CONTRIBUTIONS FROM THE RUBBER RESEARCH SCHEME, CEYLON

REPORT ON SULPHUR DUSTING EXPERIMENTS ON GONAKELLE ESTATE

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1. *The Experimental Area.*—The total area of rubber on Gonakelle Estate is 93 acres, consisting of three fields of approximately 45, 40, and 8 acres respectively. The latter field is situated about $\frac{1}{4}$ mile distant from the main portion of the rubber, and served as an untreated control in the dusting experiments. Roughly speaking, the two main fields consist of relatively narrow strips planted down a steep hillside from an elevation of over 3,000 feet down to about 1,500 feet. Whereas one field is well roaded, having a path "zig-zagging" from the top to the bottom, the other has few paths, such as there are being badly placed for dusting purposes. This matter has an important bearing on the success of the operations, as indicated below.

The rubber is mature and well grown for so great an altitude, and has not been tapped for some years. Before the dusting was commenced the intensity of *Oidium* was judged to be approximately equal in the three fields, the extent of defoliation being, perhaps, slightly less in the control block. Every tree was affected to a greater or less degree, and it was estimated that approximately 30% of the trees had been completely defoliated. The fungus was active when dusting was commenced.

2. *The Dusting Operations.*—For the most part the Björklund Duster was used, as in the experiments in Matale. With the exception of a few minor points due to the vibration of the two-stroke engine the machine gave entire satisfaction. In conjunction with the dusting experiments a trial machine of British manufacture was tested.

Two kinds of sulphur were used:

(1) "Acme 300" sulphur dust manufactured in America.

(2) "Flotate" sulphur from the Kawah Poetih volcanic deposits in Java.

The price of the American sulphur f.o.r. Colombo is about 13½ cents per lb., whereas for the Java product the corresponding cost is about 6½ cents per lb., the difference in price being largely due to the heavy freight charges from America. The only advantage which the American sulphur appears to possess is that it may be used without any preliminary treatment. "Flotate" sulphur, on the other hand, must be dried in the sun for a few hours before use, and may be passed through a sieve to advantage. This operation, however, costs not more than about 1/10 cent. per lb., so that it would appear that the extra cost of the more specialised product is not justified. When satisfactorily dried "Flotate" sulphur possesses as good cloud-forming properties as "Acme 300," and its fungicidal properties appear to be at least as good. The conclusion that "Flotate" sulphur is preferable to "Acme 300" should not be interpreted as a general statement unfavourable to specially prepared American sulphurs. Price is a very important factor, and if an American firm can place on the Ceylon market a suitable article at a price competitive with that of Java sulphur, its use must be considered. At the present time it is not known whether the Java sulphur possesses any advantages over American sulphur on account of its acid content.

A total quantity of 6,200 lb. of sulphur was applied to the experimental fields on Gonakelle, 4,000 lb. of "Acme 300" dust being first applied in four applications followed by 2,200 lb. of "Flotate" sulphur in three applications. In all an average of 73 lb. per acre was applied. Mechanical trouble with the experimental machine somewhat interfered with the later dusting operations, with the result that portions of the rubber have received 7 applications while others have had only 6 dustings. The first application was made on May 7th, and 8th, 1930. Subsequent dustings followed at approximate fortnightly intervals, the final application being made on August 19th, and 20th.

Owing to the steepness of the land and scarcity of the paths in part of the experimental area each application occupied two days, so that an average area of only 42½ acres was treated per day. The dusting operation was confined to the mornings. The coolies were seldom able to return to the lines before about 2 p.m. and were not, therefore, required to work in the afternoons. All the work was personally supervised.

3. *Quantities and Costs.*—The following figures represent the approximate costs of the dusting operations on Gonakelle. It is impossible to give exact figures owing to the complications introduced by the testing of the experimental British machine. The figures are of little value as a gauge of the general cost of

sulphur dusting owing to the excessively high price of the American sulphur. Depreciation of the machine and cost of special supervision are not included.

			Rs.	cts.
Sulphur.	(1)	4000 lb. "Acme 300" @ 13·3 cts.	532	00
		2200 lb. "Flotate" @ 6·6 cts.	145	20
		(costs are excluding transport from Colombo)		
Labour.		140 coolies @ -/60 cts.	84	00
Petrol.		7 gallons @ Rs. 1-75	12	25
Oil.		1½ gallons @ Rs. 4-50	6	75
		Rs.	780	20

This is equivalent to about Rs. 9-25 per acre. It is again emphasised that this figure does not represent the economic cost of sulphur dusting in Ceylon.

4. *Results.*—Before reporting the results of the dusting experiments it is necessary to consider the condition of the foliage when the dusting was started and during the course of the operations. The normal "wintering" process occurs on Gonakelle during February, March, and April. When dusting was started on May 7th most of the trees had put on their new foliage and had suffered as the consequence of a severe *Oidium* attack. It was estimated that about 30 per cent. of the trees had been completely defoliated. These trees put out a second crown of foliage during the course of the experiments, so that there was at all times a proportion of the trees in young leaf. In addition a considerable percentage of trees underwent a secondary "wintering" in July and August so that there was a large quantity of young leaf in August and early September. This secondary "wintering" is normal in parts of Uva and is doubtless due to a prolonged period of dry weather following the N. E. Monsoon.

Oidium was active throughout the course of the experiments but did not cause as severe leaf-fall as in March and April. It became more virulent in the control field after the normal secondary wintering referred to above, and its increase in virulence appeared to be associated with the advent of showery weather.

It may at once be stated that the benefit in the foliage due to the sulphur dusting was disappointing. This is considered to be chiefly due to the fact that the dusting was carried out at the wrong time of the year. It was the intention to commence dusting early in April, but owing to unforeseen delays in shipping the sulphur from America, the start was postponed until May 7th, by which time the foliage had already suffered severely from the disease. As far as the control of the fungus is concerned, however, very definite results were obtained.

In considering the results of the dusting it is necessary to distinguish between the two treated fields. It has already been mentioned that whereas one field is well "roaded," the other is poorly provided with paths. In order to determine whether it is necessary to apply the sulphur carefully to every portion of the rubber, or whether, once a good cloud of sulphur has been projected, the breezes will effectivly distribute it to all parts, the latter area was dusted chiefly from such paths as existed. As a consequence the treatment was comparatively ineffective, and only those portions of the field to which the sulphur could be easily applied have benefited to any marked extent. The valuable conclusion is drawn that it is of the utmost importance to ensure that every portion of the rubber receives its full quota of sulphur. On steep land this is often a matter of great difficulty, and would probably be a limiting factor to the success of sulphur dusting on some mid-country estates. Attention is directed below to the results obtained on the well "roaded" field in which it was possible to dust every portion from the paths.

The foliage of the dusted and control fields was carefully examined on September 4th and 5th, and the following points were noted:

(1) In the dusted field about 15 per cent. of the trees were or had recently been in young leaf, and in every case examined the preceding defoliation was of the normal secondary type described above. In the control field the corresponding proportion was about 30 per cent. the defoliation in about half these cases being due to *Oidium* attack in the previous month or two.

(2) In the dusted field 38 trees in young leaf were examined, and in every case *Oidium* infection was either absent or slight. Leaf-fall was negligible. In the control field 48 such trees were examined, *Oidium* infection being classed in all cases as moderate or severe. The extent of leaf-fall was considerably greater than in the dusted field.

(3) There was an abundance of healthy flower in the dusted field, and a small quantity in the control.

(4) A small number of trees in the dusted field which had refoliated during the dusting operations appeared to be quite free from the disease, while, of a total of 240 trees examined, 31 per cent. showed only mild secondary attack. In the control field no entirely healthy trees were found, and the proportion with mild secondary attack was 10 per cent.

(5) A large percentage of trees in both areas possessed a thin crown of distorted leaves, mainly the result of *Oidium* attack before the dusting operations were commenced.

The above remarks apply only to the control field and the well "roaded" dusted field.

5. *Conclusions.*—As the result of the dusting experiments and other observations on Gonakelle the following conclusions have been drawn:

(1) "Flotate" volcanic sulphur from Java is as effective a fungicide as the more specially prepared "Acme 300" dust from America, and is preferable on account of its cheapness.

(2) In order that the dusting operations should achieve the maximum success they should be carried out during the period of refoliation after the normal "winter." The applications on Gonakelle were started too late in the year. It is probable that the first application should be made at the first appearance of young leaf after "wintering." This matter is to be investigated in further experiments to be carried out in Matale.

(3) The importance of ensuring that every portion of the rubber receives its full dose of sulphur is stressed. Steep land with few convenient paths may be very difficult and slow to dust effectively.

(4) Severe attacks of *Oidium* appear to be associated in the Passara district with showery weather. This may appear at first sight to be contradictory to the previous conclusion that a dry atmosphere is the most important climatic factor favouring the disease. It must be noted, however, that Passara is a dry district, and the humidity between showers is relatively low. It is possible that the showers provide the quantity of moisture necessary to the vegetative growth of the fungus mycelium, the intervening dry spells being favourable to the production of the conidia.

(5) Although the dusting operations, as judged by the general appearance of the treated rubber, cannot be considered highly successful, it is considered that the experiments, as such, have fulfilled a useful purpose in elucidating several problems in connection with the treatment.

6. *Acknowledgment.*—Thanks are due to Mr. G. Kent Deaker, Superintendent of Gonakelle Estate, for his kind co-operation in these experiments.