NEW THOUGHTS ON SHADE*

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During the last five years there has been something of a revolution in botanical thinking on shade and it is the purpose of this article to give an account of what this means in terms of the tea industry and towards what end the current research on shade at Tocklai is proceeding. It will be necessary to introduce some botanical terms and these will be explained as they occur although it is expected that many of them are already well understood.

Firstly, let us examine the revolution of botanical thinking mentioned above. For many decades it has been customary to divide plants into shade demanders and shade bearers, or conversely, light demanders and light bearers. This classification was usually based on where the plants were found in nature and as such dependent on their own ability to overcome their limitations in a particular environment. For plants in a natural state the classification is still valid. Recent work however shows that most plants may be taken from their normal environment and grown successfully if special steps are taken. This appears obvious when one considers that nearly all of crop production depends on removing plants from their normal environment and growing them in single stands over vast areas. In the particular case of "shade" plants it has been amply demonstrated that all the species so far tried can grow well in full sunlight if (and this is of vital importance) water and nutrients are in adequate supply. This aspect will be referred to in more detail later but for the moment let us accept the hypothesis and consider the special case of tea in N.E. India.

A combination of observation, experience and experimentation has established two facts.

1. Generally speaking, unshaded tea gives a lower yield than shaded tea.

2. Overshaded tea gives a lower yield than medium or lightly shaded tea.

From this it has been normal practice to use shade trees which cast a light even shade over the tea bushes and *Albizzia chinenis* was a most suitable tree for this. With the decline in the use of *Albizzia chinensis* due to canker, red rust, *etc.*, many other shade trees are now in use and an important part of recent investigations has been to see to what extent these "new" trees give a light, even canopy. It must be stressed at the outset that other attributes of the shade trees have not been examined as thoroughly, but here we are interested in a tree's value as shade, not as firewood.

Using a specially constructed light meter the actual light intensity under the canopy of several species of shade tree was measured on the surface of each tea bush under the canopy. This was then expressed as a percentage of full sunlight which was considered as 100%. The average intensity and the variation are given to show both the overall effect and the evenness (or lack of it) of the canopy. The trees are referred to as A.B.C. *etc.* in order that hasty conclusions are not drawn before the ivestigations are complete.

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TABLE 1

Species	Mean Light Intensity	Range as % full sunlight	Comments
A	42	28–60	Very uneven
B	50	44–70	Fairly light & even
C	28	16–40	Too dense
D	64	60–70	Light even shade
E	52	38–64	Light but uneven
F	37	30–50	Dark and even

We can see that most of the trees give a much denser shade than is normally acceptable for the optimum growth of the tea bush and that many of them are extremely uneven.

The next table gives the diameter of the canopies and the number of bushes shaded by a single tree of each species. The trees are all of the same age and the readings were taken when the trees were fully foliated.

TABLE 2

Species	Diameter in feet	No. of bushes covered (5′ × 2½′ hedge planting)
A	40	100
B	60	160
C	22	44
D	60	160
E	40	100
F	35	90

It is quite obvious that to obtain the same average amount of shade from different trees they will have to be planted at very different distances initially and in a mixed stand this raises many problems which will be the subject of a later article.

The second part of the investigations concern the tea bush itself. For fully efficient crop production it is necessary for each leaf to produce in excess of its own requirements and the remainder is added to the bush reserves. To do this each leaf must receive a certain amount of light, and the light value where there is no gain or loss to the leaf is called the "Compensation point". Below this value the leaf may be considered a passenger to the extent that it receives foodstuffs from leaves in a more advantageous position on the bush. Modern planting methods are based on rapid ground cover using more plants per acre than was previous practice and hence more leaves are heavily shaded by those of adjacent bushes than formerly.

For example, in tea planted at 120 cm × 60 cm (4′ × 2′), the lower leaves receive only about 30% of the light received by leaves on 150 cm × 107 cm (5′ × 3½′) planting. When you consider that a fully mature bush may possess up to 10,000 leaves the proportion of overshaded leaves becomes very considerable, and once you

shade such tea with heavy canopied shade trees the proportion rises still further until an appreciable percentage of the tea leaves are virtually parasitic. This fact is probably responsible for the rather disappointing results of much young hedge planted tea which may give 1,400—1,600 kilos per hectare (15—18 maunds/acre) in 5 years and never get beyond it whereas expectations have been 2,300—2,700 kilos per hectare (25—30 maunds/acre). A tea bush is a complex system and we know that if over-shaded bushes do not respond well to nitrogen it cannot be expected that a bush which has over 80% of its foliage overshaded will respond as well as one in which only 20% is overshaded. Recent measurements have amply shown that as little as 2% of full sunshine reaches the base of the canopy of some mature bushes and this is far below the level required for optimum photosynthesis. This low light intensity is a natural consequence of close planting and is one of the prices to be paid for quick returns, but there seems to be little point in aggravating the situation by using unsuitable shade trees at an unsuitable spacing.

Still further complications are introduced by using clones of differing leaf characters. We may use as two extreme cases, Tocklai clones 1/7/1 and 19/29/13 in which the former has large leaves at right angles to the stem and the latter has fairly small leaves with an upright habit. For each leaf to receive the equivalent amount of light in the lower foliage it is necessary for different spacings to be employed and different species of shade trees to be used and this is assuming that both clones require the same amount of light for optimum growth.

It can be seen that these investigations, although by no means complete, will have a considerable influence on tea garden practice in future years. When completed it should be possible to say that a given clone or jat, planted at a given distance, should be given a definite amount of shade and to indicate how this degree of shade may be obtained. Such questions as when to thin green crops, when to lop shade, when to interplant and rotation timings will also be covered in the investigations and it is confidently expected that the results will be of great practical value to the industry.