1964a). After rehabilitation with Guatemala grass, the experimental area was planted with tea and shade trees in June, 1961. Tipping weights were recorded in September and December, 1962 and in May, 1963. The 16 blocks of the experiment were arranged in eight classes according to their elevation, class I being at the lower end of the slope on which the experiment was laid out and class 8 at the crest.

Results and Discussion

The relation between total weight of tippings collected since planting until 15, 18 and 23 months after planting respectively and position on the slope is shown in Figure 1.

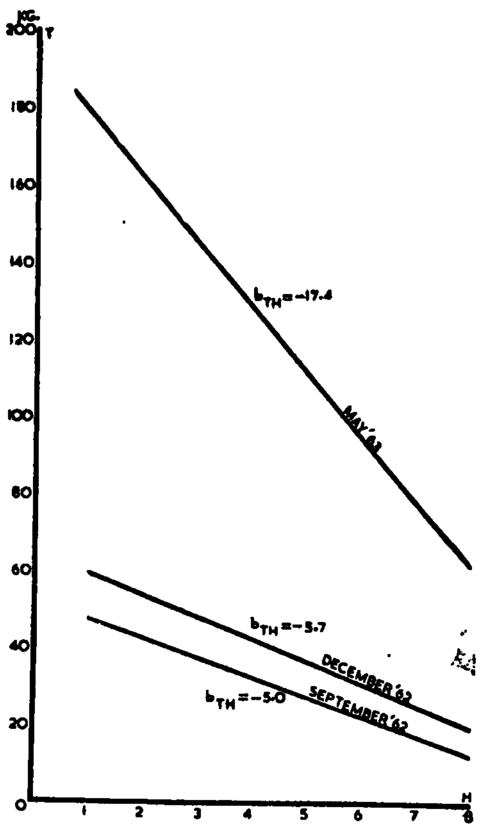

Figure 1.—The relation between total weight (T in kg) of tippings of 135 plants of clone T.R.I. 26 obtained since planting in June 1961 until September 1962, December 1962 and May 1963 respectively, and position (H) on slope (class 1 is lowest, class 8 is highest position on slope)

It will be seen from Figure 1 that with time, *i.e.* with increasing age of the plants, the effect of position on slope on growth of the tea plants, as measured by their tipping weights, increased, the lower slope soils producing increasingly higher yields with time than the upper ones. The three regression coefficients of these relations were highly significant (P=0.001) and rose from b_{TH}=–5.0 in September 1962 to –5.7 in December 1962 and to –17.5 in May 1963. The differences between the May 1963 regression coefficient (b_{TH}–17.5) and those of September (–5.0) and December 1962 (–5.7) respectively were found to be significant at P=0.01, but not between the two latter.

In order to find out whether or not tea plants in the shaded and unshaded blocks responded differently to the observed productivity gradients along the slope, the regression coefficients for each of the 8 shaded and unshaded blocks were worked out separately (table 1).

TABLE 1.—*Regression coefficients (b^{TH}) of the relation between position on slope and tipping weights produced in shaded and unshaded blocks. (Note: period September - December and December - May cover the wetter and drier part of the year respectively)*

Period up to	regression coefficients b_{TH}		Significant Difference between (a) and (b)
	shaded blocks (a)	unshaded blocks (b)	
September 1962	– 4.2**	– 5.1**	N.S.
December 1962	– 5.7**	– 4.3**	N.S.
May 1963	–22.0***	–10.0*	P=0.02

*Sign at P=0.05
**Sign at P=0.01
***Sign at P=0.001

It might be concluded from Figure 1 and Table 1 that with time not only did the effect of differences in soil productivity become more marked but also that this effect was aggravated by the effect of interplanting shade trees in tea.

It was shown earlier (Hasselo, 1964) that at least two-thirds of the effect of the productivity gradient along the slope in this trial could be assigned to differences in effective rooting depth, the soils on the upper part of the slope having an effective rooting depth of only 20″ which gradually increased to 40″ or more in the blocks lower down the slope. The results strongly suggest a shortage in available soil moisture as the cause for the trends obtained in Table I and Figure I, as nutrient availability was adequate owing to the generous amounts of fertilizers applied to young clonal replantings (Hasselo, 1964a). Differences in availability of soil moisture would explain (a) the observed (Figure 1) time effect (*i.e.* owing to increased water requirements with increasing age of both tea plants and shade trees), (b) the effect of soil depth (*i.e.* owing to a decreasing availability of water with decreasing soil depth) and (c) the different response of shaded and unshaded tea (see Table I and Figure 2) owing to increased competition for water between shade trees and tea on shallow soils.

The regression lines for shaded and unshaded tea are drawn for May 1963 in Figure 2.

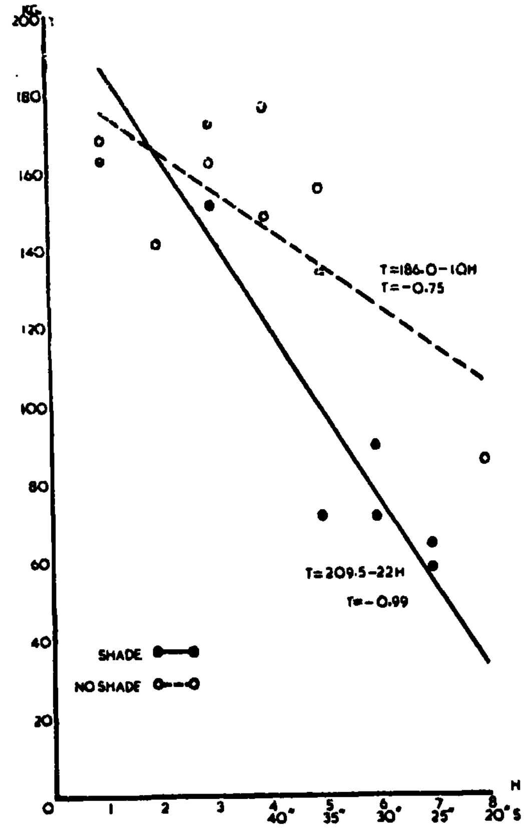

Figure 2.—The effect (May 1963) of shade trees on tipping weights of tea grown on soils with different depth (S in inches). See also Figure 1.

It will be seen from Figure 2 that the adverse effect of shade trees on growth of tea is more apparent on the shallow soils than on the deeper ones lower down the slope. At H = 2, the two regression lines cross each other, indicating that where the soils are deeper than 40", there is little or no difference in growth rate between the shaded and unshaded tea plants. On the other hand, it can be computed from the two regression equations that growth rate of the unshaded tea at H = 8 (which corresponds with a soil depth of 20") is the same as that obtained by shaded tea at H values of between 4 and 5 (which correspond with soil depths of between 35" and 40"—see also Hasselo, 1964). In other words, in order to attain the same rate of growth of unshaded tea on a shallow (20") soil, shaded tea would require a much deeper soil (soil depth of 35"-40"). One may, therefore, deduce from the data that Dadap trees interplanted at 14' × 14' used almost as much available soil moisture as tea, planted 4' × 2', on a shallow soil of 20 inch depth. It thereby depressed the growth of shaded tea to less than one third of that obtained for unshaded tea grown on the same shallow soil.

The above results were obtained with tea plants and shade trees up to the age of 2 years under the climatic conditions prevailing at St Coombs Estate, where the dry season is mild (Tennekoon, 1963 and 1964). It is obvious that in areas where the dry season is more pronounced (*e.g.* Uva District) the differences may be expected to be much larger. In this context, it is worth mentioning that the observed time effect (Figure 1) would provide one explanation why death of plants in young clonal clearings during droughts in the Uva District generally do not occur in the first year or two after planting.

The extent to which shallow soils are cultivated with tea in Ceylon is not known and cannot be assessed accurately without a soil survey. It is likely (Hasselo, 1964) however, that many of the upper and steeper parts of sloping tea land have shallow soils, so that their sum total may add up to a large proportion of the acreage of cultivated tea soils.

Water relationships is only one aspect of the shade tree question (Joachim, 1961; Visser, 1961 and 1961a; Hadfield, 1963). The results presented here do indicate, however, that other aspects (light intensity, nutrient supply, etc) are operative to a much lesser degree on shallow soils during dry periods.

In studies on the desirability of interplanting tea with shade trees, soil productivity gradients, alternatively soil depth and waterholding capacity, should be taken into account or alternatively included as a treatment. Even under the favourable climatic conditions prevailing at St Coombs, the results obtained with young tea plants and shade trees, whose maximum potential growth and consequently maximum water requirements had not been reached, were influenced by soil depth to such a large extent that it might well bias the effects of other factors under investigation.

In a broader sense it might even be claimed (see also Hasselo, 1964) that any yield trend obtained in a field trial whose layout does not account for the soil productivity factor, might well be biased.

Summary

The effect of interplanting shade trees in tea on the growth of young clonal tea (St Coombs Estate) was assessed by means of the total tipping weights obtained 12, 15 and 18 months respectively after planting in the field.

It was shown that Dadap shade trees (interplanted at 14′ × 14′ square) depressed the growth of tea only when the soils were shallow, *i.e.* on soils with an effective rooting depth of less than 40″. Since this effect became more pronounced with increasing age of the plants and with decreasing soil depth, the underlying cause was assigned to shortage of available soil moisture in dry periods resulting in the competition for water between tea and shade trees. The results suggested that under the conditions of this trial the Dadap shade trees took up almost as much available soil mositure as was needed by tea plants on soil with an effective rooting depth of 20″. The competition between tea and shade trees depressed the growth of tea to less than one third of that obtained in unshaded tea on the same shallow soil.

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