CROP PROTECTION BY COPPER FUNGICIDES.

PART I. THE EFFECT OF WEATHER ON COPPER RESIDUES.

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The problem of spray residues can be divided into two parts.

Firstly, does the fungicide remain on the leaf under adverse weather conditions?

Secondly, what fungicidal residue, is to be expected in teas manufactured from sprayed or dusted areas?

Normal crop protection practice is to spray under dry conditions, or to dust under moist conditions, but not in rain. However, in those areas badly affected by blister blight it is quite impossible to pick and choose these conditions during the period of the South West monsoon.

Practical experience in 1949 indicated that satisfactory protection could be given to tea in spite of continuous rainfall and it became necessary, therefore, to determine to what extent copper fungicides are retained by the tea leaf under conditions of heavy rainfall. When Dr. Dike of Universal Crop Protection came to work at the Tea Research Institute in May of this year he felt it desirable to carry out some preliminary investigations on this matter. With the assistance of Mr. Ramaswamy of the Biochemical Department he established the fact that copper fungicides are retained on tea leaf to a marked degree even when subject to heavy rainfall after application.

When I joined the staff of the Institute in August 1950 it was thought desirable that I should follow up this work using more exact methods of analysis than were employed in the preliminary experiments, definitely to establish the principles of this most important aspect of blister blight control investigations. In my first experiment pieces of cut flush were given varying protective treatments.

1 set was treated with a 12 per cent copper oxychloride dust.

1 set was treated with a 6 per cent copper oxychloride dust.

2 sets were treated with a copper oxide spray.

The two dusted sets and one of the sprayed sets were put out into moderately heavy rain immediately after treatment, the remaining set of sprayed flush being allowed to dry before being exposed. One piece of flush from each set was removed daily and the copper content of the individual leaves of each piece was determined. A note was also made of the daily rainfall. The results of this experiment are given in Table I.

TABLE I.

Copper residues on tea leaf exposed to rain.

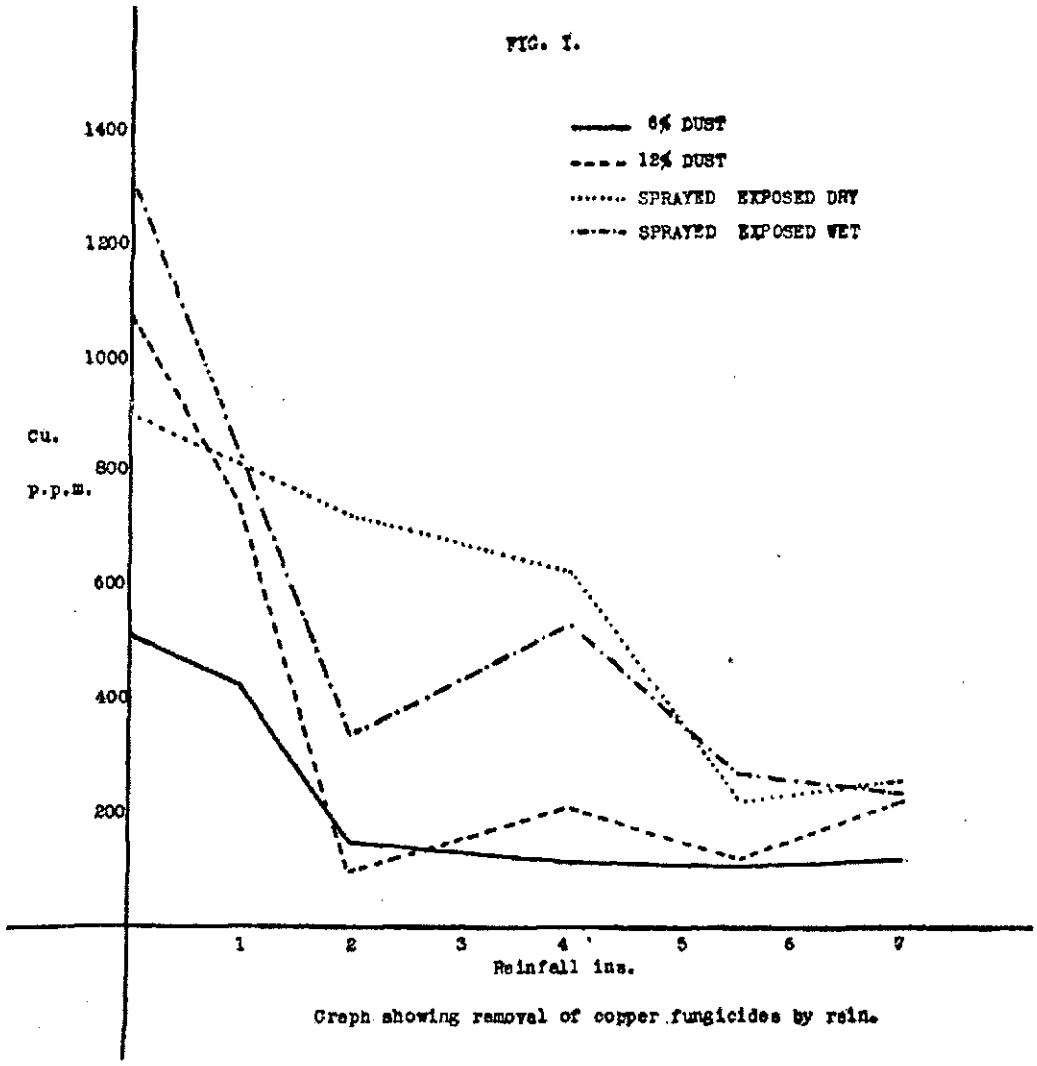
Cu. p. p. m.

Rain.	12% Dust.	6% Dust.	Sprayed and exposed wet.	Sprayed & dried before exposure.
0"	1,044	536	1,300	884
0.84"	717	403	—	—
1.99"	108	137	284	708
4.07"	196	72	492	600
5.73"	116	69	232	204
6.99"	176	88	168	200

From these figures it is evident that the fungicides applied to dry leaves were retained against the washing action of moderately heavy rain, thus verifying the earlier work of Dr. Dike on this problem.

A most interesting and important fact emerges from a more detailed study of these figures. It is best seen when the results are presented in the form of a graph. Fig. 1.

FIG I.



Graph showing removal of copper fungicides by rain.

It appears that a comparatively small amount of rain was sufficient to remove the bulk of the fungicide applied but that the remainder was held against much more prolonged washing. The reason for the retention of this small amount of fungicide is not clear.

The next step was to consider the application of the fungicides to wet leaves in rainy weather. Owing to a spell of dry weather, which intervened, rainy conditions had to be created by the use of a knapsack sprayer fitted with a fairly high output nozzle. Single bushes were sampled to determine the inherent copper content of the leaves. After being thoroughly wetted with water two bushes were sprayed in the usual way and two were dusted using a hand dustgun. Further leaf samples were taken immediately after treatment and also after the equivalent of 2½" of rain which was applied over a period of 2 hours. The results are shown in Table II. It is seen that under these conditions retention is reasonably good.

TABLE II.

Cu. in p.p.m. of dry matter.

	Dusted	Sprayed
Initial ...	30	27
Plus fungicide ...	826	1,030
After 2½" rain ...	64	88
Actual residue ...	34	61

As a final test of retention in rain, 4 bushes of Clone No. 21 were sprayed at the beginning of a deluge of rain, being sampled before spraying and 2 hours afterwards. Some 0.7" of rain fell in the 15 minutes following the application of the spray. Dusting was not attempted since it would be quite impracticable under these conditions.

Under these severe conditions no retention of fungicide was detected.

From the results of large scale spraying trials carried out at Kataboola and dusting trials at Castlereagh it seems as if the small amount of copper fungicide retained under bad weather conditions is sufficient to give a *measure* of protection against blister blight infection. However, it must be emphasised that spraying and dusting are not necessarily of equal efficacy.

Obviously with such stubborn retention of the applied fungicide the question of copper residues in the made tea is an important consideration.

At Castlereagh Estate during the last south west Monsoon, Dr. Dike started small scale dusting experiments which were continued by Mr. Baker, Superintendent of the estate, when Dr. Dike left the Island. The made teas from these trials were analysed for copper content. The results are given in Table III.

TABLE III.

Copper content of made teas from Castlereagh Dusting Experiment.

Date	Cu. p.p.m. Dry Matter.	
12.6.50	416	
27.7.50	62	
14.8.50	68	
26.8.50	64	Mean 61
29.8.50	55	
31.8.50	66	
5.9.50	52	

The first very high figure was due to dusting on the day before plucking and stands as a warning of what may happen if dusts are improperly applied.

The St. Coombs loss of crop experiment which has already been described by Mr. Loos has also provided very valuable information about the extent of the copper residue in made tea. The leaf from the control and sprayed plots has been manufactured separately and copper analysis done on each sample. The figures obtained from this experiment are shown in Table IV.

TABLE IV.

Copper contents of made teas from the St. Coombs Loss of Crop Experiment.

Cu. p.p.m. dry matter.

	Plot A.	Plot B.	Plot C.
Mean value	28	53	58
Highest figure	31	80 (Nov. 4th)	68
Lowest	24	39	40

The figure for the crop plucked on the 4th November is of special interest since virtually no rain fell between spraying and plucking. There is unfortunately no comparable figure for the copper content of the made tea from a dusted area under these dry conditions.

It may, therefore, be concluded that if spraying is carried out immediately after plucking, using the recommended amounts of fungicide, the copper content of the made tea should be less than 100 p.p.m. even under dry conditions.

Teas made from areas dusted under typical South West monsoon conditions can be expected to have copper contents below 80 p.p.m. provided that the interval between dusting and plucking is of the order of 7-8 days.

The full implications of these results will be discussed by Mr. Lamb in the next paper.