

DIEBACK.

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The dying back of a varying number of branches after pruning is a well-known phenomenon, particularly at lower elevations, where it is frequently so severe as to result in the death of the entire bush. In districts where this is a common experience it is customary to expect the loss of a percentage of bushes after pruning, the percentage being found to vary according to the severity of the pruning method employed. It is of importance, therefore, to determine more accurately than is possible on an estate, the extent to which variations in the type of pruning affect the amount of dieback and the number of deaths.

An experiment was designed for this purpose and carried out on Galatura Estate in the Kiriella district in a field of high jât tea about 200 feet above sea level, the area being pruned at the end of April, 1932. Three methods of pruning were tested. The first was clean pruning three inches above the previous clean prune level, the second rim-lung pruning in which up to six lungs were left on the edge of the bush, small bushes having fewer lungs in proportion. The third method was cut-across pruning at the same level as the other two treatments, no small wood or twigs being removed below the pruning level. It should be carefully distinguished from a Travancore prune, which is pruned *above* the tipping level of the previous prune and is therefore considerably lighter in nature.

The three treatments were randomised in six blocks, each block containing each of the three treatments once only. There were, therefore, a total of eighteen plots, (each consisting of two hundred and fifty bushes) divided up into six blocks. Since each *block* contains one plot of each treatment, the differences in the total amount of dieback between different blocks will be due to differences in the environment of the different blocks, and not in any way to the methods of pruning employed. The differences between the plots situated within one block will be due to differences in the effect of the different prunings, since environmental conditions may be assumed to be uniform within the compass of a single block. The application of a method of mathematical analysis, known as the "Analysis of Variance" to the results enables the significance of the observed differences between blocks and between treatments to be gauged.

The numbers of dead bushes at the end of three months after pruning are shown in Table 1 from which it will be seen that, of a total of one thousand five hundred bushes in each treatment, sixty-seven or 4.47% died after clean pruning, while twenty-seven or 1.80% died after cut-across pruning. The rim-lung treatment resulted

in the fewest number of deaths, namely eight or 0.53%. Statistical analysis shows that the clean prune treatment results in a significantly greater number of deaths than either of the other two treatments, but the difference between rim-lung and cut across is not significant. The difference between blocks is also not significant.

The amount of dieback was determined by performing a careful secondary prune at the end of July, 1932 to remove all dead material, which was collected from each plot separately and weighed. The results show that a total of 346 lbs. were collected from the clean pruned plots against 130 pounds from the rim-lung plots and 227 from the cut-across plots (Table III).

The question arises as to whether only the pruning treatments used have influenced the amount of dieback, or whether the differences in the environmental conditions associated with different blocks also have an influence—in other words, does the *position* of a bush in a field have an influence on the dieback shown by it, in addition to the effect of the type of pruning employed? In Table II the weight of dieback in different blocks is given, the figures showing that large differences exist between the different blocks.

It therefore appears that both pruning and environmental conditions affect dieback. The application of the Z test to the results of an analysis of variance shows that the differences observed between pruning treatment totals, and between block totals are in fact real and cannot be considered to be the result of fortuitous circumstances. The chance of the observed differences being accidental is less than one in a hundred in each case.

The differences between the three pruning treatment totals are examined in relation to the standard error of the difference of totals of six plots, the value of which is 32.10 lbs. Differences between totals (Table III) of more than twice the standard error (i.e., more than 64.2 lbs.) may be adjudged to be real and not accidental. The test shows that the difference between each pair of treatments is real.

The evidence gained so far may be briefly summarised thus:

- (a). Clean pruning results in more deaths than rim-lung or cut-across.
- (b). The amount of dieback caused by clean pruning is greater than that due to rim-lung or cut-across pruning, and cut-across pruning causes more dieback than rim-lung pruning.
- (c). The amount of dieback is influenced by environmental conditions.

These results fall into line with the evidence given by Gadd ⁽¹⁾ that death and dieback after pruning was due to a deficiency of starch reserves in the roots, the removal of the whole of the carbohydrate

manufacturing apparatus (the leaves) resulting in the bush being unable to produce new leaves and shoots. He suggested that "a very light form of pruning should also be practised in affected fields. . . . The object is to leave as much leaf as is possible on the bush, so that the manufacture of food supplies may be carried on without a break." On this theory of the causation of dieback, it was to be expected that methods of pruning which varied in the extent to which the bush was deprived of its leaves would vary in the amount of dieback caused. It is interesting to note that the number of leaves left on after pruning were found to be:—

Clean prune	3.0	} Means derived from 240 bushes in each treatment.
Cut across	41.6	
Rim lung	200.5	

The results described above, however, suggest that other reserves in addition to carbohydrates may be of importance. It is well known that the yields of flush vary in different portions of the field, and the results of a well-organised field experiment upon yields are expected to show this. But the fact that the amount of dieback shows a positional variation similar to that found for yield suggests that the amount of carbohydrate reserves (e.g., starch) present in the bush may not be the only factor affecting dieback, and that the factors which affect yield also affect the amount of dieback.

The blocks are all of the same jât. It is unlikely, owing to the lateral spacing of the plots across the slope of a hill, that aspect has affected dieback. It is more probable that the actual fertility of the soil is the factor concerned in this connection, especially since the greatest dieback occurs in those blocks which yielded least in tippings (Table II) although a portion of this effect may be due to the effect of dieback on tipping growth.

The fertility of the soil is the final resultant of a very large number of factors, including the many elements necessary for plant growth and the factors concerned with physical condition of the soil. It is, therefore, rather difficult to select any particular aspect which may be regarded as typical of fertility, but it is usual to consider as foremost the three principal manurial substances, potash, phosphorus and nitrogen.

Lincoln and Bennett ⁽²⁾ examined the distribution of total nitrogen in pear trees and found that the percentage present in the branches and roots was lowered considerably during the summer i.e., when foliage production was making demands on the nitrogen present in the stem, while Thomas ⁽³⁾ showed that large amounts of nitrogen are stored, chiefly in the one-year-old wood, in the autumn. In other words, a form of storage during periods of slow growth can occur in the case of nitrogen as well as of carbohydrates. It is probable that similar phenomena occur with phosphorus and potassium, and one

is led to the view that the amounts of mineral substances present in the bush before pruning may be of considerable importance in relation to dieback. Figures are not available on the composition of the tipping growth at Galatura, but information on this subject has been obtained at St. Coombs. The percentage of total nitrogen in the young growth at the time of tipping was 2.796, the amount localised in the young growth of one bush being 2.016 grammes. At three thousand bushes to the acre, this gives a figure of thirteen and one-third pounds of nitrogen per acre. It is a moot point what proportion of this is absorbed from the soil during recovery from pruning, but one may assume that a large proportion of it is originally removed from the root reserves, the deficit in the root being made up as absorption from the soil continues. These figures illustrate the drain upon the root reserves which accompanies the recovery of the bush from pruning.

It is probable that the fertility of the soil influences the amount of carbohydrates produced by the plant previous to pruning, and, in fact, it is known that potash does exercise an influence upon this process. The block variance previously referred to may be considered as due to a combination of the effects of fertility directly, and also indirectly via carbohydrate reserves, upon dieback.

The conclusion to be drawn from the above evidence is that at elevations where dieback is frequent, rim-lung pruning offers great advantages. On poor areas a very generous provision of lungs is advisable, since the lungs will remedy any deficiency of carbohydrates, and may conceivably, judging from the results obtained from experiments upon temperate fruits, also supply a certain amount of mineral elements to the growing shoots.

It may be objected that in the present state of low-country tea, the extra expense of rim-lung pruning must be considered. The only extra expense, a small one, involved is that of cutting back the lungs at or near tipping time. The amount spent will vary with the method used, but in any case cannot amount to anything approaching the capital cost of bushes saved. At three thousand bushes to the acre, and cts. 50 per bush, the saving by using rim-lung instead of clean pruning in this case works out at Rs. 59-00 per acre.

REFERENCES.

- (1) Gadd, C. H.—*The Tea Quarterly*, 1928, 89-93.
- (2) Lincoln, F. B. and Bennett, J. F.—*Proc. Am. Soc. Hort. Sci.*, 1928, 253-255.
- (3) Thomas, W.—*Plant Physiology*, 1927, 2, 245-277.

APPENDIX.

TABLE I.

No. of deaths in three Months in 1,500 bushes.	Clean Prune.	Rim Lung.	Cut Across.	Mean	Standard Error.
	67	27	8	34	7.96
Percentage of mean.	197.1	79.4	23.5	100	23.4 .

TABLE II.

Blocks.	G	H	I	J	K	L
Weight of dieback.	160	180	125	81	85	72
Dry weight of material removed from the bush in 1st tipping in lbs.	13.99	14.20	18.70	20.56	20.10	23.65

Blocks giving high yield in 1st tipping show the least dieback.

TABLE III.

	Clean Prune	Rim Lung	Cut Across	Mean	Standard Error
Pounds of dead material from 1,500 bushes.	346	130	227	234	22.7
Do. as per cent of general mean.	147.6	55.5	96.7	100	9.7

The three pruning systems differ significantly from each other in their effect on the amount of dieback.