# CONTRIBUTIONS FROM THE RUBBER RESEARCH SCHEME (CEYLON)

## FURTHER SULPHUR DUSTING EXPERIMENTS AGAINST OIDIUM

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### INTRODUCTION

IN 1930 the first experiments to be undertaken in Ceylon on the sulphur dusting treatment for *Oidium* were carried out on Kandanuwara Estate, Matale. A fair measure of success in the control of the disease was obtained, and a brief report on the experiments (with photographic illustrations) was published in Rubber Research Scheme *Quarterly Circular* Vol. 7, Part 2, 1930. A further series of experiments was carried out later in the year on Gonakelle Estate, Passara, and a full report appears in Rubber Research Scheme *Quarterly Circular* Vol. 7, Part 4, 1930. As was to be expected with an entirely novel method of treatment complete control of the disease was by no means obtained, but it was possible to deduce various reasons for this lack of entire success. Particular attention has been paid to these points in the recent experiments which, thanks to the courtesy of the Warriapolla Estates Company, Limited, have been carried out on the same field on Kandanuwara Estate as in 1930. The following is a report on these experiments:

### THE EXPERIMENTAL AREAS

The treated area is a field of 30 acres of mature rubber surrounded on three sides by Tea, and abutting, on the fourth side, on the area selected as a control. This somewhat isolated position was selected as being particularly suitable for the purpose since the risk of sulphur being blown on to the control area, and of *Oidium* spores being blown from the control to the treated area, was thereby reduced as far as was compatible with an efficient control. The trees are planted 30 ft. × 15 ft. on one side of a hill of moderate slope, and are well grown for the elevation. The field is well provided with paths so that the dusting operation is rendered relatively easy and quick. This area has been dusted during two successive "wintering" periods.

The area selected as a control occupies the side of a hill facing in the same direction as the treated field. The two fields are almost contiguous, being separated only by a narrow strip of land occupied by a road, buildings, etc. The slope of the land is somewhat steeper, than that of the dusted field and the trees, though of approximately the same age, are, for the most part, smaller. The planting distance is about 18 ft. × 15 ft.

Before the dusting was commenced ten rectangular 16-tree plots were marked at regular intervals throughout each field. Each tree in these plots is separately numbered so that the condition of the foliage can be periodically examined and recorded. The plots are tapped on alternate days by an employee of the Rubber Research Scheme, and the yields for each plot recorded. The results as regards yield figures and foliage observations are not considered separately for each plot, but the summation of the results from the ten plots in each field is considered to be representative of that field as a whole. This method has been adopted owing to the impossibility, with the land available, of laying out plots in accordance with statistical requirements.

In 1929, before any sulphur dusting was commenced, both experimental areas were severely affected with *Oidium*, the extent of defoliation being approximately equal in the two fields. (See figures for 1929 on page 119). The disease had been present since 1925, and defoliation severe since 1927. The undusted area may, therefore, be considered to serve as an effective control, so that any marked distinction between the two fields after sulphur dusting can be justifiably regarded as due to the treatment.

## THE DUSTING OPERATIONS

As in the previous experiments the machine used was the Björklund Motor Duster. Very little mechanical trouble was experienced, but on several occasions the sulphur in the fan chamber became ignited and caused somewhat serious conflagrations. On only one occasion, however, was any damage done to the machine, and in this case a new fan had to be fitted. The cause of these fires is not clearly understood, but it is hoped that they will not recur after the machine has been re-conditioned. A machine with a closed fan-box would have an advantage in this respect.

With the exception of a trial application of "Sulphur Smoke", "Flotate" sulphur from the Kawah Poetih volcanic deposits in Java was used throughout. On the day on which "Sulphur Smoke" was used a light "drizzling" rain was falling, and despite these adverse conditions the sulphur formed an

excellent cloud. It is possible that under the same conditions "Flotate" sulphur, being hygroscopic, could not have been applied to the same advantage. In other respects, however, "Flotate" sulphur, when thoroughly dried, is at least as good as the American product, and is to be preferred on account of its lower price. Further experiments are necessary before the most satisfactory dusting powder can be determined, but in the meantime it is the writer's opinion that within limits (regulated by the particle size) the brand of dusting sulphur used is not of such great importance as the technique employed in the dusting operation.

In all, six applications were made to the experimental field as follows:

| | |
|---|---|
| December 9th, 1930 | "Flotate" @ 13 lb. per acre. |
| December 30th, 1930 | "Flotate" @ 15 lb. per acre. |
| January 13th, 1931 | "Sulphur Smoke" @ 14 lb. per acre. |
| January 29th, 1931 | "Flotate" @ 15 lb. per acre. |
| February 10th, 1931 | "Flotate" @ 15 lb. per acre. |
| March 3rd, 1931 | "Flotate" @ 13 lb. per acre. |

Total 85 lb. per acre.

The work was supervised alternately by the writer and the Superintendent, Kandanuwara Estate.

The dusting operation has been described and illustrated in previous publications, and it is sufficient to state that working with 10 coolies the 30-acre field was dusted in an average time of $1\frac{1}{2}$-2 hours. This rate of progress would be considerably exceeded were a larger area to be treated.

It is of interest to record the progress of wintering in relation to the dates of application. When dusting was commenced on December 9th only an insignificant proportion of the trees had "wintered". *Oidium* could be found on such young leaves as were present, but the fungus had not attained its full virulence. The great majority of the trees shed their leaves during the latter part of December, and on January 13th, when the third application was made, 90% of the trees were completely bare. It may be remarked in passing that such a regular "winter" is unusual. During the next few weeks the trees were in progress of re-foliation. On February 10th the dusted field exhibited an excellent foliage in various stages of development. Although active *Oidium* was to be found throughout the field, the extent of defoliation was almost negligible, and most of the leaves were undistorted. In the control field, on the other hand, defoliation was very severe, and only the early winterers

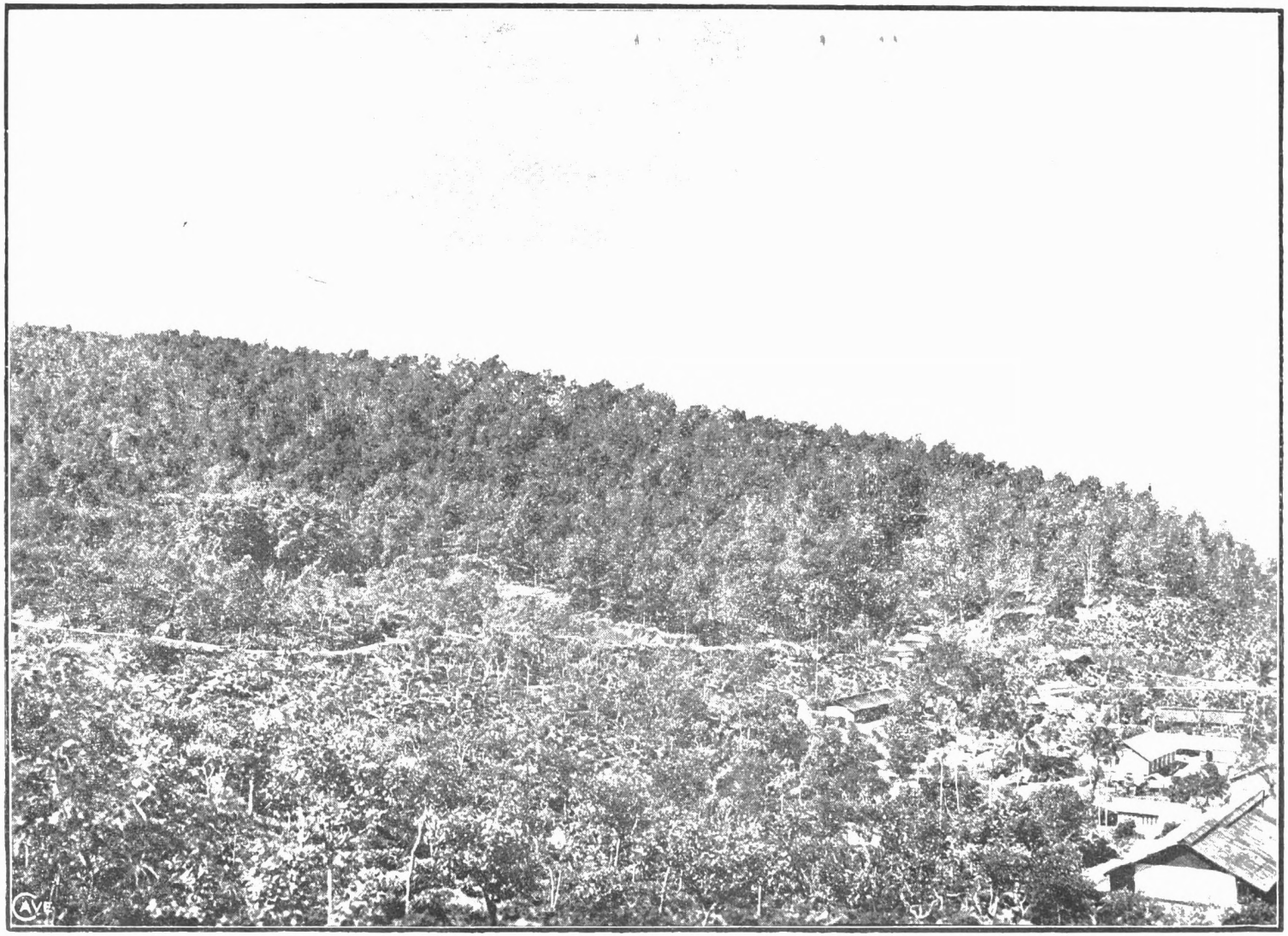

Plate I Kandanuwara Estate Dusted field. 14-3-31.

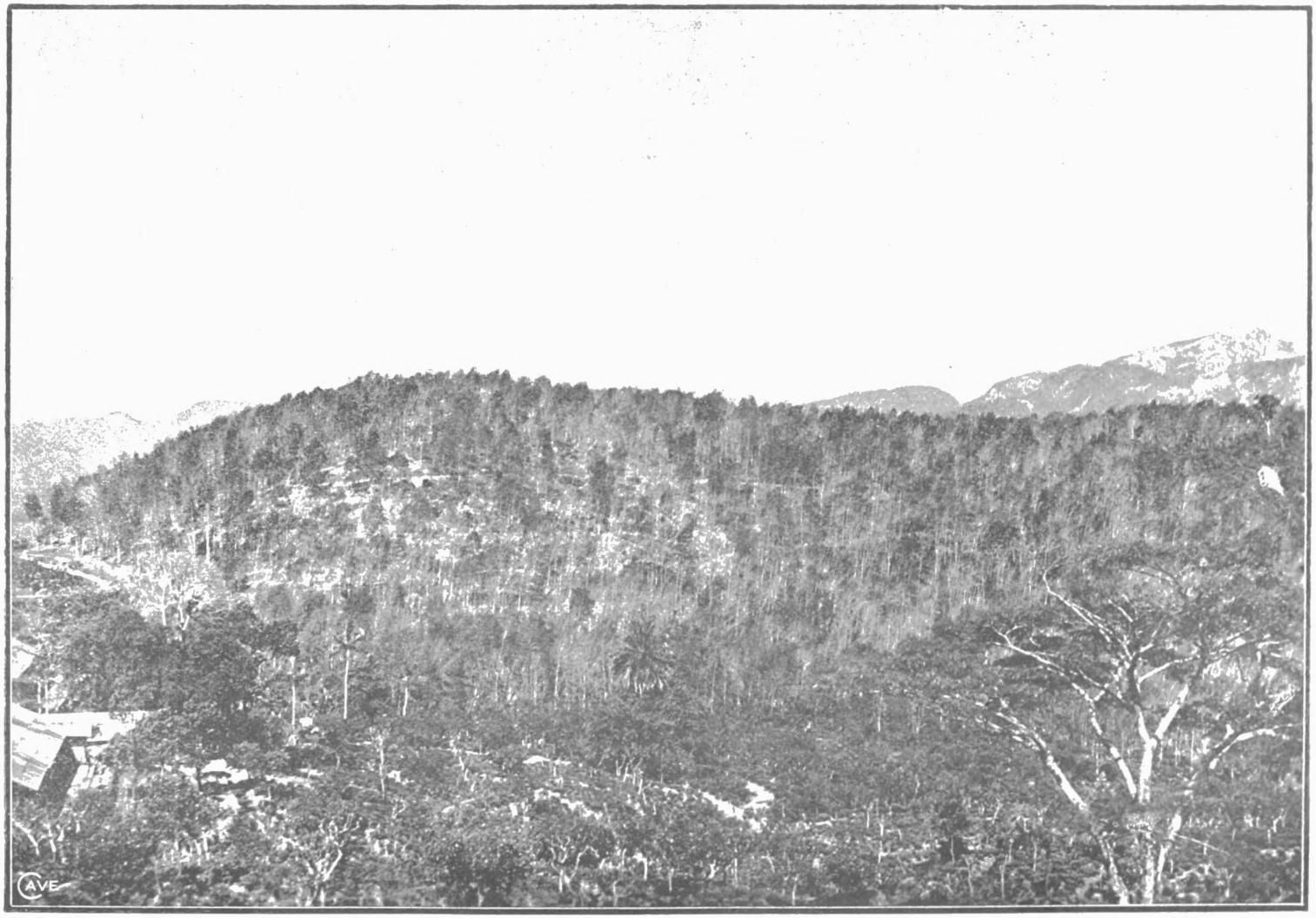

Plate II Kandanuwara Estate. Control (undusted) field 14-3-31.

had retained their leaves. A final visit was paid to Kandanuwara on March 14th. By this time the foliage in the dusted field was quite mature, and although "secondary" *Oidium* was prevalent throughout the field the applications were discontinued since it was thought that further leaf-fall was unlikely to occur. The condition of the foliage in the two fields on this date is further described below:

## RESULTS

(a) *Foliage.*—The two photographs shown bear testimony to the striking difference in the appearance of the two fields on March 14th. Whereas the control area is practically leafless, having the appearance of rubber during a normal "winter", the foliage of the dusted field, as viewed from a distance, would bear comparison with most areas at this elevation and, indeed, with many in the low-country. When comparing the two photographs it must be borne in mind, also, that the trees are more closely planted in the control than in the dusted field so that, other things being equal, a denser canopy in the former would be expected.

On March 14th an examination was made of every individual tree in the experimental 16-tree plots and the foliage was classified according to the intensity of *Oidium* attack. The figures together with those for 1929 and 1930, are shown on page 119. It will be noted that in the dusted field the proportion of trees classed as severely or completely defoliated (Classes E and F) has been reduced by the sulphur dusting from 56% in 1929 to 9% in 1931. In the control field, on the other hand, this percentage has risen from 51% to 76%. Correspondingly the proportion of trees in the dusted field in which leaf-fall is absent or very slight (Classes B and C) is 80%, as compared with 13% in the control field.

These figures indicate that the treatment has been extremely successful in preventing the most harmful effect of the disease viz: defoliation. Entire control of the fungus has, however, by no means been obtained, and "secondary" attack is still severe in comparison with low-country estates. It is probable that by continuing the treatment during March and April this attack on mature leaves could have been considerably reduced, but it is doubtful if such a procedure is an economic proposition. Although "secondary" attack is harmful in that the transpiration of the leaves is greatly increased, it is defoliation which imposes the severest tax on the vitality of the tree, and once the leaves are mature defoliation is not to be feared. On Kandanuwara the disease remains active throughout the greater part of the year so that at almost any time re-infection from neighbouring undusted rubber will occur. In order, therefore, to keep the

foliage healthy it would be necessary to make periodical applications throughout at least 9 months of the year, thus incurring an expenditure which would probably be disproportionate to the results achieved. In the most severely attacked areas the main aim of sulphur dusting must be to maintain the leaves on the tree, and it is probable that after two or three seasons the extent of "secondary" attack will also be reduced.

The present appearance of the control field is indicative of the worst effects of the disease if allowed to remain uncontrolled. Only the very early winterers have maintained their foliage, and even on these trees the leaves are small and distorted. As the result of the depletion of food reserves caused by continual defoliation many twigs and branches have died back, so that the number of branches left to bear leaves is greatly reduced. Consequently later in the year, when the trees recover to some extent, only the scantiest crowns are presented.

It must be mentioned that the above observations have been made at the time when there is the greatest contrast between the two fields. From about June to November *Oidium*, although not becoming entirely passive, loses some of its virulence, and the trees are able to recover to a great extent. Later in the year, therefore, most of the trees in the control field, instead of being leafless, will possess a thin crown of malformed leaves.

(b) *Yields*.—Comparative yields must constitute the ultimate criterion of the value of sulphur dusting as of any other treatment, and this matter is being investigated at Kandanuwara. Daily records of the latex and dry rubber are being taken from the ten 16-tree plots in each field, the same tapper being employed throughout. The results will be published later in the year, but in the meantime it may be stated that a large difference in yield in favour of the dusted field has been manifested during March, April, and May 1931.

## QUANTITIES AND COSTS

The following is a full statement of the costs of the dusting operations. Owing to the small area involved it is difficult to give a significant figure for depreciation of the machine. This has been written down as Re. 1-00 per acre, which is considered to be a reasonable figure for work on a large scale.

## SULPHUR

(Costs include all transport, handling charges, etc.)

| | Rs. | cts. | Rs. | cts. |
|---|---|---|---|---|
| 2,130 lb. "Flotate" @ 09 cents | 191 | 70 | | |
| 420 lb. "Sulphur Smoke" @ 11 cents. | 46 | 20 | 237 | 90 |

## LABOUR

| | | | | |
|---|---|---|---|---|
| 76 coolies drying and dusting sulphur @ 60 cents. | 45 | 60 | | |
| Extra labour (Cleaning, transport, etc.) | | | | |

## RUNNING EXPENSES

| | | | | |
|---|---|---|---|---|
| Petrol and Oil | 9 | 00 | | |
| Minor repairs to machine | 5 | 87 | 14 | 87 |
| Depreciation on machine @ Re. 1 per acre | | | 30 | 00 |
| | | | 331 | 07 |

This works out at approximately Rs. 11-00 per acre. Owing to the small area treated all costs are proportionately higher than if the work had been undertaken on an estate scale. It is calculated that if 200 acres were dusted the cost would be about Rs. 9-00 per acre. It may be remarked that the transport charges to Kandanuwara are probably higher than to the average estate.

As mentioned above the field was dusted in the previous season, and the results achieved must be to some extent regarded as cumulative. It is more accurate, therefore, to consider the results as due to two years' treatment. In 1930 the quantity of sulphur applied was 1,600 lb. and the inclusive cost about Rs. 7-00 per acre. The total expenditure in the two years has therefore been about Rs. 18-00 per acre. On a crop basis of 450 lb. per acre per year the cost of the treatment has therefore been about 2 cents per lb. of rubber produced per year.

## CONCLUSIONS

The experiments described above confirm the conclusions previously formed. The greater measure of control secured in these as compared with previous experiments is to be attributed mainly to the earlier start of the operations. Dusting

was commenced at the first sign of severe *Oidium* attack on the young leaf, whereas in previous experiments circumstances did not permit a start until the disease had already caused serious defoliation. Owing, however, to the limited time (10-14 days) during which the sulphur remains toxic on the leaves there is a limit to this early start, and it is valueless to commence dusting while the fungus is still passive. A careful watch must be kept for the first sign of *Oidium* activity, and no time lost in making the first application when this is apparent.

The question now arises—"Does sulphur dusting pay". Assuming that rubber will again become a remunerative crop the answer, as far as estates as severely attacked as Kandanuwara are concerned, is a definite affirmative. It is somewhat premature to discuss the yield figures obtained to date, but there is every indication that the comparative gain in yield as the result of dusting would pay for the treatment were rubber selling at even the moderate price of 20 cents per lb.

Disregarding yield figures the treatment could confidently be recommended as the result of the improvement in foliage alone. It may safely be asserted that for an addition of 2 cents per lb. to the cost of production no manurial or other treatment has ever effected so marked an improvement in the general condition of a field of rubber. The ultimate fate of the control field can only be viewed with the utmost apprehension. Bark renewal is almost negligible, the yield shows a considerable decline, and it seems possible that the very existence of the trees is jeopardised. The dusted field, on the other hand, possesses a fair foliage which should be further improved if the treatment is carried out in subsequent years, and the yield, so far from declining, appears in 1931 to be on the upward grade.

The experiments on sulphur dusting have, therefore, reached a stage at which the treatment can be definitely recommended on the most severely diseased areas. Whether the work should be undertaken on more mildly affected estates is a matter for further enquiry, and will largely depend on local conditions and the price of rubber.

**ACKNOWLEDGMENT**

The helpful co-operation of Mr. M. C. Evans, Superintendent of Kandanuwara Estate, is gratefully acknowledged.

| | No attack | Mild to moderate "secondary" | Severe "secondary", little or no defoliation | Moderate defoliation | Severe defoliation | Complete or almost complete defoliation | Total |
|---|---|---|---|---|---|---|---|
| DUSTED PLOTS | | | | | | | |
| March 1931 | 0 | 64 (41%) | 60 (39%) | 17 (11%) | 10 (6%) | 5 (3%) | 156 |
| April 1930 | 0 | 31 (20%) | 51 (33%) | 26 (17%) | 30 (19%) | 18 (11%) | 156 |
| April 1929 (before dusting) | 0 | 5 (3%) | 30 (19%) | 34 (22%) | 30 (19%) | 57 (37%) | 156 |
| CONTROL PLOTS | | | | | | | |
| March 1931 | 0 | 1 (1%) | 18 (12%) | 16 (11%) | 19 (13%) | 96 (63%) | 150 |
| April 1930 | 0 | 4 (3%) | 18 (12%) | 22 (15%) | 26 (17%) | 80 (53%) | 150 |
| March 1929* | 0 | 49 (7%) | 162 (24%) | 126 (18%) | 147 (22%) | 197 (29%) | 681 |

* These figures (March 1929) refer to a different series of plots in another portion of the control field.