SHADE REQUIREMENTS OF TEA IN NORTH INDIA

G. B. Portsmouth

The Annual Report of the Indian Tea Association Scientific Department for 1953 contains some interesting information concerning the various shade experiments now being carried out at Tocklai. Many of these experiments are complicated ones, being designed to explore the interactions of shade and manurial treatments, but in the present article only the effects of light intensity per se and in relation to the different species of shade trees commonly grown in North India will be considered.

An experiment of fundamental importance is one in which the light intensity reaching the bushes is artificially reduced by means of bamboo screens. Two types of screen are in use, both made from bamboo strips 1 inch wide and $\frac{1}{8}$ inch thick. One with 3 inch. wide spaces between the strips gives approximately 70 per cent. of full light intensity; the other with 2 inch. wide spaces gives approximately 50 per cent. of full light intensity. The screens are supported 6 feet above the tea on bamboo posts and frames.

The experiment is a big one comprising 96 plots in all. There are thus 32 plots receiving each of the three different light treatments, *i.e.* 100 per cent., 70 per cent. and 50 per cent. light. It is laid out on an area of tea planted at $4\frac{1}{2}' \times 4\frac{1}{2}'$ triangular in November, 1935 in area No. 8 of the Borbhetta Field Experimental Estate.

For the present experiment the bushes were pruned between 11-2-52 and 14-2-52 by leaving half an inch of new wood above the previous pruning level. After tipping at 8 inches, the bushes were then plucked weekly to the fish leaf from April till October.

The mean yields, in maunds (1 maund=80 lbs.) made tea per acre, for 1952, *the first year of this experiment*, are given in table 1.

Table 1. *Yields under Artificial Shade* **

Light intensity	Yield	Increase with shade
100%	6.35	—
70%	8.53	2.18
50%	8.18	1.83

** Taken from table on page 11 of Report.

Both these increases in yield obtained under reduced light intensities of 70 per cent. and 50 per cent. of full light are highly significant and fully confirm that, under North Indian conditions at any rate, tea requires shade to give its optimum yield. The difference in yields under 70 per cent. and 50 per cent. of full light is not, however, significant. This is helpful, as when shade is provided by trees, it is difficult to maintain the same density at all times. However, as will be seen later, the optimum light intensity is likely to vary for different kinds of shade and for different types of tea.

It may be noted that the increased yields in this experiment were obtained in the very first year of introduction of shade, which indicates that the effects of shade are both rapid and definite. Further results will be awaited with interest.

A rather more elaborate experiment, designed to study the effects of different species of shade trees, was started in 1939, when an area was planted up with 1-year old seedlings of an Assam type of tea. Two years later the area was divided up into hexagonal plots containing 108 bushes each and the centre bush of each plot replaced by one of the following species of shade trees:—

1. *Albizzia stipulata* (with Green stipules)
2. *Albizzia stipulata* (with Red stipules)
3. *Aleurites montana*
4. *Dalbergia assamica*
5. *Albizzia procera*
6. *Derris robusta*
7. *Albizzia odoratissima*
8. Control—no shade tree

There are sixteen repeats of each shade tree (divided amongst four different manurial treatments), so that the whole experiment comprises a total of 128 plots.

Using only half the available plots, (*i.e.* eight repeats of each shade treatment), light intensities were measured in foot candles by means of an exposure meter and recorded at intervals of approximately five weeks throughout 1952. The readings were taken at five points along the north—south diameter of each hexagonal plot on clear days between 10 a.m. and 3 p.m. In June 1952 the height of each individual shade tree was determined by means of a theodolite.

The plots were plucked weekly throughout the 1952 cropping season and the average yields obtained per plot, in pounds of green leaf, are given in Table 2.

Table 2. *Average light intensities, heights of shade trees and yields for* 1952**

Shade tree	Average light ft. candles	Average height of shade tree in feet	Average yield lbs.
Control—no shade	3339	—	160
Albizzia procera	2455	44	177
Albizzia stipulata (Green)	2420	36	177
Albizzia stipulata (Red)	2062	42	193
Dalbergia assamica	1989	46	179
Derris robusta	1938	38	181
Albizzia odoratissima	1853	53	207
Aleurites montana	1834	34	166

**Calculated from table on pages 14, 15 of Report.

With the exception of the plots under *Aleurites montana*, which is the only non-leguminous species under test, it can be seen that yields show a general tendency to increase with decreasing light intensities. This experiment therefore also confirms the necessity for some degree of natural shade, if the highest yields are to be secured.

Owing to the very large differences in growth made by individual trees of the same species, the relationship between yield, average light intensity and the height of the shade tree is not obvious from the figures given in Table 2. Accordingly an analysis was carried out in which the specific differences between trees were disregarded and the average effect of shade per se determined. This showed that:—

'For each foot increase in the height of shade trees, yield increased by 1.549 pounds of green leaf per plot of 108 bushes and the light intensity decreased by 15.0444 foot candles'.

Though indicating clearly the general trends which may be expected under shade, the figures quoted above are, of course, only applicable to the conditions of this particular experiment.

Even with an ideal lie of land, such as that utilised for the present experiment, there still remain many difficulties in interpreting the effects of natural shade. Thus it was found that the control plots had received some benefit of shade from the adjoining plots. Similarly, now vacant plots had received benefit in past years from the then standing shade trees, although light intensities recorded in 1952 were high. However, when the records from all such plots were excluded from the analysis, it was found that optimum yields were secured within the range of light intensities between about 1,200 to 2,200 foot candles, which was approximately between 33 per cent. and 60 per cent. of full light. The maximum yields appeared to be obtained at about 50 per cent. of full light.

Definite figures such as the above for the optimum light requirements of tea under natural shade must, however, be treated with caution. They have been determined from observations made on a few trees only and it is very likely that when large areas under a pure or mixed shade are observed the actual light intensities recorded in relation to the heights of shade trees and to maximum yields may be quite different. The extension of this work to an estate scale would thus appear to be necessary before detailed recommendations are possible.

The same experiment has also been made use of to compare the relative efficiencies of the different species of shade trees. This was done by discontinuing nitrogen manuring on certain of the plots from 1948 onwards. The annual yields from 1946 for tea under the different species of shade trees are given in table 3.

Table 3. *Annual yields in maunds of made tea per acre* **

Species of shade trees	Year	1946	1947	1948	1949	1950	1951	1952
	Nitrogen per acre	80 lbs.	80 lbs.	Nil	Nil	Nil	Nil	Nil
No shade tree		19.74	16.24	18.74	17.06	15.18	10.52	8.65
Alnurites montana		18.77	16.76	17.96	17.35	15.75	10.62	8.98
Albizzia stipulata (Red)		20.46	18.46	21.69*	20.41*	17.39*	12.48*	10.52*
Albizzia stipulata (Green)		20.60	18.82	21.79*	19.96*	17.06*	12.25*	10.14*
Albizzia odoratissima		20.39	18.92	20.34*	19.94*	17.43*	12.27*	10.60*
Albizzia procera		19.20	17.02	19.27	18.36	15.83	11.07	9.72*
Derris robusta		19.74	16.89	19.56	18.94*	16.84*	12.03*	10.20*
Dalbergia assamica		19.74	16.73	18.72	17.92	15.58	10.98	9.46
Significant Difference required at 5% level		1.33	1.73	1.45	1.49	1.57	1.22	0.93

* indicates significantly higher yields than under no shade.

** Taken from table on page 22 of Report.

In discussing these results the report presents the following conclusions:—

1. '*Albizzia stipulata* (Green), *Albizzia stipulata* (Red) and *Albizzia odoratissima* are the three most efficient trees amongst the ones used in this experiment.

2. Benefit from the application of sulphate of ammonia remains till the year after application of the manure both in shaded and unshaded tea.

3. Some of the benefit, can be observed for an extra year in tea that is under a more efficient species of shade tree.

4. Tea under the leguminous, nitrogen-fixing, species of shade trees used, benefits from their shade, but the time taken to become efficient varies inversely with the efficiency of the trees *i.e.* a tree low efficiency takes longer to produce its benefit to the tea.

5. *Dalbergia assamica* is a tree of low efficiency, but the indications are present that if left long enough, the tea under it may produce significantly higher yields than tea without any shade trees.

The low efficiency may be explained by the fact that this tree remains leafless for nearly six months in the year and thus is not a very useful shade-giving tree.

6. *Aleurites montana,* the only non-leguminous tree used in this experiment, is not benefitting the tea at all, as the yield of the tea under this tree has always been about the same as the tea with no shade.

This is possibly because such benefit as the tea under this shade receives is being offset by the fact that the tree is drawing all its nutrients from the soil without fixing any nitrogen from the air.

This finding does not support the view held by some, that any tree which gives shade is good enough. In the opinion of the writer, such trees may be of use only if extra manure is supplied to these trees, but that would be an unnecessarily wasteful method'.

Reading the above it would appear that much of the benefit derived from the more efficient species of shade trees is attributed to nitrogen fixation. However on referring to Table 3 it will be seen that the increases in yield secured under natural shade are of the same order as those secured under artificial shade and given in Table 1. The question as to whether the benefits of natural shade are due merely to a reduction in light intensity, to extra nitrogen produced by fixation, or to a combination of both effects would thus appear to be still unsolved. However, the fact that tea, under North Indian conditions, requires some degree of shade to give optimum yields has been proved beyond doubt by these experiments.