

A FURTHER NOTE ON THE EFFECTS OF FUNGICIDES ON THE VIABILITY OF HEVEA BUDS.

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During the past year, considerable work has been carried out both in Ceylon and Malaya to determine the types and strengths of fungicides which may with safety be used for the disinfection of imported or exported budwood and budded stumps, in order that such material may comply with possible plant quarantine regulations.

The results obtained in the two countries seemed to be at variance, especially as regards the possibility of using copper sulphate as a disinfectant, and an interchange of correspondence and treated material took place between the Rubber Research Scheme, Ceylon, and the Rubber Research Institute, Malaya. As a result, a satisfactory explanation has been found for the apparently divergent views of the authorities in Ceylon and in this country.

According to the monthly reports of the Mycologist, Rubber Research Scheme, Ceylon, the first experiments in Ceylon were projected in October 1929. A year later, in the report for October 1930, it was stated that the results of the experiments so far carried out indicated that a 5 per cent. solution of copper sulphate was an effective and harmless disinfectant for both budwood and budded stumps. Co-operation with this Institute was solicited, and in November 1930 a box of budwood from clone AVROS 50 was treated according to specification at the Experiment Station, Sungei Buloh, packed, and despatched to Ceylon.

The treatments were as follows :—

- (a) Immersion for 5 minutes in a 5 per cent. solution of copper sulphate.
- (b) As in (a), but washed afterwards with water.
- (c) Immersion for 5 minutes in a 2 per cent. solution of copper sulphate.
- (d) As in (c), but washed with water.
- (e) Control untreated.

When the box was opened on arrival in Ceylon, it was found that considerable damage had resulted from the treatments. Bud-

wood from treatment (a) was completely rotten; that from (b) and (c) was severely injured; while budwood from (d), although showing less damage than any of the other treated material, was still seriously affected by the treatment it had received. The control sticks appeared healthy, and it seemed obvious that the damage had been due to treatment with copper sulphate. Buds were taken from sticks treated by (b), (c), (d), and (e), but although budding operations were personally supervised by a research officer of the Rubber Research Scheme, Ceylon, not a single successful result was obtained even from the control sticks.

These results were in direct contradiction to those previously obtained in Ceylon, when even 5 per cent. copper sulphate solution had caused no damage to budwood or budded stumps. The results obtained in Ceylon with the Malayan budwood were however corroborated in Malaya during extensive investigations of the problem of budwood disinfection carried out at the Experiment Station, Sungei Buloh, in December 1930. The results of these investigations were published in the *Quarterly Journal of the Rubber Research Institute*, Vol 2, No. 4, April 1931.

In the meantime, the results obtained in Ceylon with Ceylon budwood had also been corroborated by further experiments carried out in that country at the Research Laboratories, Culloden Estate, during which budwood treated with a 2 per cent. solution of copper sulphate, packed and stored, looked quite healthy after 11 days. The box of budwood which had been sent from Malaya to Ceylon was only 9 days in transit, and yet not one healthy bud could be obtained from the whole consignment.

It was therefore suspected that the differences between the results obtained in the two countries were due to differences in susceptibility between the budwood from different clones to damage by copper sulphate. Budwood for the Malayan experiments had been taken from clone AVROS 50, while that for the Ceylon experiments had been chiefly taken from a local clone known as G. 771. Evidence pointed to clone AVROS 50 being relatively susceptible, and to clone G. 771 being relatively resistant to damage by copper sulphate.

In order to elucidate this point, it was arranged between the two research stations that a box of budwood treated with copper sulphate solution should be despatched from Ceylon to Malaya during the next Malayan budding season, and that each treatment should contain budwood from both the clones involved.

This box of budwood was despatched on May 2nd 1931, was delivered in Kuala Lumpur on May 19th, and budding operations were performed on May 20th. The results obtained were of great interest and are quoted and discussed in the following paragraphs.

DETAILS OF TREATMENT.

The treatments employed were as follows :—

- (1) Two yards of budwood immersed in a 2 per cent. solution of copper sulphate for 5 minutes, then washed in water.
- (2) As in (1), but not washed after treatment.
- (3) Two yards of budwood immersed in a 1 per cent. solution of copper sulphate for 5 minutes, then washed in water.
- (4) As in (3), but not washed after treatment.
- (5) Two yards of budwood untreated.

In each treatment one yard (marked 1A, 2A, etc.) was of clone AVROS 50, and the other (marked 1G, 2G, etc.) of clone G. 771.

The budsticks were wrapped individually in sacking and packed in moist fibre in a wooden box. There was considerable delay in delivery, and the abnormally long period of seventeen days elapsed before the box arrived in Kuala Lumpur. When the box was opened in the nursery at the Experiment Station, the budwood was found to be very severely injured. The observations made on the condition of the budwood are summarised in Table I.

TABLE I.

The condition of the budwood, and the number of apparently healthy buds taken from each stick at the time of budding.

Treatment.	Condition of Sticks.	Strippable Buds.
1 A	Completely dead and mouldy ...	0
1 G	Severely injured ...	17
2 A	Completely dead, with rich growth of moulds ...	0
2 G	Very severely injured ...	3
3 A	In an advanced state of decomposition ...	0
3 G	1½ feet of stick dead ...	10
4 A	Completely dead and mouldy ...	0
4 G	Severely injured ...	14
5 A	Completely dead and mouldy ...	0
5 G	1 foot of stick dead ...	8

RESULTS OF BUDDING FROM THE TREATED MATERIAL.

The buds were worked on uniform vigorous stocks in a 2½ years old nursery. The tapes were removed after 16 days, and the condition of the budpatch determined, and at the expiration of a further period of a month a second and final examination was made.

The dates of treatment, budding, and inspection, and the details of successful buddings obtained, are summarised in Table II.

TABLE II.

*Summary of the operations performed on the box
of budwood, and of the results obtained.*

Budwood treated	...	May 2nd.
Budding operations performed	...	May 20th.
Tapes removed and first inspection made	...	June 5th.
Second inspection made	...	July 5th.

Treat- ment	Number of Buds cut.	Number of Buds used.	Successes			
			1st inspection		2nd inspection	
			No.	Per cent	No.	Per cent
1 G	17	15	11	73	10	64
2 G	3	3	0	0	0	0
3 G	10	8	4	50	4	50
4 G	17	16	6	38	6	38
5 G	8	7	5	71	5	71

ANALYSIS OF RESULTS.

It is immediately obvious from an examination of Tables I and II that budwood from clone AVROS 50 is considerably more susceptible to injury than budwood from clone G. 771. Not only is the effect of copper sulphate on the former clone so much more intense than on the latter that not one strippable bud of AVROS 50 could be found on any of the treated sticks, but even the control stick of that clone had succumbed after the long period of transit, while two thirds of the control stick of clone G. 771 still remained healthy.

These results support those obtained with the treated budwood sent from Malaya to Ceylon in November 1930 and explain why they

differed so considerably from results previously obtained with Ceylon budwood.

No great significance was expected of the results from the treated sticks of clone G. 771 since the number of available buds was so small, but the actual differences obtained in successes between the several treatments were considerable enough to warrant the following deductions :—

- (a) Treatment 2 G was the strongest.
- (b) Treatments 1 G and 3 G, in which the budwood was washed with water after treatment, were much weaker than treatments 2 G and 4 G, in which the budwood was not subsequently washed.
- (c) That the results obtained from treatments 1 G and 3 G were comparable with those obtained from the untreated control.

Deduction (a) would be expected *a priori*.

Deduction (b) agrees with the results obtained in this laboratory and published in the paper already referred to (Q.J. of R.R.I., Vol. 2, No. 4, April 1931), in which budwood of a different clone and a large number of different fungicides were used.

Deduction (c) agrees with the results obtained in the laboratories of the Rubber Research Scheme, Ceylon, which led to the statement in October 1930 that a 5 per cent. solution of copper sulphate appeared to be a harmless and efficient disinfectant for budwood and budded stumps.

Thus the observations made on the treated budwood sent from Ceylon to Malaya during May 1931 have corroborated the main observations previously made in each of these two countries on the efficiency of copper sulphate as a disinfectant for budwood and budded stumps, and have indicated that the lack of agreement between the results obtained has been due to the differences in susceptibility to damage by this fungicide between the budwood of the different clones employed.

The observations also indicate that, in the event of the requirements of plant quarantine regulations becoming more exacting, it may be desirable to lay down a further series of experiments on the disinfection of imported and exported budwood and budded stumps using a single fungicide and a range of clones, to supplement those already carried out with a range of fungicides and a single clone, so that recommendations for the treatment of any particular consignment may be given with confidence.

At the moment however the necessity for such experiments does not arise and pressure of work of more immediate importance precludes for a time the possibility of further investigation of the problem in this laboratory.

SUMMARY.

1. Considerable discrepancies have been apparent between results obtained in Ceylon and in Malaya as to the efficiency of copper sulphate as a disinfectant for budwood and budded stumps.
2. The results were consistent in each country, and it was suspected that the discrepancies were traceable to differences in susceptibility to damage by copper sulphate between the budwood used for experiment in Malaya and that used in Ceylon.
3. The budwood used in Malayan experiments was taken from clone AVROS 50, and that used in Ceylon experiments from a local clone known as G. 771.
4. A box of budwood, containing sticks of both these clones treated (in duplicate) in various ways with copper sulphate, was prepared in the laboratory of the Rubber Research Scheme, Ceylon, and despatched to the Rubber Research Institute of Malaya.
5. Budding results obtained with this material showed that budwood from clone AVROS 50 was much less resistant than budwood from clone G. 771 to injury by copper sulphate, and that the effect of the treatments was of the same type on both clones but different in degree.
6. Should the problem of the disinfection of imported and exported budwood and budded stumps assume a greater importance, the need is indicated for the investigation of the relative susceptibilities of the more popular clones to injury following disinfection by various fungicides.