STUDIES IN BLISTER BLIGHT CONTROL

VII. POWER DUSTING WITH "CUPROSANA" DUSTS CONTAINING 2, 4 AND 6 PER CENT. OF COPPER

By

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In 1950 Dr. Dike of Messrs. Universal Crop Protection Limited, brought out to Ceylon his prototype "Whirlwind" power dusting machine which had been designed primarily for use with the same Company's "Cuprosana" fungicidal dusts containing various percentages of copper in the form of the oxy-chloride. Dr. Dike's preliminary experiments indicated that power dusting might be economically possible for blister blight control especially on areas too steep for knapsack spraying or where water supplies present a major problem. The "Whirl-wind" duster can be mounted for transport on an open van for dusting along car roads, or when fitted on a trolley is sufficiently manoeuvrable to be taken along ordinary estate paths. A full description of this duster and its use on tea planta-tions has already been published by Dr. Dike in the Tea Quarterly (1).

The experiment reviewed in the present article was designed to test out the efficiency of the "Whirlwind" duster in the distribution of "Cuprosana" dust and the effectiveness in disease control of dust formulation containing 2, 4 and 6 per cent. copper during the south west monsoonal months. The limit of 6 per cent. copper in the dust was decided on both for economic reasons and on account of the possibility of excessive copper contaminations in the made tea should higher concentrations be employed. Application rates were fixed at 5 lbs. of dust per acre at 5 day intervals for reasons of general agricultural practice.

The area selected for the experiment was a tea field on the upper Abbotsford Division of Dessford Group, Nanu Oya (elevation approximately 5,000 ft.). The field lies on a south-westerly facing hillside with fairly low-lying and open country for miles in front of it. The position was such as would permit south-west monsoonal winds, during the normal monsoonal weather, to blow over the selected area without obstruction or deflection. In other words every attempt was made in the selection of a site over which dust could carry for fairly long distances, when supported by a south westerly originating wind.

A cart road for a short distance and its continuation as a foot path divided the area selected for the experiment into two parts. The dusted plots were laid out above the road and footpath while the unprotected plots, required for comparative purposes as to the incidence of disease during the experimental period, were sited below the road to the windward side so as to avoid any carry over of dust during the dusting operation.

Above the road and footpath three areas of approximately five acres each were selected and in each 5 acre block a rectangular plot of one acre (325 ft. long and 134 ft. wide) was wired off. The 325 ft. boundary was set running S.W. to N.E. to ensure, if possible, an even dust cover with winds blowing from a south-westerly direction. Other one acre plots, which remained untreated throughout the experiment, were wired off below the road and footpath.

The plots were treated as follows :—

Plot No. 1 — Protected with "Cuprosana" 2% copper dust applied at the rate of 5 lbs. per acre every 5 days.

Plot No. 2 — Protected with "Cuprosana" 4% copper dust applied at the rate of 5 lbs. per acre every 5 days.

Plot No. 3 — Protected with "Cuprosana" 6% copper dust applied at the rate of 5 lbs. per acre every 5 days.

Plot No. 4, Plot No. 5 — No treatment (unprotected).

From a point midway along the basal wire of each plot to be dusted wooden posts, 4½ ft. long, were planted 1½ ft. into the ground, at points 25, 50, 75 and 100 yards along the length of the plot. A few minutes prior to each dusting operation glass plates, of known surface area, were placed on top of these posts which stood a few inches higher than the surrounding tea bushes. After the dust clouds had settled the glass plates were collected and brought back to the laboratory for estimations of the amount of copper deposited at the different distances from the dusting machine.

The experiment commenced at the begining of May and concluded on October 15th, when the south-west monsoonal period was over.

Dustings and Copper Distribution

At the commencement of the experiment it was decided that all dusting operations should be along the road or footpath, even if wind conditions were not sufficiently strong to carry the dust cloud over the entire plot. Attempts to give a cover on the few occasions when winds were not sufficiently strong to cover the selected areas would have complicated the experimental results.

At each dusting, which was planned for five day intervals, 25 lbs. of each dust formulation were applied through the "Whirlwind" machine. In practice, however, the intervals between dustings sometimes ranged from four to six days when the fifth day fell on a Sunday. On most occasions an application of dust followed a day or two after a plucking while the next application was three to four days before the subsequent pluck, although on a few occasions it was applied two days before plucking.

The decision was made to try to cover each five acre block with 25 lbs. of dust, in which operation the experimental area of one acre should receive its required 5 lbs. quota. In practice, however, the machine operator, unconsciously perhaps, exhibited a tendency to settle a cloud of dust with the one acre experimental area as his target. Under the conditions of the experiment, therefore, this area was more effectively dusted than the complete five acre block.

Plots 1 (2% "Cuprosana") and 3 (6% "Cuprosana") were on all occasions more satisfactorily dusted than plot 2 (4% "Cuprosana") as the dust clouds appeared to sweep fairly evenly over the two former plots. The 4% "Cuprosana" plot, due to a ravine along one side, suffered from changing wind currents. One corner at the extreme top of this plot often received no dust at all. This, viewed in connection with the results of the dust carry experiments in the Talawakelle railway tunnel, means very little as it is now known that a negligible amount of copper in this dust formulation carried to 300 feet. (2).

Table 1 shows the results of copper estimations, expressed as residues on the glass plates and on samples of fifty third leaves (leaves not usually plucked for manufacture), carried out during the course of the experiment (June—end of September). There were six dustings in each month.

Table 1. *Laboratory estimations of copper residues on plates and third leaves from collections made at varying distances from point of dustings. Copper expressed as parts per million on the leaf dry weight.*

	AVERAGE OF SIX DUSTINGS PER MONTH								Average for 24 dustings	
	June 1951		July 1951		Aug. 1951		Sept. 1951			
	Leaves	*Plates	Leaves	*Plates	Leaves	*Plates	Leaves	*Plates	Leaves	*Plates
2% Cuprosana at										
25 yards	63	37	58	51	42	27	93	47	64	41
50 ,,	22	23	25	26	27	21	24	17	25	22
75 ,,	14	16	12	18	11	14	12	11	12	15
100 ,,	9	17	8	14	7	13	12	11	9	14
4% Cuprosana at										
25 yards	72	42	76	61	91	58	86	81	81	61
50 ,,	27	21	22	32	51	33	39	45	35	44
75 ,,	12	18	26	13	35	16	30	15	26	16
100 ,,	11	18	14	12	18	9	8	10	12	15
6% Cuprosana at										
25 yards	194	79	90	55	112	102	80	77	109	105
50 ,,	95	75	84	52	69	49	37	27	71	51
75 ,,	69	47	51	36	42	24	20	14	46	30
100 ,,	27	28	28	18	40	18	16	12	28	19

**The equivalent values in parts per million on the leaf dry weight for the plate estimations given in this table have been calculated by multiplying the total copper in micrograms by 1.5625. Plate size—4 inches × 4 inches.*

Dependence solely on wind to carry the copper dusts appears to results in unevenness of distribution and a fall in the amount of copper deposited, as the distance from the machine increases. Although the amount of copper deposited at 25 yards from the machine increases with the higher percentage of copper in the dusts applied these increases are not directly proportional to the strengths employed. For instance, 4% "Cuprosana" dust did not deposit twice as much copper as the 2% dust nor did 6% dust give a deposit three times as much as the 2% dust. At 50 yards from the machine there was a very considerable fall in deposited copper when compared with the deposits at 25 yards. At the 50 yards point 4% "Cuprosana" gave, for the average of 24 dustings, twice the amount of copper on glass plates as the 2% dust. At the 75 yards point the 6% dust gave twice the amount of deposited copper as both the 4% and the 2% dusts, which at that range were equal. At 100 yards range there was nothing to choose between the three concentrations—all were almost equally low for deposited copper. From the copper distribution angle the 4% dust was better than the 2% and the 6% better than the 4% dust. These observations are similar to those recorded in the Talawakelle railway tunnel experiment (2).

Weather conditions at the time of application largely determine the amount of copper deposited as residue on leaves or plates. Throughout the Dessford experiment, copper residues immediately after application never exceed 194 p.p.m. with the 6% dust, 110 with 4% and 93 with 2% at points 25 yards from the machine. At distances further away the deposited copper fell far below those figures.

Estimations of total copper from leaf used for manufacture was made from each of the experimental plots at each plucking (Table 2). For estimating the copper as residues 25 p.p.m. should be deducted, as the inherent copper content of the undusted tea was in the region of 25 p.p.m.

Table 2. *Copper estimations (expressed as total copper) on dried tea at pluckings between 4th June and 8th October, 1951.*

Plot No.	Treatment	Copper parts per million
1	2% Cuprosana*	36
2	4% Cuprosana*	38
3	6% Cuprosana*	51
4	Unprotected	25
5	Unprotected	25

**It should be borne in mind that the heaviest dust deposits in the region of 0—25 yards from machine contribute chiefly to the total estimation over the one acre plot.*

Weather Conditions

The south west monsoon broke on 29th May with a rainfall over the 24 hours of 1.90 inches. During the period 29th May to 25th June the rainfall of 54.91 inches was probably an all time record on Dessford Group. Over one inch of rain was recorded on each of 21 days. Besides retarding new growth of leaves susceptible to infection, the heavy rains created conditions unfavourable to the disease. During the period 26th June to 26th July conditions were ideal for the building up of blister infections but the advent of sunshine and rainless days, from 27th July to 3rd August, reduced a potentially severe attack to a low level. Thirteen rainless days sufficiently staggered through August continued to keep infections in check. A further period of eight days continuous sunshine from August 27th to September 4th completely eliminated the possibility of a severe blister attack developing in September. Control of the disease in the experiment described has therefore to be assessed under conditions of this season only, which were not sufficiently severe for conclusive results when compared with the more disease favourable weather of prolonged mists and light rain experienced in past years.

Estimation of Blister Blight Control

At each plucking 50 samples of flush points (bud and 3 fully opened leaves) were collected at random at points 25, 50, 75 and 100 yards from the plot base line. From these samples counts were made of blister infections (translucent spots and white blisters) formed on the oldest leaf. In addition infected flush points were

estimated as a percentage of the 50 flush points collected. Table 3 shows the results of these estimations for the period 14th June to 25th July 1951, during which time blister blight was at its peak.

Table 3. *Blister infections (mean of 50 samples) from recordings at 5 pluckings (14th June—25th July, 1951).*

Plot No.	Treatment	Distance from base line of plots : yards	Average number of blisters per third leaf			Percent infected flush points		
1	2% Cuprosana	25	1.41			72		
		50	0.88			61		
		75	1.16			65		
		100	1.23			74		
2	4% Cuprosana	25	0.70			38		
		50	0.96			56		
		75	0.84			60		
		100	1.06			68		
3	6% Cuprosana	25	0.22			20		
		50	0.41			34		
		75	0.42			34		
		100	0.63			49		
4	Unprotected	25	2.18			78		
		50	1.89			78		
		75	2.15	2.10		70	74	
		100	2.17		2.03	70		73
5	Unprotected	25	2.20			76		
		50	2.02	1.96		73	72	
		75	1.85			69		
		100	1.77			72		

Table 3 should be examined together with Table 1, in which the falling off of copper deposits at progressive distances from the point of dusting is tabulated.

All the dusted plots, under the weather conditions experienced during this season, showed control superior to the unprotected plots. The 2% dust has obviously given light control over the experimental area, but the degree of control achieved was insufficiently high. The 4% dust gave better control than 2% but, even at 25 yards from the point of dusting, control was far less effective than that achieved with 6% dust over the same range. A progressive decline in protection can be noted as the distance from the dusting point increases when 4% dust was used. In the case of 6% dust, however, the range of effectiveness was further, although there appears to be a marked falling off in control at the 100 yards limit. Visual observations on 10 different dates are given in Table 4.

Table 4. *Visual estimations of control.*

Treatment	Distance from base line	DATE OF OBSERVATION									
		4/6	25/6	4/7	6/8	16/8	27/8	6/9	17/9	8/10	18/10
2% Dust	25 Yards	1	1	1	2	2-3	2-3	2-3	2-3/4	2	2
	50 "	1	1	2	2-3	2-3	2-3/4	2-3/4	2-4	2	2
	75 "	1	2	2	2-3	2-3	2-3/4	2-3/4	2-4	2-3	2-3
	100 "	1	2	2	2-3	2-3	2-3/4	2-3/4	2-4	2-3	2-3
4% Dust	25 Yards	1	1	1	1	2	2	2	1	1	1
	50 "	1	1	1	2	2	2	2-3	2	1	1
	75 "	1	2	2	2-3	2-3	2-3/4	2-3	2-3	1	2
	100 "	1	2	2	2-3	2-3	2-4/5	2-3/4	2-3	2	2
6% Dust	25 Yards	1	1	1	1	1	1	1	1	1	1
	50 "	1	2	1	2	2	2	1	1	1	1
	75 "	1	2	1	2	2	2	2	2	2	1
	100 "	1	2	1	2	2	2	2	2	2	2
Unprotected	25 Yards	1	2	2-3	2-3	2-3/4	2-3/4	2-4	2-4	2-3	2-3
	50 "	1	2	2-3	2-3	2-3/4	2-3/4	2-4	2-4	2-3	2-3
	75 "	1	2	2-3	2-3	2-3/4	2-3/4	2-4	2-4	2-3	2-3
	100 "	1	2	2-3	2-3	2-3/4	2-3/4	2-4	2-4	2-3	2-3

Key

0 — No leaf blisters or die-back
1 — Leaf blisters few
2 — Leaf blisters fairly numerous
3 — Die-back slight
4 — Die-back fairly severe
5 — Die-back severe

A marked feature in the dusted plots was the screening or shielding effect of the larger bushes. Weak plants and bushes lower in height than the bushes in front of them showed evidence of fairly severe die-back indicating that little or no dust was deposited. Such shielding action was apparent even a few yards from the dusting points.

Yield Records

No undue reliance should be placed on these records (Table 5) as the plots were not laid out on a randomised basis or replicated. There has, however, been some indication that control gave increased yields in comparison with the areas left unprotected.

Table 5. *Crop returns for dusted and unprotected plots.*

Period		25/4-25/6		26/6-27/8		28/8-27/9		25/4-27/9
Plot No.	Treatments	Yield as lbs. dry matter per acre	Order of merit	Yield as lbs. dry matter per acre	Order of merit	Yield as lbs. dry matter per acre	Order of merit	Order of merit
1	2% Cuprosana	119	5th	90	3rd	87	5th	5th
2	4% Cuprosana	138	4th	102	2nd	105	3rd	2nd
3	6% Cuprosana	156	2nd	124	1st	115	1st	1st
4	Unprotected	153	3rd	74	4th	105	3rd	4th
5	Unprotected	161	1st	66	5th	107	2nd	3rd

Plots 4 and 5 (unprotected) which were placed in order of merit as 3rd and 1st for the plucking period 24th April to 25th June, before loss due to blister blight was possible, take 4th and 5th place on the result of pluckings between 26th June and 27th August. The 6% dust plot moves up from 2nd place to a very good 1st, while the 4% plot takes 2nd place and the 2% dust plot moves up from 5th to 3rd position. This order of merit corresponds very closely to the control achieved by protection (Table 4).

The falling off in blister intensity, due to improved weather conditions, from the end of August onwards is reflected in the yields for the period 28th August to 27th September. The 6% dusted plot continued to give the highest yields, while the unprotected plots 4 and 5 rose from 4th and 5th positions to 2nd and 3rd. The 4% dusted plot, though it has fallen back in yield capacity, ties for 3rd place with the unprotected plot No. 4. The 2% dusted plot goes back again to the last position from 3rd place which it held at the end of the blister blight season.

Summary

This power dusting experiment to test the efficiency of " Cuprosana " copper fungicidal dusts of 2%, 4% and 6% copper contents was conducted under south-west monsoonal conditions which were not fully conducive to severe blister blight attacks. The abnormal weather during the 1951 south-west monsoon created conditions which kept attacks down to a fairly low level, thus preventing a sufficient build up of mature blisters to cause the widespread damage we have been accustomed to at this season of the year. Under the conditions of the experiment there have been definite indications that fairly effective control of blister blight is possible with 4% and 6% " Cuprosana " dusts, if an even coverage is possible. Relying on wind distribution of the 6% dust in conjunction with the " Whirlwind " duster distances further than 50 yards were protected to only a limited degree. Lighter protection was afforded with 4% " Cuprosana " dust but for a shorter range only. 2% " Cuprosana " gave inferior control throughout the plot. When the " Whirlwind " duster is used for application of dusts effective control would appear to be limited to a swathe of not more than 50 yards wide with 6% dust and 25 yards wide with 4% dust.

Acknowledgments

Our thanks are due to the Directors of the Lunuva (Ceylon) Tea and Rubber Estates Ltd., and their Agents, Messrs. Harrisons & Crosfield Ltd., for permission to conduct the experiment on Dessford Estate. Our special thanks are due to Mr. Gatehouse, the Superintendent of Dessford Estate and his assistant, Mr. Roberton, for their willing help and co-operation. The assistance given by Mr. R. N. Jodrell, of Universal Crop Protection Ltd., during the early stages of the experiment is also gratefully acknowledged.

The numerous copper determinations were made by Dr. Haworth, Agricultural Chemist of the Tea Research Institute of Ceylon.

Mr. E. S. Rajiah, Field Assistant to the Plant Physiologist, was in charge of the collection of all data and conducted the dustings. I have pleasure in acknowledging his efficient help.

References

(1) Dike, H.—Mechanical Dusting against Blister Blight, *Tea Quarterly*, XXI, Parts II/III, pp. 29-35, 1950.

(2) Haworth, F.—Distribution of Copper Containing Dusts, *Tea Quarterly*, XXII. Part III, pp. 97, 1951.