A NOTE ON THE SUPPLY OF FIREWOOD FOR TEA ESTATES*

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I. SILVICULTURE.

Compared with the subjects which have hitherto been discussed in *The Tea Quarterly* the organization of estate clearings for perpetual supplies of firewood is a simple matter which is familiar to the majority of readers. However, it will be generally admitted that a large area of the estate properties classified as firewood reserves or gum clearings is not being worked intensively to give the best financial results and one finds a wide divergence of opinion as to the object in view and the method of attaining it.

It is suggested in these notes:—

(1) that a definite loss occurs when accessible waste land is not worked at its maximum efficiency ;

(2) that firewood can be more economically produced from a continuous supply of trees of small size ;

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(3) that firewood from young red gum if properly dried is equal in value to the firewood obtained from the mature trees.

In conclusion, an attempt will be made to correlate the acreage of tea in bearing and the acreage of gum plantations which will meet the whole fuel requirements of the estate.

As regards the past history of fuel supplies very little has been published in the past; two pioneer planters made a valuable contribution to the study of exotic species but the question was not followed up and the results and species under trial have been lost sight of. It appears that between 1870 and 1875 two interesting plantations of exotics were formed at Pedro and on Abbotsford estate but records are not easy to trace at this stage and the indentification of mature Eucalyptus without reference to herbarium material is difficult. An article in *The Tropical Agriculturist* dated 1895 shows that a species known at that time as *Eucalyptus pilularis* flourished on Carlabeck estate in Dimbula and that the proprietor of Pedro intended to plant his new clearings with it. *Eucalyptus (robusta* (?)) is stated to have been freely introduced on tea estates. In the same journal dated 1-9-02 the Himalayan Birch, *Betula acuminata*, with an edible bark, is recorded on Abbotsford estate together with *Eucalyptus pauciflora* and *E. ficifolia*; the firewood of *Eucalyptus globulus*, the Blue Gum, is condemned on account of a gummy deposit which occurred on the flues of the tea driers. A correspondent in 1888 predicts a shortage of fuel for railway and estate supplies and discusses the desirability of forming fuel plantations for manufacture and for domestic use by estate labour; the proposal was unfortunately discouraged; it was observed that with labour at the rate of one cooly per acre, the annual acreage of prunings would provide sufficient twigs for the latter purpose and no serious effort was made to replace the jungle timber felled for estate and railway supplies.

In *The Tropical Agriculturist* of 1-6-86 Mr. W. Twine gives a very sane appreciation of the question of fuel for tea estates. At that time coal was the only rival of firewood and he estimates, without giving details, as a fair average cost per pound of made tea

a figure of ·33 cent for firewood and 1 cent for coal; dealing further with a 300-acre tea estate he suggests that 2 acres of fuel should be made available annually on a 25-year rotation which we now know to be excessively long.

Abbotsford estate now contains very fine mature specimens of *Arancaria excelsa*, *Arancaria bidwillii*, *Syncarpia laurifolia*, *Betula acuminata;* and numerous *Bucklandia populaea* of moderate size. The Eucalyptus species could not be identified. On Balmoral estate, Agrapatana, *E. pilularis* has grown to very large size in 50-60 years. Many trees have been cut up for timber and one specimen still standing is over 13 feet in girth. *E. marginata* has also reached marketable size; one tree not very satisfactorily indentified, being now 6 feet in girth and over 100 feet high. A complete survey of exotic trees on privately-owned land with details of age, girth and height would be valuable.

For fuel supplies in clearings devoted to this purpose Red Gum answers well at any elevation over 2,000 feet. The ideal plantation is spaced 6 feet by 6 feet, grown from stumps or basket plants and is worked on a rotation of 12 years. At this spacing no thinning will be required and at the age of 12 years the species coppices readily from the stump and is very easily cut up into 3 feet lengths for transport and firing. The yield per acre on this system in a favourable locality should exceed 400 yards per acre and it may be emphasised that any deviation from this standard of 1,000-1,200 stems per acre involves definite loss of productivity and financial return. Where perpetual supplies of firewood are wanted it is inadvisable to grow large sized timber and smaller firewood in the same clearing. Timber can be grown on roadsides, in ravines, or in separate timber clearings without damage to the surrounding tea; softwood timber of immature Grevillea is in common use and if this species were allowed to reach its normal girth of 8 feet and upwards, the resulting timber would be much more durable ; it appears to have a beneficial effect on the surrounding tea bushes, unlike Toona, Eucalyptus and Cupressus, all of which have disadvantages

in close association with tea. Trees in fuel plantations should if possible be felled in one smooth cut with a cross-cut saw about 1 foot from the ground, a method which is no more expensive than felling with the axe, but it has the advantage of reducing rot in the stump; further many estate plantations are subject to daily or nightly theft of poles and if all stumps are cut off smooth with a saw such offences committed with an axe or catty are much more easily detected.

On certain estates these questions have received full attention and separate clearings have been opened for firewood timber and for bamboos destined to be used in plucking baskets. It sometimes occurs that large sums are spent on liquid fuel on estates which have ample acreages capable of producing firewood; elsewhere, instead of 1,200 stems per acre or a minimum of 1,000 the stocking has been reduced to 200 per acre or even 20. The number of stems per acre is deceptive and difficult to estimate by the eye; the only real test is to measure a sample $\frac{1}{4}$ acre and count the stems. It is not possible to interplant seedlings in a middle-aged plantation and all that can be done is to fell and interplant as early as possible, bringing the stocking per acre up to 1000; new seedlings can be interplanted among coppice stumps without disadvantage.

It might be argued that the firewood obtained from mature Red Gum over 30 years of age is more valuable than the softer firewood obtained at 12 years but this notion is disproved by recent investigations at the Tea Research Institute. Also the increased acreage required for a longer rotation makes it impossible to grow Red Gum for 30 years. The Tea Technologist has tested 4 samples of Red Gum, A. about 6 years old, 24 inches in girth; B. about 15 years, 35½ inches in girth; C. 23 years old, 72½ inches in girth; and the results are recorded in the annexed table; specimen D was 18 inches in girth taken at random from "dry" Red Gum firewood; the tests were carried out on the sawdust obtained from diameters of average length on cross sections 2 inches thick. It was hardly to be expected that four determinations would give tangible results but the agreement in column 6 is significant. One must conclude that the calorific value of Red Gum depends not on its age and girth

but solely on the thoroughness of the drying process before firing. This removes any doubt as to the advantage of a 12-year rotation designed to give the highest yield per acre; this yield naturally depends, not on the size of individual trees but on the number per acre and the size of the average tree.

TABLE I.

Specimen A	Girth @ 1 foot	Approx. age	Per cent. Moisture	Calorific value as felled (B.T.U's)	B.T.U's per lb. dry matter
Red Gum	24	6	48·2	4222	9157
Red Gum	35½	15	33·3	5870	9341
Red Guui	72½	23	48·0	4317	9299
Red Gum	18	—	16·2	7253	8860

It is probable that a fuel reservation equal to 10 per cent. of the acreage of tea in bearing is sufficient, but owing to such uncertain factors as the different rate of growth at various elevations and on exposed situations and the varying consumption of different types of dryers it is difficult to give approximate figures. Excluding any acreage reserved for scenic purposes, inaccessibility, or steepness, it is estimated that 50 acres of fully developed plantation should suffice for the entire firewood supply of an estate with 500 acres of tea in bearing, 35 for an area of 300 acres and 30 for an area of 200 acres in bearing.

If the area of reserved land is insufficient for a complete rotation of 12 annual clearings it may still be divided by 12 and the deficiency may be made up by liquid fuel. Or alternatively where an estate borders on Crown jungle the area can be increased by the lease and reafforestation of fuel blocks; there is no reasonable danger that these blocks will not be leased to the estate, at a higher rate, when they reach maturity, but their usefulness is reduced by the delay which seems inseparable from the demarcation and sale of these blocks.

In the case of an estate which has no land in reserve for fuel plantations it would be highly convenient to arrange a perpetual supply from shade trees felled in rotation in the tea. It would be a simple matter to divide the estate into 9, 12 or 15 sections for the felling and replanting of perhaps Grevillea on a sufficient scale to meet the whole annual requirements. However, there are very serious drawbacks to such proposals, (a) the damage caused to the frames of tea bushes by felling medium-sized trees all through the area, (b) the damage of fungal infection spreading to the tea bushes from the felled stumps of fuel-cum-shade trees; (c) there is the less serious disadvantage of excessive shade due to the large number of shade trees required per acre. As regards (a) the damage can be minimised by felling the trees immediately before pruning and by limiting the trees to the smallest size practicable; (b) will cause many people to dismiss the idea without further thought but the danger is known to vary with different districts, just as there is a marked difference in the rate of growth of Grevillea in Uva and in Dimbula. The suggestion is put forward tentatively for consideration on any estate in which a heavy shade of Grevillea is approved by the management. The substitution of Grevillea mulch for Dadap mulch may result in a loss of nitrogen in the soil but since the former is admirable in its physical properties, the deficiency can possibly be made good by artificial mixtures. For instance, on a 300-acre estate, assuming that Grevillea is fit to cut in 9 years and that the pruning cycle is 3 years one might anticipate a yield of 1,000 yards per annum by felling the 9-year-old trees on 33 acres; these "mature" trees might be 18 inches to 20 inches in girth and there would be 100 per acre, also 100 per acre of 2 other age classes. Unfortunately no records are available to show the rate of growth in different districts but these can be readily collected if required. The following Table II shows 3 main blocks A, B & C pruned in rotation; block A would contain 100 trees per acre 9 years old; 100 six years old and 100 three years old, and so on. The fact remains that a very similar scheme has been operating for some years on a Dimbula estate, the species being the discredited *Acacia decurrens* which, however, causes no appreciable spread of fungal disease. If

the shade of 300 per acre of young Grevillea is considered excessive, the number per acre may be reduced and part of the fuel requirements met by liquid fuel.

TABLE II.

Block A, 100 acres	9	6	3 years.
Block B, 100 acres	8	5	2 years.
Block C, 100 acres	7	4	1 year.

GROUND COVER ON A DIMBULA ESTATE*

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Since the article headed "Some Indigenous Weeds" appeared in *The Tea Quarterly*, 1933, Vol. VI, page 176, more experience has been gained and the following further notes may be of use to those who feel it would be beneficial to proprietary interests to arrest the soil denudation which continues annually. Before the dry period of the current year certain "Ground Covers" were established, mostly in exposed beds, on the same estate and were deliberately subjected to a severe test of not being watered except at rare intervals. I tabulate below the list of these with my observations on their utility.

Artemisia vulgaris.—This has survived the ordeal very well. Stringent measures are taken, however, to eradicate it from the tea area when it appears—not because I am convinced it is harmful, provided the ground is forked at frequent intervals, but because there is such great prejudice against it generally and there are so many more ground covers which to my mind are definitely harmless to tea.

Cardamine trichocarpa.—This has not survived the ordeal and I have therefore cut it out as a useful ground cover in Dimbula.

Cardamine hirsuta.—The same remarks applies here.

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